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Digital Proficiency Level of Accounting Science Professors in Southern Brazil

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Abstract

Aim: Identifying the Digital Proficiency Level of Accounting Science professors in public and private universities in Southern Brazil.
Method: Survey based on a fully online questionnaire developed at Google Forms sent to professors' e-mail. The sample encompassed 156 respondents from public and private universities in Southern Brazil. Data statistical assessment was carried out through descriptive and inferential analyses based on group comparison tests run in IBM - SPSS software (version 22).
Results or Discussion: Professors classified their Digital Proficiency Level as intermediate - Experts (B2). The teaching modality and training area showed significant differences in comparisons of tests applied to the groups. It is worth observing the need for professors to close gaps in and improve their proficiency level regarding Digital Technologies, and Resources and Learner Training dimensions, which accounted for the lowest proficiency levels.
Contributions: From a theoretical perspective, the Digital Competence framework and its theoretical fundamentals in the literature could be added the educational process as guiding element for digital practices incorporation to Accounting Science discipline matrices in order to effectively develop knowledge, skills and attitudes required for Accounting professionals' training. From a practical standpoint, this approach enabled identifying actions related to faculty members' continuous professional development in higher education institutions. Moreover, the DigCompEdu self-assessment allowed professors to recognize and assess their digital profiency level and, consequently, to enhance it.

Keywords: Digital Proficiency; Professor; Accounting Sciences; DigCompEdu.

How to Cite:

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Introduction

Major changes and updates in information and communication technologies (ICTs) pointed towards digital skills, and gradually required individuals involved in the Education system to acquire a differentiated qualification (Roda & Morgado, 2019). The demand set for 21st-century professors relate to new methodologies and to technology integration into the learning process. Initial and ongoing training was required to help professors develop new skills, the so-called digital skills, which are inherent to an increasingly digital and connected society (Sales et al., 2019).

The reviewed literature disclosed an understandable and relevant report about these proficiencies. The DigComEdu report is a digital proficiency self-assessment aimed at educators/professors. It lists six areas divided into sub-areas encompassing digital resources, pedagogical practices, professional engagement, among others. A pre-established score was adopted to assess how proficient a professional is in digital technologies (Sales et al., 2019).

Digital skills regard knowledge, abilities and cognitive processes working as the very basis to apply and integrate several resources required in digital technologies (Santos et al., 2021). According to Roda and Morgado (2019), studies providing an in-depth investigation of digital skills and associating them with educational level are of interest to research.

Momo et al. (2017) stated that Education technologies open a window of opportunities aimed at changes in the teaching-learning process. Their use makes it easier to explore issues in a more flexible way since it provides content presentation diversity and takes into consideration students' individual features. However, currently, technologies hold an integrating power that requires professors to appropriate such resources and keep a critical-reflective vision in order to adjust themselves to all the digital tools available (Giraffa et al., 2021).

Cooperation between students and professors could be a step forward in teaching and learning because most students bring along a digital-knowledge background, although they lack guidance and the will to face new challenges within an understandable Education scene that extrapolates the classroom and is provided by teachers themselves (Giraffa et al., 2019). Feldkercher and Mathias (2011, p. 84) emphasized that technologies have "a formative potential capable of contributing to broaden the pedagogical spaces and times, to make discipline matrices flexible and to achieve closer interaction between subjects in both in-person and distance education". Thus, these technologies provide a broader aspect of their use and extrapolate the classroom physical spaces.

New skills, such as the digital ones, are required for professionals within a scenario of constant innovations. Changes and innovations in the so-called "economic system" are clear in the Accounting Science higher education field; therefore, professionals must keep up with market updates and chat-up with continuous updating (Oliveira, 2014). According to Malau (2021), updates in technologies have had impact on Accounting Science education to the extent that it became mandatory to develop digital skills in order to prepare these professionals for the digital age. This demand is clear in the labor market which, currently, focuses data management through computerized systems and altered processes.

Technological updates have already led to changes in the educational context. However, after the pandemic, the sudden embodiment of digital media into learning processes became clear and it posed new challenges for professors (Sales & Moreira, 2022). Rodrigues et al. (2024) highlighted that technological proficiency should be added to the major Accounting Science discipline matrices and integrated to the course's Pedagogical Program. It should be done in compliance with national discipline matrix guidelines, so that these professionals could develop the skills featuring their profession.

A research gap on technological update impacts on higher education was herein identified. Technological innovation in the educational environment has set challenges and dilemma for teaching practices, and it demanded professors to use Digital Communication and Information Technologies (DICTs), and to rely on their integration and pedagogical exploration efficiency. Therefore, the DigCompEdu self-assessment could boost formative actions (Sales et al., 2019). The study by Mishra and Koehler (2006) is noteworthy; it addressed the relevance of having professors integrating technologies to pedagogical contents and practices. Technologies could bring about significant changes to classrooms; however, their effectiveness depends on professors' intension behind using these tools for content formulation and presentation. Thus, professors must develop new technological-knowledge skills.

The following research problem emerged from this technological-innovations context: what is the digital proficiency level of Accounting Sciences course professors at universities in Southern Brazil? The aim of the current study is to identify the digital proficiency level of Accounting Sciences course professors at universities in Southern Brazil in order to answer this question.

The relevance of monitoring teaching and learning pro cesses in the Accounting Science field justified the conduction of the present study, given the constant changes and transformations in it environment, which require adaptation. Companies are gradually seeking not only Accounting-practice knowledge in their professionals, but the use of digital technologies appropriate for their professional context (Pinto Júnior et al., 2019). Professors improvements towards these needs could be guided by the DigCompEdu approach (Sales et al., 2019).

The current study is expected to theoretically and practically help improving the Accounting Science teaching-learning process based on the observed results. The structure addressed by DigComEdu, and its conceptual basis, have the potential to shape the theoretical implications of the educational process by guiding digital practices' addition to a discipline matrix aimed at training Accounting professionals, and at boosting effective knowledge and skills' development, and the attitudes of these future professionals.

Furthermore, the present study contributed to practical implications through diagnoses based on digital-skills self-assessments. It enabled professors to manage their own continuing education within a context of constant improvements required by technological innovations. It helped institutions understanding these skills importance for present times. Therefore, the herein observed gaps pointed out that training actions could increase professors' digital proficiency level (Sales et al., 2019; Santos et al., 2021; Carvalho et al., 2021).

2 Theoretical References

2.1 Digital Competence

Digital technologies and the changes they caused in society required individuals to develop Digital Proficiency (DP) to deal with all technological innovations (Silva & Behar, 2019). According to Dias-Trindade et al. (2019), the importance of developing professors' skills in using digital technologies in the educational context highlighted the need of their application in order to help pedagogical practices. However, it is necessary understanding why and when to use them.

Studies on digital proficiency in the Brazilian Education remain limited. There are different concept interpretations among the existing studies. Some authors in the literature have explored the understanding of digital proficiency concepts (Silva & Behar, 2019). The studies by Itu (2006) and Erstad (2005) stand out as cornerstones among research on the existing Digital Proficiency concepts.

According to Itu (2006, p. 7), digital proficiency means "the knowledge, creativity and attitudes necessary to use digital media for learning and understanding the knowledge society". Erstad (2005, p. 133) added by stating that these "skills, knowledge and attitudes through digital means [are used] to master the learning society". Based on Larraz (2013), digital proficiency compasses the ability to mobilize different literacies, manage information and communicate knowledge, and solve problems within a constantly evolving society.

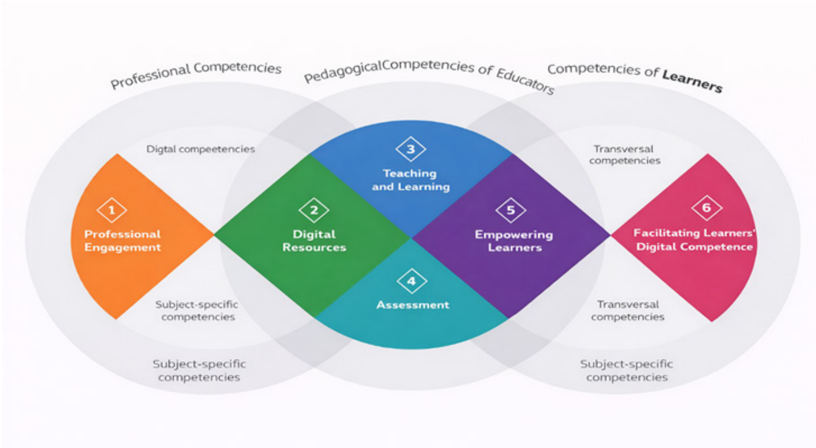
According to Silva and Behar (2019), several authors highlighted different concepts and models that have been changed, over time. Therefore, treating digital proficiency as new literacy is not enough as new tools gave rise to different situations and required other proficiencies. Digital proficiencies linked to technological mastery mobilize a set of knowledge, skills and attitudes aimed at solving problems in digital environments (Silva & Behar, 2019).

According to Ferrari (2012), a person must master the use of digital media to search for information, make critical analyses of data available on the internet and be comfortable communicating digitally to be considered digitally proficient. Similarly, professors must master the use of digital media to search for information, make critical analyses of data available on the internet and be comfortable with only communicating through digital means. UNESCO (2009) and the European Commission (2012) have set digital proficiency as one of the eight essential competencies for lifelong development. They also defined a repertoire of digital competencies aimed at digital-technology users, at international level (Silva & Behar, 2019).

The Joint Research Centre of the European Commission conducted several studies on this subject to assess key digital proficiency components. This study enabled educators to lever the digital technologies potential and foster innovation in the teaching and learning process. The Joint Research Centre of the European Commission carried out several studies on this subject and their results allowed to develop several digital-proficiency standard models. One of them was herein adopted to achieve the research aims. The European Digital Competence Framework for Educators – DigCompEdu – stands out among models to synthesize national and regional efforts to capture educators' specific digital proficiency. It provides a general reference applicable to all Education levels, from early childhood to higher education and adult education (Lucas & Moreira, 2018).

The Digital Competence of Educators project (DigCompEdu model) was developed in 2017 and translated into Portuguese in 2018. DigCompEdu presents the premises required for professors to properly develop digital proficiency in teaching and, consequently, to properly explore ICTs in the classroom, as well as to innovate in Education and training practices integrating the power of digital technologies (Lucas & Moreira, 2018; Sales et al., 2019). Figure 1 depicts three major proficiency groups: educators' professional and pedagogical proficiency, and students' proficiency.

Figure 1. Proficiency Areas for Educators

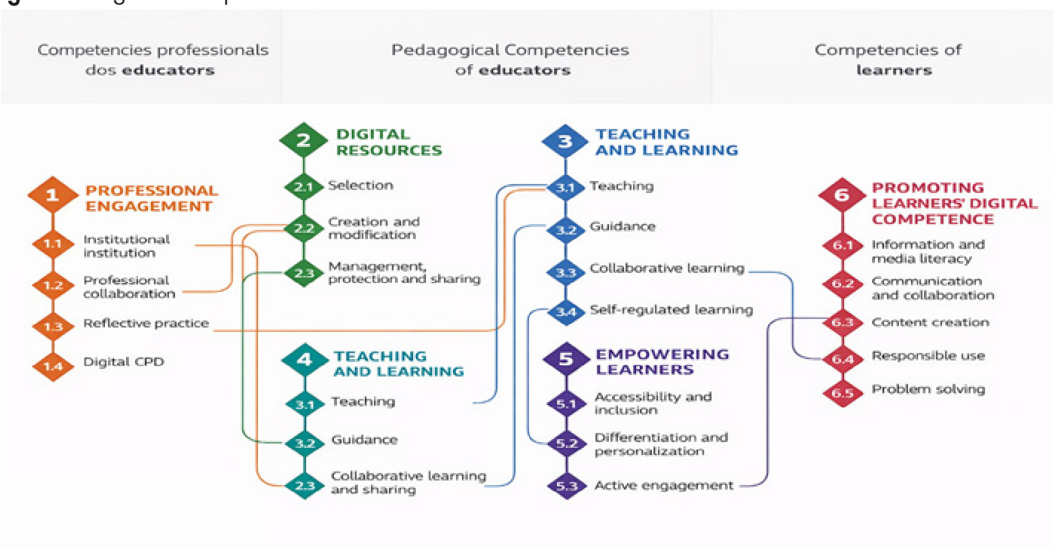


Note: These 06 (six) DigCompEdu areas bring together different aspects of assignments to be developed by professors teaching these proficiency types. Source: Lucas & Moreira (2018, p.15).

Professional Engagement is the first area: it addresses the professional environment where educators should engage with everyone in the institution through technology. Digital Resources is area 2: it focuses the skills needed for using, creating and sharing digital resources for learning. Teaching and Learning is area 3: it aims at managing the use of digital technologies in teaching and learning. Assessment is area 4: it addresses the use of digital strategies to improve assessment. Students Empowerment is area 5: it focuses digital technologies potential for students-centered teaching and learning strategies. Promoting Students Digital Proficiency is area 6: it describes the specific pedagogical skills needed for achieving students' digital proficiency.

Therefore, 22 proficiency types within this six (6) areas are necessary for educators to use technologies in teaching practices (Figure 2).

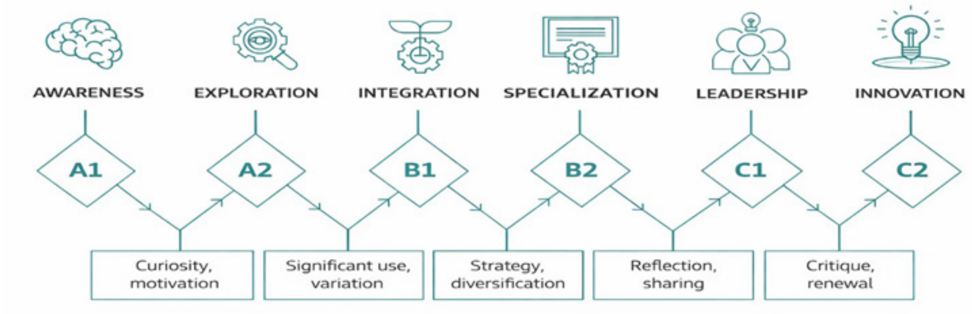
Figure 2. Digital Skills per Area



Source: Lucas & Moreira (2018 p.16).

A progression model divided into classification levels based on these six (6) fields helped identifying educators' strengths and weaknesses (Figure 3) (Lucas & Moreira, 2018).

Figure 3. DigCompEdu Progression Model



Source: Lucas & Moreira (2018 p. 29).

From this perspective, educators acquire new information and develop basic digital practices in the first two levels: (A1) Newcomer and (A2) Explorer. Educators apply, broaden and set the very basis of their digital practices at the second level: (B1) Integrator and (B2) Expert. The third level holds the highest levels: (C1) Leader and (C2) Pioneer, where they share their knowledge, critique existing practices and develop new ones. The features set for each classification level can be observed in Table 1.

Table 1. Digital Skills Classification Levels

Levels		Features
(A1)	Newcomers	Teachers are aware of technologies potential. However, they have had little contact with these technologies throughout their career and only used them to prepare assignments, for managerial purposes or for organizational communication. They need encouragement and guidance to apply digital technologies in their teaching practices.
(A2)	Explorers	They are aware of ICTs potential and are interested in exploring them to improve their teaching practices. they have already started using digital technologies, but in a disorganized way. They need guidance, ideas, inspiration and even help from their peers.
(B1)	Integrators	They experiment ICT in a variety of contexts and for a variety of purposes, integrating them into their practices. They creatively use ICT to improve several aspects of their professional development. They seek to broaden their repertoire of practices, but they are still learning about which tools work best, in what situations and how to adapt ICT to pedagogical strategies and methods. They Need time for experimentation and reflection, which is complemented by collaborative encouragement and knowledge sharing, in order to become an expert.
(B2)	Experts	They use a whole variety of ICTs with confidence, creativity and critical thinking to enhance professional activities. They select technologies depending on the situation and try to understand the advantages and disadvantages of different digital strategies. They are curious and open to new ideas, knowing that there are many things they haven't tried yet. They use experimentation as means to broaden, set and consolidate their repertoire of strategies. They are the backbone of any educational organization when it comes to innovative practices.
(C1)	Leaders	They have a consistent and comprehensive approach to use ICT to improve teaching practice. They have a broad repertoire of ICT strategies and choose the most appropriate one according to the situation. They continuously reflect on and develop their practices, share ideas with colleagues, and stay updated on new possibilities and ideas. They are a source of inspiration and share their knowledge.
(C2)	Pioneer	They question the adequacy of contemporary pedagogical practices they are leaders. They are concerned about the limitations or disadvantages of these practices, they feel motivated to innovate even further in Education. They experiment with highly innovative and complex ICTs and/or develop new pedagogical approaches. In addition to leading innovation, they are a role model for other teachers.

Source: Adapted from Sales et al. (2019).

According to Sales et al. (2019), this model is very complete, as it provides individual feedback to support skills' development based on identifying training needs. Thus, the DigCompEdu purpose is to standardize educators' digital proficiency based on an international standard aimed at synthesizing it into a coherent model available for teachers at all education levels to understandably assess their own pedagogical digital proficiency (Lucas & Moreira, 2018).

2.2 Related studies

Several DigCompEdu national and international studies aimed at clarifying this topic in higher education were found, besides two research reports in the Brazilian Education field. One study was carried out by MetaRed Brasil (Carvalho et al., 2021) and another by the Superintendence of Distance Education at UFBA (Ribeiro et al., 2020).

One international study was conducted by Cabero-Almenara et al. (2020) in the University of Andalusia (Spain) to validate the DigCompEdu questionnaire. Their sample consisted of 2262 professors from different public universities in the region. They highlighted that professors had been using digital technologies for more than 20 years. Most of these professors classified themselves as Digital Proficiency 'Integrators' in the final assessment (B1).

From this perspective, the study by Santos et al. (2021) showed the digital skills level of professors in Portugal. Approximately 695 professors responded to the survey, and those with the highest schooling levels among them, who were teaching in postgraduate programs, distance learning and in polytechnic institutions, also recorded the highest digital proficiency level. According to the overall classification, approximately 35.5% of professors in the sample were at level B1 (Integrators).

The study by Mishra and Koehler (2006) disclosed a framework encompassing content knowledge, pedagogy and technology aspects, and how complex these relationships are. Mishra and Koehler (2006) highlighted that this subject has been discussed since Shulman, in 1980s, when technologies already existed, although in other representation forms. They already linked professors' knowledge to contents generated for students. However, technologies have evolved and they are related to the use of internet, software, games and others. These tools created significant challenges to teacher-training, given the need for new techniques and skills. The aforementioned authors emphasized the relevance of Technological Pedagogical Content Knowledge (TPCK), but the use of technology could not be dissociated from content and pedagogy. Only the interaction of these three levels could set the basis for teaching through technology.

The study by Melo (2019) stands out among national research. He analyzed professors' digital proficiency based on the professional, pedagogical and student-related dimensions. His sample comprised 141 professors from IFTO, Palmas and Porto Nacional campi, and addressed several knowledge fields. Overall, his results have highlighted that professors' digital proficiency level was moderate; in other words, they reached level B1 (Integrators).

Carvalho (2020) assessed professors' digital skills at Federal University of Tocantins, Palmas Campus. According to his overall results, most professors reached the Integrator level (B1), and professors in the Applied Social Sciences field scored 42 points; they also fell into this intermediate range (Integrators -B1). On the other hand, the study by Sales and Moreira (2022) was an assessment of professors' digital skills at State University of Bahia – UNEB. Approximately 210 professors responded the questionnaire; they represented 26 different study fields. According to the results, 43% of the professors were in the Integrator group (B1).

Another study conducted by Lima et al. (2021) was an analysis of professors' digital competence level at Federal Institute of Maranhão (IFMA) campi. The sample included 421 respondent professors. Based on the results, Applied Social Sciences professors achieved the lowest index at the basic level. They were categorized as Newcomers (A1) (1.82%), Explorers (A2) (29.09%), Integrators (B1) (29.09%), Experts (B2) (25.45%), Leaders (C1) (14.55%) and Pioneers (C2) (0%).

Furthermore, two other studies (reports) reflected professors' proficiency diagnosis. The first one was conducted at Federal University of Bahia (UFBA) during the pandemic and it aimed at investigating professors' digital proficiency and at using research findings to support future investments in policies in this field and in digital technologies to be added to the teaching and learning process. The overall results of the report showed that the 1399 professors forming the sample and working in functional classes were at intermediate levels; they were classified as Innovative (B1). This finding highlighted significant gaps in digital proficiency levels among the University's professors (Ribeiro et al., 2020; UFBA, 2020).

The other study covered the whole country and was carried out in 2020 by the Educational Technologies Group of MetaRed Brazil. The aim of this study was to diagnose the digital proficiency achieved by Brazilian professors. In total, 45 higher education institutions participated in the study, and 3.122 professors joined it. Based on the results, 70% of professors were at intermediate levels (in the Integrator/Expert Dimensions). This finding highlighted their ability to apply and reflect on digital practices. Another factor lied in using ICT resources; approximately 90% of professors used technology (Carvalho et al., 2021).

Given the aforementioned literature, Education professionals' digital skills are of paramount importance, since current teaching and learning processes cannot be separated from digital technologies. This scenario requires teachers' qualification in digital practices associated with pedagogical content and practices. Therefore, DigCompEdu is the model presenting the features for a complete assessment.

3 Methodological Procedures

The present study followed a quantitative approach to solve the research problem. It is a descriptive research aimed at introducing the opinions, attitudes and beliefs of a given population (Gil, 2008). It was conducted in the field in order to reach the study purposes. Data collection was carried out through a survey. A questionnaire was developed at Google Forms to gather research data. According to Gil (2008), questionnaire is a standardized data collection technique featuring descriptive research.

The research followed the guidelines in National Health Council Resolution n. 510/2016, which set forth the applicable standards for research in Human and Social Sciences. Its methodological procedures regard using data provided by participants, from identifiable information or from information that may entail greater risks than those observed in everyday life. The study was registered on the Plataforma Brasil platform, under CAAE number 58201722.3.0000.5324 and opinion number 5.453.080.

The construct consisted of professors teaching in undergraduate Accounting Sciences courses at public and private higher education institutions in Southern Brazil. The choice of the Southern region was intentional given the ease of access to contact the professors, as well as the selection of individuals who present features seen as relevant to the study scope. This process led to a non-probabilistic sample (Gil, 2002). Therefore, the gathered information was used to send the questionnaire by email for totally voluntary participation in the research. The message included details on how to answer the survey and the link to access the data collection form.

This sample comprised 156 professors who answered the electronically sent questionnaires. Some participants were excluded for being outside the research scope. The first exclusion happened because the respondent chose not to answer the questionnaire, the second one took place because the respondents belonged to another Brazilian region and the third exclusion was justified by the fact that the professors only taught in the distance learning modality.

A pre-test was run by sending it to professors at several universities, including UCPEL, UNILASALLE (Distance Learning), UFMS (coordination), UFG (16 professors), UFPE (41 professors) and UFRN (33 professors), in order to validate the questionnaire. Initially, questionnaires were sent to universities that hold Accounting Sciences courses provided through the Distance Learning modality. Unfortunately, only one response was sent back; thus, the instrument was sent to professors from other regions that were not included in the research population at the first round of questionnaires. In total, 6 responses were sent back after the July 4th/August 1st, 2022, time frame. Minor adjustments were made in the questionnaire to get further contributions. The updated instrument was validated on August 2nd, 2022 by an expert professor of the Accounting Sciences course.

The questionnaire with questions adapted from Manuel (2016) and Sales et al. (2019) was sent online via Google Forms. Digital proficiency questions included 21 statements and a self-assessment scale developed by the Science and Knowledge Service of the European Commission (EU Science Hub). Its Portuguese version was validated by Dias-Trindade et al. (2019) - this study was inspired by DigCompEdu CheckIn (Redecker & Punie, 2017). The 22 questions from the original scale were validated, except for one item; the exploratory analysis showed this item's disregard to area 2 (the area it was classified to) and to one of the factors.

A statement (item) was presented for each proficiency in the used scale. Respondents selected the option that best featured their position regarding such a statement. Statements ranged from "I never do this" to "I do this constantly". This 5-point Likert-type scale presented adequate reliability level for data interpretation and measurement, besides being adjustable to the skill level recommended by Dalmoro and Vieira (2014).

The same scoring was assigned for each item, which ranged from 0 (for the first hypothesis) to 4 points (for the last hypothesis); thus, the total test score was 84 points and the proficiency levels were divided as shown in Table 2. Therefore, based on the sum of scores recorded per area, the aim was to identify professors' proficiency level.

Table 2. Proficiency Levels and their Scores

Digital proficiency levels		
(A1)	Newcomers	Lower than 19 points
(A2)	Explorers	From 19 to 32 points
(B1)	Integrators	From 33 to 47 points
(B2)	Experts	From 48 to 62 points
(C1)	Leaders	From 63 to 77 points
(C2)	Pioneer	Higher than 77 points

Source: Adapted from Lucas & Moreira (2018); Dias-Trindade et al., (2019).

This self-assessment tool allowed checking the digital skill levels divided into the (06) areas within the DigCompEdu model.

Data were first tabulated into Excel® spreadsheet for data analysis. This procedure was followed by statistical treatment based on descriptive and inferential analyses carried out in the IBM Statistical Package for the Social Sciences (SPSS) software - version 22. Initially, the research sample was featured through descriptive statistics. Subsequently, descriptive and inferential analyses applied to the Digital Proficiency question block were performed to achieve the overall research aim. The variables and research constructs were classified as shown in Table 3.

Table 3. DigCompEdu items

Areas	Scale – Educators' Digital skills (6 constructs) adapted from Dias Trindade, Moreira, & Nunes (2019)	Questions	5-point Likert scale	Statistical Treatment
A1	Professional Engagement (PE) - (4 items)	1.1, 1.2, 1.3 and 1.4	Statements related to "I never do this" corresponded to 0 points, up to statements that declared "I do this constantly" corresponded to 4 points.	Descriptive Analysis: Position measures (mean and standard deviation) Inferential analysis: Normality test; Comparison tests.
A2	Technology and Digital Resources (TRD) - (2 items)	2.1 and 2.2		
A3	Teaching and Learning (TL) - (5 items)	3.1, 3.2, 3.3, 3.4 and 3.5		
A4	Assessment (A) - (2 items)	4.1 and 4.2		
A5	Student Training (ST) – (2 items)	5.1 and 5.2		
A6	Promoting Students' Digital Competency (PCDE) – (5 items)	6.1, 6.2, 6.3, 6.4 and 6.5		

Source: Elaborated by the authors.

Kolmogorov-Smirnov first normality test set for samples n>30 (Fávero and Belfiore, 2017) was ran in the descriptive analysis. Spearman correlation non-parametric tests were run as the variables were not normally distributed. Comparison tests were run because there was no correlation between the profile variables and the digital proficiency variables. A comparison test was run between the groups of variables described in Table 4 after the descriptive analysis, based on the means recorded for professors' Digital Competency. The following corresponding non-parametric comparison tests were run: Mann-Whitney, which is equivalent to the parametric t-test 'Student' for two groups; and Kruskal-Wallis test, which is equivalent to ANOVA, for more than two groups (Field, 2009).

Table 4. Groups for the Comparison Test

Profile Variables	Groups	Statistical Test	Author
Teaching Method	In-person vs. Both	Mann-Whitney equivalent to the parametric t-test (Student) for two groups.	Field (2009)
Work area	RS x PR x SC	Kruskal-Wallis (equivalent to ANOVA) for more than two groups.	Field (2009)
Training Area	Accounting Sciences x Business x Economic Sciences x Others		
Titles	Undergraduate Degree x Specialization x Master's Degree x PhD x Post-Doctorate		
Students per class	Up to 10 students x Up to 20 students x Up to 30 students x Up to 40 students x Up to 50 students x Over 50 students		

Note: Elaborated by the authors.

Thus, in order to achieve the study aim, professors' proficiency level score was measured based on the progression table set for proficiency levels (Table 5) corresponding to (A1) – Newcomer, (A2) – Explorer, (B1) – Integrator, (B2) – Specialist, (C1) - Leader and (C2) – Pioneer per Area. It was done to find how digitally fluent professors were. These features encompassd knowledge and skills related to digital technologies use in education processes.

Table 5. Scoring per Area

	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6
GENERAL	<19	19-32	33-47	48-62	63-77	>77
levels						
(A1) - Newcomer	4	3	4	3	3	5-6
(A2) - Explorer	5-7	4-5	5-7	4-5	4-5	7-8
(B1) - Integrator	8-10	6-7	8-10	6-7	6-7	9-12
(B2) - Experts	11-13	8-9	11-13	8-9	8-9	13-16
(C1) – Leader	14-15	10-11	14-15	10-11	10-11	17-19
(C2) - Pioneer	16	12	16	12	12	20

Source: Adapted from DigCompEdu Checking.

These progression levels were inspired by Bloom's revised taxonomy because his classification explains the cognitive responses in the learning process. Each proficiency level regarded the extent a specific digital technology was used at each competency stage (Lucas & Moreira, 2018). These levels were organized into three categories based on their features: "Basic (A1 and A2) level', educators assimilate new information and develop basic digital practices; "Intermediate (B1 and B2) level', professionals' apply, broaden and reflect on their digital practices; and "Advanced (C1 and C2) level', educators share their knowledge, critique existing practices and develop new ones.

Thus, the scores recorded for the 21 questions on the scale were summed according to each digital proficiency area as follows: Area 1 – Professional Engagement, Area 2 – Digital Resources, Area 3 – Teaching and Learning, Area 4 – Assessment, Area 5 – Learner Training and Area 6 – Promoting Learner Digital Competency. In addition, the scale internal validity was assessed through Cronbach's Alpha coefficient (Hair et al., 2009).

4 Results

4.1 Featuring the sample profile

Respondents' identification data is shown in this section. It led to 156 professors. Sociodemographic variables were highlighted to represent the sample and to identify participants' personal, professional and locational features. The variables described below were used for the herein carried out analysis.

With respect to professors' academic background, most of them stated to hold a degree in Accounting Sciences when they were questioned about their " study field" (approximately 73.7%); this field was followed by Business (12.8%), Economics (4.5%) and other fields (9%). Regarding academic qualifications, most of the sample held a doctoral degree. As for teaching styles, approximately 35.9% of professors taught classes with up to 40 students.

When professors were questioned about their "Teaching Modality", approximately 78.8% of them worked in-person and 21.2% taught in both modalities (in-person and distance learning). When it comes to higher education institution location, most respondents worked in Paraná State (approximately 41.7%); they were followed by professors from Rio Grande do Sul (39.1%) and Santa Catarina (19.2%) states.

4.2 Descriptive Analysis

The digital competency level was classified through points ranging from 0 (I never do this) to 4 points (I do this constantly). Based on the 21 statements, the score could reach up to 84 points depending on the proficiency variables and areas. The DigCompEdu scale was subjected to Cronbach's Alpha reliability test, based on Hair et al. (2009), and it resulted in a score equals to 0.927 for the 21 analyzed items.

Scale reliability based on Cronbach's alpha 0.927 pointed towards high internal robustness. Thus, it was capable of meeting the study's proposed aim, namely: assessing professors' digital proficiency. Similar reliability values could be found in studies by other authors (Dias-Trindade et al., 2019; Dias-Trindade et al., 2020; Cabero-Almenara et al., 2020; García et al., 2021). Descriptive analysis was performed with a general population and with that for the proficiency area in order to validate the scale. This procedure was followed by other statistical tests.

Overall results based on the sum of Digital Proficiency scores led to 48.46 global average, 14.18 standard deviation and 201.19 variance. Accordingly, based on the level table adapted from Dias-Trindade et al. (2019), the average score allowed inferring that professors were at the Expert proficiency level (B2). This competency level often showed that professors were at intermediate technology-use level. They also applied their developed knowledge, and sought to broaden and improve their digital practices (Sales et al., 2019).

Analysis conducted per area showed that the highest mean proficiency level was B2 – Specialist (μ = 11.93; σ = 3.402) in Area 3 – Teaching and Learning, and the lowest mean was A2 – Explorer (μ = 3.99; σ = 1.911) in Area 2 – Technologies and Digital Resources. This finding pointed out that professors were aware of digital technologies' potential and they had already used them in some areas. The collected data can be seen in Table 6.

Table 6. Mean Results per Area

Areas		Proficiency Level	Global Average	Standard Deviation (σ)
AREA 1	Professional Involvement	B2 - Experts	10.17	2.787
AREA 2	Technologies and Digital Resources	A2 - Explorer	3.99	1.911
AREA 3	Teaching and Learning	B2 - Experts	11.93	3.402
AREA 4	Assessment	B2 - Experts	7.09	2.665
AREA 5	Student Training	A2 - Explorer	4.88	1.836
ÁREA 6	Promoting Students' Digital Proficiency	B1- Integrator	10.40	4.632

Source: Research data (2023).

According to Lucas and Moreira (2018), the aim of the proficiency level progression model is to support professors' continuous professional development, so they can identify their current level and invest in developing other competencies. Furthermore, this model is a framework consistent with European frameworks.

Therefore, Accounting Sciences course professors at initial level in Area 2 presented a lower average. Thus, they were recommended to improve their proficiency in this area by broadening their digital practices and skills through sharing and collaborating with colleagues. This process would allow them to reach the Integrator level in this area (Lucas & Moreira, 2018). Professors in Area 5 were recommended to adapt digital resources to the learning context, which would raise their classification to the Integrator level. A practical approach would be the inclusion of Technological proficiency in the discipline matrix to be developed in undergraduate studies. This would be a practical approach for them to accomplish an effective professional accounting training and to enhance the skills and values inherent to their profession. This process would also raise students' skills, proficiency and attitudes (Rodrigues et al., 2024; Lucas; Moreira, 2018).

Carvalho (2020) assessed professors' digital proficiency at Federal University of Tocantins – Palmas Campus. Results recorded for the six areas often showed that the lowest level was achieved in Area 6 - Explorers (A2); the recoded average in this area totaled 20 points. These data differed from the herein recorded ones. According to him, this find could be related to lack of digital practices as pedagogical strategy, and it required knowledge broadening through sharing with other colleagues. This process would allow them to develop new assignments using ICTs, which could raise their proficiency level in this area.

Overall, it is possible highlighting that Reflective Practice (μ=3.256; σ=0.7609), Guidance (μ=2.628; σ=1.0669), Institutional Communication (μ=2.596; σ=0.9421), Differentiation and Personalization (μ=2.596; σ=1.0272), and Content Creation (μ=2.442; σ=1.1373) were the proficiencies accounting for the highest averages. Reflective Practice stood out among the others with 21 proficiencies, on average. This outcome stressed that professors also collectively reflected on knowledge collaborative construction, in addition to individually reflecting on digital practices. According to Caena and Redecker (2019), reflective practice is one of the essential proficiencies for 21st-century professors because they have to interact with the complex individuality of "digital natives".

Reflective Practice belongs to Area 1 – Professional Engagement. Therefore, mean results recorded per area showed that professors were experts in developing this proficiency. In other words, they used different ICTs and experimented them in their professional activities, as well as were opened to new ideas and to knowledge pursuit.

4.3 Comparison test

The following non-parametric tests were used for comparisons: Mann-Whitney and Kruskal-Wallis (Field, 2009).

Professors who taught in both modalities recorded the highest averages for the analyzed Teaching Modality variable (Table 7). This difference pointed out that digital proficiency level is closely linked to digital-environment effective use (Dias-Trindade & Santo, 2021).

Table 7. Proficiency Level per Teaching Modality

Teaching Method	N	Global Average	Standard deviation	Proficiency Level
In person	123	47.31	1.302	B1 – Integrator
Both	33	52.73	2.170	B2 - Experts

Source: Research data.

The Digital Proficiency level comparison between Teaching Modalities highlighted significant differences between the averages recorded in the Mann-Whitney test ($U = 1559.500$; $t = 0.041$; $p<0.05$). Professors who taught in both modalities were classified as Digital Proficiency Experts, whereas those who only taught in person were integrators and represented the majority of this study's sample (123 professors, in total). Similar findings were recorded by Santos et al. (2021), according to whom, professors' proficiency level is higher when they teach in person than in the distance learning modality, regardless of the ratio.

Professors from Rio Grande do Sul and Santa Catarina states achieved the highest mean level when the analysis regarded the federal unit they taught in (Table 8). They were classified as Digital Proficiency Experts.

Table 8. Proficiency Level per Region

State	N.	Global Average	Standard deviation	Proficiency Level per Region
RS	61	49.16	1.424	B2 – Experts
PR	65	46.05	2.025	B1 - Integrator
SC	30	52.23	2.594	B2 – Experts

Source: Research data.

No significant difference was found between the means recorded for the comparison of Digital Proficiency level among professors' states in the Kruskal-Wallis test ($X2\ (2) = 2.786$; $p>0.05$). It was possible comparing the current results with those from studies conducted in other states (Sales and Moreira, 2022), such as the assessed professors' digital proficiency at Federal University of Bahia (UNEB). According to the research findings, most Accounting professors reached the Integrator (B1) and Expert (B2) levels. Carvalho (2020) conducted a study at Federal University of Tocantins with Applied Social Sciences professors and classified them as Integrator (B1) level. This same level was observed in Paraná State, in this same research.

With respect to teacher training and competency level, according to average results in Table 9, Accounting Sciences professors were Digital Proficiency Integrators, whereas professors from other areas were classified as Experts (B2).

Table 9. Proficiency Level per Study Area

Training area	N.	Global Average	Standard deviation	Competency Level
Accounting Sciences	115	46,61	1,335	B1 - Integrator
Business	20	57,35	3,155	B2 – Expert
Economic Sciences	7	47,29	3,637	B2 – Expert
Others	14	51,50	2,753	B2 – Expert

Source: Research data.

Significant difference was identified between the means recorded for the comparison of Digital Proficiency levels between professors in the training area in the Kruskal-Wallis test ($X2\ (3) = 9.728$; $p<0.05$). Post-hoc test disclosed difference between training professors' groups in the Accounting Sciences and Business areas. The significant difference observed for means recorded between courses highlighted that Accounting Science course professors presented deficiencies in their academic training on digital technologies. This process involves several factors, including theoretical Accounting and technological skills concepts (Rodrigues et al., 2024; Rodrigues 2025), even during these professors' continuing education, since each individual has different experiences and learning contexts that exceed simple innovation addition to their pedagogical practices (Sales & Moreira, 2022).

Averages were not very far from each other in the Proficiency level per qualification comparison (Table 10).

Table 10. Proficiency Level per Qualification

Title	N.	Global Average	Standard deviation	Proficiency Level
Only graduation	-	-	-	-
Specialization	12	48.50	5.517	B2 – Expert
Masters'	54	49.07	1.732	B2 – Expert
PhD	79	47.67	1.631	B1 – Integratdor
Post-doctorate	11	51.00	4.319	B2 – Experts

Source: Research data.

There was no significant difference between the means recorded for Digital Proficiency level comparisons regarding professors' qualification in the Kruskal-Wallis test (X2 (3) = 0.524; p>0.05). Santos et al. (2021) found difference between levels recorded for graduate and Masters' degree, and doctoral degree. This finding corroborated findings in the current research, according to which, professors holding this qualification were at the Integrator level (B1). Carvalho (2020) found that Master's, PhD and Post-Doctoral Degree professors were at the same Integrator level (B1).

Table 11 showed variation in the averages recorded for students' competency level per class, although the difference was not very significant.

Table 11. Students Proficiency Level per Class

Students per class	N.	Global Average	Standard Deviation	Proficiency Level
Up to 10 students	1	35.00	-	B1 - Integrator
Up to 20 students	18	47.67	2.402	B1 – Integrator
Up to 30 students	37	50.16	2.334	B2 – Expert
Up to 40 students	56	49.00	2.155	B2 – Expert
Up to 50 students	31	44.94	2.395	B1 – Integrator
More than 50 students	13	51.77	3.290	B2 – Expert

Source: Research data.

There was no significant difference between means recorded for the Digital Proficiency levels between students per class in the Kruskal-Wallis test (X2 (5) = 4.931; p>0.05). However, it could be observed that professors teaching for classes with 20 up to 40 students, and for those with classes with more than 50 students, were Experts. Yet, professors teaching in classes with up to 20 students and with 40 to 50 students, were Integrators.

The overall assessment of Accounting Sciences course professors were mostly B2 – Expert level. This is an intermediate level where professors connect digital tools, creatively use a whole variety of them, have a critical spirit to improve their professional practices, are curious and open to new and not previously tried ideas. Professors should discuss and renew their professional practice to stay updated and share ideas with their peers to reach the Leader (C1) level (Lucas & Moreira, 2018). According to Mishra and Koehler (2006), technologies play, or could play, a significant role in the teaching process, but it would depend on professors' ability to associate them with pedagogical practices and contents to achieve a better performance.

Therefore, the DigCompEdu questionnaire covers a whole range of proficiencies to promote innovation in the teaching process. Therefore, professors can understand and improve their teaching methods, as well as make better use of digital technologies, based on accurate diagnosis (Lucas & Moreira, 2018).

5 Final Considerations

Knowing a model capable of allowing self-assessment as initial step in the continuing education process helps addressing the need for adjustments aimed at digital media and pedagogical methods due to technological updates and professors' demand for meeting several requirements. Therefore, the aim of the current study was to identify Accounting Sciences courses professors' digital proficiency level at universities in Southern Brazil. The research sample consisted of responses from 156 professors.

Based on the present results, professors overall introduce themselves as Experts - proficiency level (B2), which is an intermediate one. These professors use different digital technologies with confidence and creativity, as well as try to improve and broaden their teaching practices. They are always receptive to new approaches (Lucas & Moreira, 2018).

The highest mean proficiency level across the six Digital Proficiency areas was recorded for Area 3 – Teaching and Learning: Expert professors (B2). It was followed by Area 1 – Professional Engagement, also at Expert level (B2); Area 6 – Promoting Students' Digital Competency, classified as Integrators (B1), Area 4 – Assessment, although it accounted for a lower mean, Expert (B2) professors, Area 5 – Student Training and Area 2 – Technologies and Digital Resources, Explorer professors (A2).

As for the 21 individual proficiencies, professors recorded the highest means for "Reflective Practice" (μ=3.256;

σ=0.7609) – A1, “Guidance” (μ= 2.628; σ=1.0669) – A3, “Institutional Communication” (μ= 2.596; σ=0.9421) – A1, “Differentiation and Personalization” (μ= 2.596; σ=1.0272) – A5 and “Content Creation” (μ= 2.442; σ=1.1373) – A6; the lowest means were recorded for “Responsible Use” (μ= 1.827; σ=1.1197) – A6, “Selection” (μ= 1.769; σ=1.1121) – A2 and “Information and media literacy” (μ= 1.462; σ=1.4251) – A6. According to this finding, professors in the Reflective Practice digital proficiency accounted for the best averages.

Comparison tests between groups have spotted some differences in the recorded averages. Professors who taught in both modalities were Experts (B2) in the "Teaching modality" variable, whereas those who only taught in person were Integrators (B1). This significant difference could be associated with professors who taught in the distance learning modality. Consequently, they were more involved with digital tools, a fact that could raise their competency level.

Professors with a Degree in Accounting Sciences recorded lower means than those with degrees in other areas; they were classified as Integrators (B1). Professors at this level were familiar with a whole variety of digital technologies and with how to creatively use them. However, they did not know the situations ICTs would best adapt to pedagogical strategies and methods (Sales et al., 2019). It is recommended to think, test new digital technologies, be encouraged by colleagues and share knowledge to progress from the "Integrator (B1)" level to the "Expert (B2)" level (Lucas & Moreira, 2018).

Another difference was observed in the teaching modality; professors who taught in both modalities (in-person and distance learning) recorded higher means and were classified as Experts (B2), whereas those who only taught in-person were classified as Integrators (B1). This higher classification level could be linked to the fact that professors used different digital tools for distance learning teaching as they need to use virtual learning environments, digital contents, communication and student assessments through virtual means, email, among others (Santos et al., 2021).

When it comes to groups “Region (State)”, “Qualification” and “Students per class”, there was no significant difference among items within each group, despite the alternating proficiency level averages. Thus, Experts - (B2) proficiency level prevailed in the herein compared groups. This finding corroborated the overall average that had classified most professors to this same intermediate level.

Accordingly, there were some gaps observed in this intermediate level professors could rule out in order to jump to a higher level. They should observe the dimensions they recorded the lower competency level in, such as Technologies and Digital Resources, and Learner Empowerment. Thus, practices used by professors to discuss and broaden their digital skills, to seek to stay updated and share ideas with their peers; to empower learners to actively involve them in the teaching-learning processes; to encourage personal and collective responsibility; to observe students’ experiences, interests and learning profiles; and to explore new digital strategies to engage learners, were some examples pointed out by Lucas & Moreira (2018).

Therefore, it could be inferred that Expert teachers were on the path to innovate in teaching, since they used several digital technologies in their pedagogical practices. They were open to new ideas and approaches, and sought to broaden and set new methodologies. According to Lucas and Moreira (2018), an expert is the very basis of an institution when it comes to innovating in pedagogical practices.

Limitations of the current study concern sample size, given the hard time finding email addresses of private universities professors, which resulted in only few responses. Therefore, it was not possible making any extrapolation on the observed features. Future studies must be carried out at state or national level and comprise Accounting Sciences course professors teaching Digital Proficiency to provide general diagnoses supporting the implementation of future continuing education measures for professors.

The present study’s contribution lied in highlighting theoretical and practical implications. The structure theoretically addressed DigComEdu. Its conceptual basis could be integrated to the educational process and worked as guide for digital practices’ integration to discipline matrices aimed at Accounting professionals’ training. These discipline matrices have proven effective in developing these future professionals’ knowledge, skills and attitudes. Institutions needed to take training actions related to professors’ continuing education and the DigCompEdu self-assessment allowed these professors to get to know and assess their digital proficiency level. This scenario enabled professors to raise their digital competency level within a context of constant technological innovation improvements.

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