

Smart Innovation, Systems and Technologies 320

Anabela Mesquita

António Abreu

João Vidal Carvalho

Cristina Helena Pinto de Mello *Editors*



# Perspectives and Trends in Education and Technology

Selected Papers from ICITED 2022

  
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# **Smart Innovation, Systems and Technologies**

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Anabela Mesquita · António Abreu ·  
João Vidal Carvalho ·  
Cristina Helena Pinto de Mello  
Editors

# Perspectives and Trends in Education and Technology

Selected Papers from ICITED 2022

*Editors*

Anabela Mesquita   
Polytechnic Institute of Porto  
Porto, Portugal

António Abreu   
Polytechnic of Porto  
Porto, Portugal

João Vidal Carvalho   
Polytechnic Institute of Porto  
Porto, Portugal

Cristina Helena Pinto de Mello  
ESPM—Higher School of Advertising  
and Marketing  
São Paulo, Brazil

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# Preface

This book—*Perspectives and Trends in Education and Technology: Selected Papers from ICITED22*—from the SIST Series is composed of the best selected papers accepted for presentation and discussion at the 2022 International Conference in Information Technology & Education (ICITED'22). The ICITED is a multidisciplinary conference with a special focus on new Technologies and Systems in the Education sector and was held between July 14 and 16, 2022. The ICITED'22 was supported by the Higher School of Advertising and Marketing (ESPM), Rio de Janeiro, Brazil and by IADITI—International Association for Digital Transformation and Echnological Innovation.

The International Conference in Information Technology & Education is an international forum for researchers and professionals in the education sector, which enables the discussion of the latest innovations, trends and concerns in several areas, in the education sector, associated with information technologies and systems. It is an event for professionals in the sector, in search of technology solutions, where academics, IT experts, and business managers meet to discuss new ideas that help them maximize the potential of learning processes through technology.

The ICITED'22 Scientific Committee is composed of a multidisciplinary group of 189 experts who assessed some 228 papers from 22 countries, received for each of the main topics proposed for the conference: (a) ICT and Virtual learning; (b) Pedagogical & Didactical Innovations; (c) Technologies issues in Education in the different scientific areas; (d) Quality in Education; (e) Technological Issues in Education and Research; (f) Educational Software and Serious Games; (g) Curriculum Design and Innovation; and (h) University-Industry Collaboration; SPECIAL SESSIONS: DTLP'22—Digital Transformation in the Teaching and Learning Process; FoE'22—Future of Education.

The papers accepted for presentation and discussion at the conference are published by Springer and will be submitted for indexing by ISI, SCOPUS, EI-Compendex, Google Scholar, and SpringerLink. We thank all those who contributed to the ICITED'22 conference (authors, committees, workshop organizers, and sponsors).

We deeply appreciate your involvement and support, which were crucial to the success of the conference.

Porto, Portugal  
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July 2022

Anabela Mesquita  
António Abreu  
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Cristina Helena Pinto de Mello

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# Assessment of Digital Teaching Skills—A Pilot Study Based on the Precepts of Digcompedu



Gustavo de Oliveira Andrade , Sani de Carvalho Rutz da Silva ,  
Manuel Florindo Alves Meirinhos , and Alessandra Dutra 

**Abstract** This study aimed to evaluate the level of digital competence of a group of 17 teachers by applying a questionnaire of the European Digital Competence Framework for Educators DigCompEdu [1]. With this information, we aimed to evaluate which are the areas of mastery and use of digital technologies in which there is less development of skills and use of these technologies when these professionals work in the classroom. This diagnostic will be part of a pilot study that will be the materials and methods of a study of bigger proportions, with a larger number of teachers. Therefore, the participants accessed the questionnaire on the DigCompEdu platform, and we collected their answers. The answers were analyzed and the teachers' scores allowed to classify them into six levels of digital competence based on the metrics proposed by DigCompEdu questionnaire. The results allowed us to identify that most teachers present intermediary levels of digital competence development, being classified with the general score B2 and present a good comprehension of the use of technological resources in the classroom. However, they not always show the necessary criticism and history of experimentation to dare to implement different tools. Finally, it was possible to identify the existing gaps in the digital competence of teachers, making it possible to map the points that need to be worked on, thus allowing these teachers to make autonomous and assertive decisions regarding their professional training.

**Keywords** Digital compentece · DigCompEdu · Pilot study

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G. de Oliveira Andrade (✉) · S. de Carvalho Rutz da Silva · A. Dutra  
Universidade Tecnológica Federal Do Paraná. R. Doutor Washington Subtil Chueire, 330 - Jardim  
Carvalho, Ponta Grossa, PR, Brasil  
e-mail: [profgoandrade@gmail.com](mailto:profgoandrade@gmail.com)

M. F. A. Meirinhos  
Instituto Politécnico de Bragança. Alameda de St.<sup>a</sup> Apolónia, 5300-253 Bragança, Portugal

## 1 Introduction

From 1990, with the progressive integration of technological innovation into the school environment and the pedagogical practices, there was a significant change in the educational context. In fact, internet, and the use of computers, when used as pedagogical tools integrated into the teacher's methodological resources, can propitiate changes in the teaching and learning processes, which will count on the availability of multimedia resources, and access to different databases and online libraries. Further, it will allow the student to know other cultures and favor digital inclusion [2]. But for this to happen, it is necessary to improve the digital skills of teachers and students, so that everyone can enjoy access to these goods.

Digital competencies can be understood as the group of skills and attitudes when using technological and digital resources, that allow the teacher to be proficient and autonomous to evaluate, select and apply these technologies to the education. Therefore, it also allows mobilization of knowledge, propose of strategies and rethinks pedagogical practices through digital technologies in the context of the classroom [3, 4].

Many Brazilian teachers do not show a satisfactory development of digital skills. Therefore, it is important to search for theoretical sources and practical experiences that serve as a basis or example for the development of teaching digital skills. Among the proposals for mapping the digital competence of teachers, one of the most successful and that is already implemented is the European Framework of Digital Competence for Educators—DigCompEdu. In addition to mapping the level of competence of teachers, the DigCompEdu questionnaire also assesses how teachers can collaborate in the development of students' digital skills and make the process of applying digital technologies for learning increasingly critical and contextualized [1].

The implementation of such a situation in Brazilian territory will allow a diagnostic of the level of teachers' digital competence, besides triggering a thought about the formative curriculum, opening a debate about the purposes of formation for the development of teacher's digital competence. Guided by this finding, the present research starts with the following question: "How can the DigCompEdu European Framework questionnaire contribute to the mapping of the level of digital competence of a group of teachers chosen for a pilot study?".

To answer this question, the present study aims to assess the level of digital competence of a group of 17 teachers from the application of the DigCompEdu Framework questionnaire (2018), in order to assess which are the areas of use and mastery of technologies in which there is a lower development of skills and use of digital technologies in teaching when these professionals work in the classroom. This diagnosis will be part of a pilot study that aims to function as a test for a study that will later be carried out with a larger number of teachers.

The results can show the alternatives of teachers' training and capacitation to help to solve possible lacks.

## 2 Theory

A study conducted by Silva and Behar, in 2019, made a literature review of 20 years of publication (from 2007 to 2017), compiling national and international journals, about the concept of digital competence. After that, the researchers were able to find a common description: “It is understood that Digital Skills are linked to the technological domain, mobilizing a set of knowledge, skills and attitudes with the aim of solving or solving problems in digital media” [3].

This definition is aligned with what is proposed by the United Nations Education, Scientific and Cultural Organization (UNESCO, 2015), which comprehends digital competence as a group of skills, knowledge and attitudes regarded digital technologies that allow their use critically and contextualized. Therefore, from these two first perspectives presented, we can notice that the idea of digital competence presupposes not only the knowledge of digital tools but also knowing how to use them critically and consciously so that the use of technologies has a contributory and ethical application in the teaching and learning process.

It can be said that these definitions converge with the idea of digital competence adopted by most researchers. Dias-Trindade and Ferreira [5], for example, developed a study that understands digital competence as the ability that a person has to deal with digital environments whether at work, in studies or in social interactions, and, in the specific case of the teacher, being also able to associate the pedagogical and technological aspects in the exercise of their profession.

One can also cite a survey carried out in Spain by Gálvez-de-la-Cuesta et al. [6], who also adopt the concept of digital competence as the one linked to the creative, critical and safe use of ICT to achieve objectives related to work, employability, learning, free time, inclusion and participation in society.

From the comprehension of what is digital competence, we need to list the studies that approached the mapping of teachers’ digital competence by using a questionnaire of the European Framework of Digital Competence for Educators: DigCompEdu [1].

According to Loureiro et al. [7], the European Framework emerged in 2017, at the initiative of the European Commission to develop a project to expand the digital skills of teachers in Europe as a way of promoting greater digital inclusion in education, signifying and innovating teaching and learning practices. In an attempt to achieve this objective, the Framework presents a structure that focuses on digital competences based on three modules, subdivided into six thematic areas: module of Professional Competences of Educators (with the thematic area Professional Involvement); Educators’ Pedagogical Competencies module (with the thematic areas Digital Resources, Teaching and Learning, Assessment and Training of Learners); and Learners’ competences module (with the thematic area Promoting learners’ digital competence [1]. From these modules and areas, we seek to have a global view of the mapping of digital skills of teachers both in their teaching process and in what they seek to provide their students in terms of promoting these skills.

Regarding the use of the DigCompEdu questionnaire for the diagnosis of digital teaching skills, Sales et al. [8], in their study on the training of higher education,

teacher in Bahia justify the choice of this data collection instrument by stating that if it is a very complete model, already validated, and that “offers individualized feedback to support processes of competence development from the identification of training needs” [8].

Corrêa et al. [9] show the utility of the questionnaire as a diagnostic when the goal is to offer proposals for teachers’ training. The researchers affirm that the questionnaire, when allowing the user’s classification into one of the six thematic areas, “establish a specific score for each competence, and when adding the questions, it is possible to identify the level of the user. Therefore, it can suggest actions and activities to upgrade the level of the user” [9].

Therefore, we can say that one of the main contributions of the European Framework of Digital Competence for Educators is to allow that the professor get to know their digital competence level and, with this knowledge, be able to undertake, in an autonomous, critical and conscious way, the search for the necessary training proposals so that he can reach the level of competence he wants.

### 3 Materials and Methods

A pilot study was carried out with to improve knowledge about the main instrument of this research: European Framework of Digital Competence for Educators (2018). According to [10], the pilot study is characterized by being a small test of the procedures, materials and methods that is aimed to carry out in a larger scale study. Still according to the author, the main goals of the pilot study are, besides elaborate a protocol of investigation, and to anticipate possible results and test data collection instruments, enabling the discovery of weaknesses and potential problems. Further, it allows possible failures can be corrected before proceeding with the larger study.

From this assumption, the current study considered 17 teachers that teach in public and private schools and different levels of teaching. The main goal of the pilot study was to do a test of the procedures that will be used for the application of the questionnaire to the participants of the larger scale study, that will be carried out considering about 100 teachers that teach in middle school in state public school. Furthermore, the pilot study also allow the teachers to practice their reading and interpretations of the results obtained from the answers, so they can appropriate of a larger knowledge of the material and its details, verifying which are the points that require better attention.

With this goal, the pilot study was conducted on the answers of the teacher in the questionnaire DigCompEdu, which is freely available for online access on the DigCompEdu<sup>1</sup> website. Of the 17 invited teachers, only 16 replied to all the questions on the questionnaire. Therefore, one teacher was excluded from our sample.

Before the application of DigCompEdu questionnaire, some personal information was collected to profile the participants. After obtaining these data, the teachers

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<sup>1</sup> Available on: <https://ec.europa.eu/eusurvey/runner/DigCompEdu-S-PT>.

accessed the questionnaire on the DigCompEdu platform. The questions on the questionnaire were related to six thematic areas approached by the Framework and are linked to the development of educational digital competencies, the way the teacher comprehends and uses digital technologies in the classroom and to communicate with the students and other members of the school community.

The answers were compiled into excel. Measures of central tendency (mean, median, mode) of participants' scores were analyzed. The relative frequencies (total and percentage) of the participants' scores were also evaluated.

With these data, it was possible to classify and identify the level of competence of the participants, using as a reference the scores delimited on DigCompEdu own material, which provides the user with a parameter for the classification. According to the minimum and maximum scores, this classification is done in six score levels, between A1 and C2, from the following reading: A1—Newcomer; A2—Explores; B1—Integrator; B2—Specialist; C1—Leader; and C2—Pioneer [1].

After the classification of the participants, a critical evaluation of the results was carried out.

## 4 Results and Discussion

About the profile of the 17 participants, 10 are women and 7 are men. Regarded to age, 4 are between 40 and 45 years old, 4 are between 35 and 40, 8 are between 30 and 35 years and only one is younger than 30.

When questioned about the institutions they work, 9 of them give classes in only one institution, 6 teach in two schools at a time, 1 teaches in three schools and 1 in four schools. About what level they teach, 6 teachers give classes in more than one level, being 9 of them teach for graduate degree, 8 for middle school and 6 teach for the final year of elementary school.

Finally, the highest level of training of teachers was asked and it was found that all of them have a master's degree. It was also asked if the teachers had already taken a course and/or specialization focused on informatics, educational informatics, or related areas. Thirteen of the 17 participants stated that they had already participated in some type of training/specialization in the area.

### 4.1 Analysis of the Questionnaire Digcompedu

After organized and analyzed the data of general scores, it was possible to characterize the level of competence of the participants of the study, as Table 1 shows:

As it is possible to observe, no participant was registered as having the competencies classified at the Newcomer level (Score < 20). Most participants were classified

**Table 1** Summary of the scores obtained by the 16 participants of the study, the correspondent competence pointing and the number of participants with each score

Participant	General pointing	General score	Total
3	23	A2	2
12	27	A2	
14	49	B1	1
1	51	B2	9
4	57	B2	
8	60	B2	
10	61	B2	
11	61	B2	
16	61	B2	
7	63	B2	
6	64	B2	
9	64	B2	
13	71	C1	
5	74	C1	
2	82	C2	2
15	85	C2	

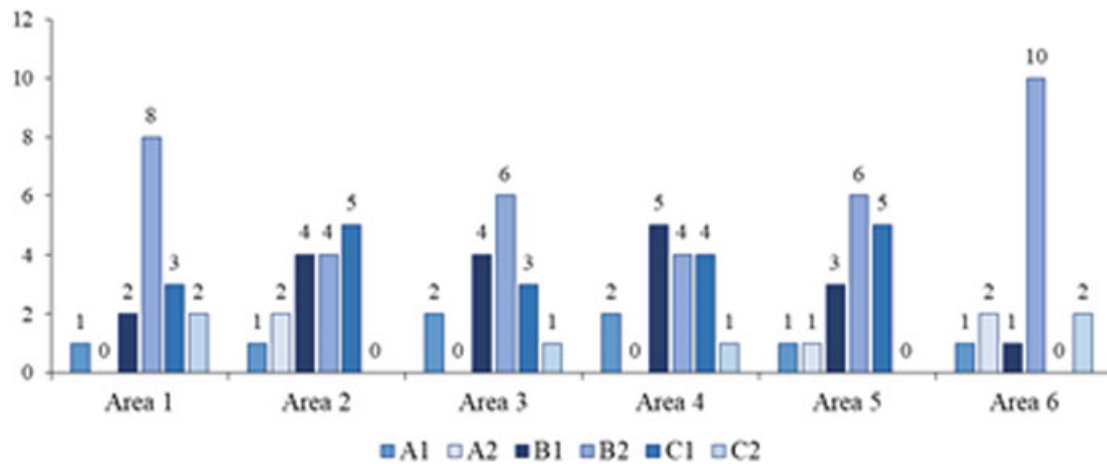
*Source* Elaborated by the authors based on research data (2021)

as having intermediate skills, totalling 62.5% of the sample between scores B1 (Integrator—6.25%) and B2 (Specialist—56.25%, the largest share of participants). The scores A2, C1 and C2 had two participants categorized in each.

Analyzing the distribution of scores obtained by the participants, the analysis that the skills are at intermediate levels is corroborated. The lowest score recorded was 23.0, while the highest corresponded to 85.0 on a scale ranging from 00.0 to 88.0 points. The median and mode coincided in the grade 61.0 (score B2) and the arithmetic mean was 59.6 (score B2).

These general data of sample characterization show that the interviewed teachers already have some degree of knowledge and mastery of digital skills, with recognition of the importance of such instruments for the teaching and learning process. Within the group, even though the classified teachers as Leaders and Pioneers is small, their presence can represent a source of inspiration for the professors, since these professionals, with C1 and C2 scores on the competence scale, can positively influence the choice of new and better technologies for the mediation of pedagogical practices.

Analyzing the frequencies of distribution of participants in each thematic area of DigCompEdu, between scores A1 and C2, it was found that most respondents are in score B2 in thematic areas 1, 3, 5 and 6 (Fig. 1). Regarding Area 1, the result makes clear the interest and engagement of the professionals interviewed with the use of technologies in their pedagogical practices, demonstrating an interest in promoting meaningful and contextualized teaching and learning in an increasingly technological



**Fig. 1** Frequency of distribution of respondents by competency score and by assessment area, according to the DigCompEdu questionnaire applied. *Source* Done by the authors based on research data (2021)

world, which is a fundamental attitudinal component for the progressive development of such competences.

In the background, concerning the greater presence of intermediate levels in areas 5 and 6, the data make evident the intention to train and provide students with autonomy in the use of technological and digital resources to mediate learning. However, this can occur in a non-critical way in relation to the instrument used, considering that the teacher is still in the experimentation phase of the technologies and can use them in a mechanical, reproductive way, without a real context or application in the face of other tools and practices available. Especially because the students included in area 6 are not only susceptible to the attitudinal characteristics of the teacher but are also likely to reproduce mechanical behaviors of those who teach, with less critical discussion about what and how to learn. Therefore, a future investigation with the teachers interviewed becomes valid to verify the effectiveness of their practices in the learning of their students.

It is also worth noting that areas 2 (Digital Resources) and 4 (Assessment) presented the most equitable distributions between scores B1 and C1 (Fig. 1). These scores and distribution were decisive in the classification of the teacher as intermediate development scores since they represent the largest portion of the sample. Both the selection of digital resources and alternative ways of evaluating learning are dependent on each other, as they indicate new methodologies and pedagogical practices put to experimentation by teachers. Therefore, the result obtained for these areas is consistent with the other results obtained.

An analysis of the scores per question was also carried out, in order to identify those points in which the educators present the lowest and the best performance, respectively, among the items evaluated in the questionnaire. The questionnaire is designed in such a way that each question has four alternatives, with grades assigned between one (lowest level of competence/frequency of technology use) and four (higher level of competence/frequency of technology use). By fashion, it was possible

**Table 2** Question with worse personal performance of the interviewed people, by DigCompEdu thematic area

Area	Question	Affirmatives
2	3	I protect with success any sensible content, for example: exams, classifications, and student personal data
3	3	When my students work in group, they use digital technology to acquire and document knowledge
3	4	I use digital technology to allow my students to plan, document and monitor their learning. For example: auto questionnaires, eportfolios for documentation and dissemination, online diaries/blogs for reflection
4	3	I use digital Technologies to provide efficient feedback
5	3	I use digital Technologies so the students can actively participate in the classroom

*Source* Done by the authors based on research data (2021)

to observe that most of the participants have individual scores for each question in the 75% ranking since score of three was the most frequent for 14 of the 22 questions presented.

The questions that had a mode less than or equal to two, or an average equal to or less than 2.5, are summarized in Table 2. These were the questions in which the teachers presented the worst average individual performance.

According to the selected questions, it is possible to notice that even though the professors have some mastery over the use of technologies, and even the usability of networks, such as email accounts and social networks, for example, their application is not secure. There was a low performance in terms of data protection, which is fundamental, especially when working with children and teenagers, whose intellectual production must be preserved in addition to being a point provided for in the relevant legislation [11].

In area 3—Teaching and Learning, it is possible to see that the use of technologies is not well used in terms of self-assessment of learning progress, according to the low performance of questions 3 and 4 (Table 2). The use of technologies for documenting learning is still not well used by teachers. Possibly it is necessary that new tools for this purpose be acquired so that the teacher can apply them effectively and relevantly in the discussions with their students. This reality is also reflected in area 4—Assessment, since teachers also do not use digital instruments for feedback to students. This gap in intercommunication must be addressed, as the instrument is not only for application and learning, but also must promote more effective and constructive dialogues between the parties involved.

Last, it is important to highlight that question 3 of area 5 (Table 2) obtained a mode equal to two. If the teachers had a low performance in this regard, it may be an indication that technologies are only mediators of learning, but not stimulators of critical thinking or the development of other skills. Therefore, it is necessary to consider the best teacher training, at higher levels of digital skills, so that the use

of such technologies also stimulates critical attitudes and questioning postures in students.

This scenery seems to be changing since the issue of area 1—professional involvement, “I participate in online training opportunities, p. ex. online courses, moocs, webinars, virtual conferences” obtained a high score among teachers (with mode 4 and mean 3.4). Thus, it can be seen in the group of teachers interviewed that there is already a well-founded complementary training concern, which is the first step towards a greater development of digital skills.

## 5 Final Considerations

The pilot study developed in this research aimed to map the level of digital competence of a group of 17 teachers using the questionnaire of European Framework of Digital Competence for Educators (2018).

It was possible to verify that most of them have intermediate degrees of digital competence development being most of them classified with the general score B2. This score is perpetuated in the individual analysis by thematic area, indicating an evenness between the evaluation axes. From this result, it was possible to identify the most recurrent gaps in the development of the level of digital competence of the teachers in the sample, making it possible for them, in case they are interested, to seek teacher training courses in order to fill precisely the gaps presented, being able to choose for more targeted and assertive courses according to their needs and focusing on the main points to be worked on.

Still in this regard, the research revealed that the teachers participating in the study have a good understanding of the use of technological resources in the classroom, but they do not always demonstrate the necessary criticality and history of experimentation to dare to implement different tools. However, participants with lower levels of digital competence (A2 and B1) may be inspired by participants who are at the “leader” and “pioneer” levels, which can be seen as role models to be achieved, in addition to the fact that they are capable of positively influencing the choices and decision-making of other teachers in relation to pedagogical practices that use technologies.

Regarding the development of the pilot study itself, it can be said that it was productive to test the application of the questionnaire, which proved to be extremely useful in mapping the level of digital competence of the teachers participating in the sample. It can also be said that there were no difficulties in relation to the use of the tool, nor doubts that made it difficult for the researcher to read and interpret data.

Finally, it is worth bringing here some of the reflections of [12] that discuss the fact that for the teacher, acquiring digital skills is not only a way of transforming and re-signifying their pedagogical practices but also of recognizing the power that technologies exert in society and in the lives of students. The knowledge and use of technologies constitute a form of appropriation of knowledge and, this, as a tool of power and opinion formation. Thus, providing the student with the opportunity to

only have contact with digital technologies does not guarantee that he will be truly digitally included for the exercise of this right and his citizenship. It is necessary that teachers and students critically appropriate these technologies, which, under the power of dominant groups, function as tools of domination and manipulation of the masses. And that's where the role of education comes in, with its emancipatory capacity, avoiding mass alienation and promoting critical thinking in relation to the use of technological resources.

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