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António Abreu · João Vidal Carvalho · Anabela Mesquita · Agostinho Sousa Pinto · Marcelo Mendonça Teixeira *Editors*

Perspectives and Trends in Education and Technology

Selected Papers from ICITED24, Volume 2

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Preface

This book—Perspectives and Trends in Education and Technology Volume 2: Selected Papers from ICITED24—from the LNNS Series is composed of the best selected papers accepted for presentation and discussion at the 2024 International Conference in Information Technology & Education (ICITED'24). The ICITED is a multidisciplinary conference with a special focus on new Technologies and Systems in the Education sector and was held between July 11 and 13, 2024. The ICITED'24 was supported by the Pernambuco University, Recife, Brazil, and by IADITI—International Association for Digital Transformation and Technological 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'24 Scientific Committee is composed of a multidisciplinary group of 143 experts who assessed some 262 papers from 26 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; ICITED SUMMIT'24—Accelerator Program for EdTech Startups; SPECIAL SESSIONS: DTLP'24—Digital Transformation in the Teaching and Learning Process; EU-AIEdu'24—EXPERIENCES IN THE USE OF ARTIFICIAL INTELLIGENCE IN EDUCATION; E4TLI—EDUCATION FOR TECHNOLOGICAL LITERACY AND INCLUSION; EUROPROJECTS'24—European projects; FoE'24—Future of Education. Difree—Digital Freelancing European Erasmus Plus KA project. SPECIAL TRACKS: Digital Literacy x Media Literacy—New Literacies and Education in Brazil; Cultural Tourism, Education and Marketing—CulTurEM'24; New Technologies in Accounting Education; Internationalization in Higher Education as a challenge; Education and the problems of the contemporary world.

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'24 conference (authors, committees, workshop organizers and sponsors).

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

July 2024

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Contents

Students' Digital Skills: A Case Study at a Higher Education Institution

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Abstract. In recent years, there has been a lot of talk about digital skills in education, but especially in teachers. The digital skills they need to have to be able to teach their students innovatively and dynamically and ensure a closer and more inclusive teaching-learning process. However, it seems to us that students have been forgotten when it comes to their digital skills and the importance they have in their learning and in acquiring skills in the most varied areas. It is, in this sense, that the need arose to carry out this research to determine the level of digital skills of higher education students. The investigation was carried out through a case study at the Higher School of Education of the Polytechnic Institute of Bragança (Portugal), using a questionnaire survey, adapted from the European Digital Competence Framework for Citizens (DigComp 2.2). Although there are positive results, it is absolutely necessary to promote continuous learning in this area so that students progress through the different levels of digital proficiency, as digital technologies have undoubtedly become one of the main tools of the 21st century.

Keywords: DigComp 2.2 · Digital Skills · Higher Education · Students · Technologies

1 Introduction

In the literature, there has been a lot of discussion about the importance of teachers acquiring digital skills to be able to teach their students innovatively and guarantee a more dynamic and inclusive teaching-learning process. Several existing studies address this topic and portray the urgency of guiding teacher training towards the acquisition of digital skills [1–5]. In addition to these studies, there are other researchers [6–12] that point to the digital skills provided in DigComp 2.2 - European Digital Competence Framework for Educators [8]. Since teachers' digital skills have become one of the most discussed topics in the literature in the field of education, it is also urgent to address students' digital skills, as they must also be able to use digital technologies in their learning.

In addition to training students, this study is timely as the European Council determined, in November 2023, that four out of every five people should have basic digital skills by 2030 [13]. DigComp 2.2 plays a fundamental role in achieving this objective

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[14]. The update of this reference takes account of emerging technologies such as Artificial Intelligence, the Internet of Things, and datafication or new phenomena [14]. These and many other skills seem to be fundamental to students' academic and professional lives, as they facilitate access to resources, promote effective collaboration and communication, increase productivity and organization, and promote self-directed learning, preparing students to face challenges.

In short, the digital skills of higher education students are essential for educational, but also professional, success in an increasingly digital world. By developing these skills, students will be better prepared to face the challenges of the 21st century and take advantage of the opportunities offered by the digital revolution that takes place every day.

With this research we intend to determine the level of digital skills of students at the Higher School of Education of the Polytechnic Institute of Bragança (Portugal), contributing to adapting educational curricula, providing adequate support they need, preparing them for the current job market, where technology is a central aspect, and promotes more effective learning.

2 Methodology

With the development of the research, the aim is to determine, with support from the European Digital Competence Framework for Citizens (DigComp 2.2), the level of digital competencies of higher education students.

To carry out the research, a case study methodology was adopted focusing on students from the Higher School of Education of the Polytechnic Institute of Bragança (Portugal).

As a data collection instrument to be applied in the case study, a questionnaire survey was adopted, which includes a set of questions that correspond to the skills set out in the European Digital Competence Framework for Citizens (DigComp 2.2).

It is important to note that the questionnaire survey was previously approved by the Ethics Committee of the institution where it was applied (Polytechnic Institute of Bragança) and was distributed electronically via email to the target audience between June 2023 and March 2024, requesting their voluntary participation. Participants were informed about the objectives and purpose of data collection, guaranteeing the anonymity of participants and the confidentiality of the data collected. In this sense, the sample is intentional and non-probabilistic.

Since only one questionnaire survey will be applied to all students, the nature of the investigation is quantitative, ensuring the confidentiality of the data through its coding. In this sense, both independent and dependent variables will be treated, categorized, and analyzed using Microsoft Excel through a quantitative/statistical analysis.

3 Results

A total of 59 students participated in the study. The data obtained on the level of Digital Competence of Students are presented by the sections of the questionnaire survey, followed by a descriptive statistical analysis of frequency guided by the responses given in the questionnaire.

3.1 Socioeconomic Variables

In Sect. 3.1 - socioeconomic variables, it was found that out of 59 students, 39 are female (66%) and 20 are male (34%). The age of the respondents ranges from 18 to 55 years, with the most representative age being 21 years (17.7%), and the least represented ages, with only one student each (1.6%), are: 18, 27, 28, 34, 35, 40, 43, 50, and 55 years. The average age of students is 32.4 years. Regarding the country of origin, students come from: Brazil (N = 4; 6.8%), Cape Verde (N = 10; 16.9%), China (N = 1; 1.7%), Czechia (N1 =; 1.7%), Guinea-Bissau (N = 5; 8.5%), Portugal (N = 36; 61.0%), São Tomé (N = 1; 1.7%), and Switzerland (N = 1; 1.7%). The majority of students are of Portuguese nationality.

Students attend different levels of study: Higher Technical Professional Course (N = 12; 20.4%), Bachelor's degree (N = 11;18.6%), and Master's degree (N = 36; 61.0%). At the Higher Technical Professional Course level, only students attending the Multimedia Product Development course (N = 12; 100%) responded to the questionnaire.

Regarding the Bachelor's degree cycle of study, the courses Animation and Artistic Production, Environmental Education, Foreign Languages: English and Spanish, and Languages for International Relations each have 2 students (18.2%). The bachelor's degree courses in Social Education and Music in Community Contexts and Other are attended by 1 student each (9.09%). The courses Art and Design, Sports, Basic Education, and Lusophone Relations and Portuguese Language are not represented in this sample.

The entirety of master's students who participated in this questionnaire survey studied ICT in Education and Training (N = 21; 58.3%), followed by Translation (N = 8; 22.2%), Pedagogical Supervision and Innovation in Education (N = 4; 11.1%), Pre-School Education and Teaching of the 1st Cycle of Basic Education (N = 1; 2.8%), Teaching of Musical Education in Basic Education (N = 1; 2.8%), and Master's in Special and Inclusive Education (N = 1; 2.8%). It is worth noting that second-cycle students in Social Education - Lifelong Education and Intervention, Science Education, Teaching of the 1st Cycle of Basic Education and Mathematics and Natural Sciences in the 2nd Cycle of Basic Education, Teaching of the 1st Cycle of Basic Education and Portuguese and History and Geography of Portugal in the 2nd Cycle of Basic Education, and Exercise and Health did not respond to the questionnaire.

3.2 Digital Competencies of Higher Education Students

Section 3.2 - Digital competencies of higher education students, consisting of 6 questions aimed to understand students' perception of their digital competencies in the 5 areas of Digital Competence (1. Information and data literacy; 2. Communication and collaboration; 3. Digital content creation; 4. Safety; 5. Problem-solving) mentioned in the European framework of digital competence for citizens (DigComp 2.2), as well as their level of digital proficiency (basic, intermediate, advanced, and highly specialized). The data obtained are presented in Table 1.

In the area of Information and Data Literacy (Area 1), participants in the study are represented across all levels of agreement and disagreement, although a large portion of students fully agree or agree that they possess skills in this area.

Table 1. Digital competencies of higher education students.

1. Information and data literacy	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can navigate, search, and filter digital data, information, and content	3	5.1	1	1.7	1	1.7	23	39.0	31	52.5	59	100
I can evaluate digital data, information, and content	3	5.1	1	1.7	4	6.8	28	47.5	23	39.0	59	100
I can manage digital data, information, and content	1	1.7	4	6.8	3	5.1	24	40.7	27	45.8	59	100
Total	7	11.9	6	10.2	8	13.6	75	127.2	81	137.3	177	300
2. Communication and collaboration	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can interact through digital technologies	1	1.7	1	1.7	1	1.7	14	23.7	42	71.2	59	100
I can share through digital technologies	1	1.7	1	1.7	2	3.4	11	18.6	44	74.6	59	100
I can engage in citizenship through digital technologies	1	1.7	3	5.1	6	10.2	17	28.8	32	54.2	59	100
I can collaborate through digital technologies	1	1.7	1	1.7	2	2.4	17	28.8	38	64.4	59	100
I pay attention to netiquette	1	1.7	2	3.4	4	6.8	22	37.3	30	50.8	59	100
I can manage my digital identity	1	1.7	3	5.1	5	8.5	25	42.4	25	42.4	59	100

(*continued*)

Table 1. (*continued*)

1. Information and data literacy	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
Total	6	10.2	11	18.7	20	33	106	179.6	211	357.6	354	600
3. Digital content creation	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can develop digital content	2	3.4	0	0	8	13.6	31	52.5	18	30.5	59	100
I can integrate and rework digital content	1	1.7	3	5.1	7	11.9	32	54.2	16	27.1	59	100
I have knowledge of copyright and licenses	4	6.8	5	8.5	12	20.3	22	37.3	16	27.1	59	100
I have knowledge of programming	12	20.3	9	15.3	16	27.1	14	23.7	8	13.6	59	100
Total	19	32.2	17	28.9	43	72.9	99	167.7	58	98.3	236	400
4. Safety	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can protect devices and digital content and take security measures	2	3.4	5	8.5	13	22.0	28	47.5	11	18.6	59	100
I can protect personal data and privacy	1	1.7	2	3.4	13	22.0	29	49.2	14	23.7	59	100

(*continued*)

Table 1. (*continued*)

1. Information and data literacy	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can avoid risks to health and ensure my well-being	1	1.7	4	6.8	10	16.9	28	47.5	16	27.1	59	100
I am aware of the environmental impact of digital technologies	2	3.4	1	1.7	10	16.9	27	45.8	19	32.2	59	100
Total	6	10.2	12	20.4	46	77.8	112	190	60	101.6	236	400
5. Problem-solving	**Fully disagree**		**Disagree**		**Neither agree nor disagree**		**Agree**		**Fully agree**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%
I can solve technical problems	3	5.1	6	10.2	24	40.7	17	28.8	9	15.3	59	100
I can identify technological needs and responses	2	3.4	5	8.5	10	16.9	34	57.6	8	13.6	59	100
I can use digital technologies creatively	2	3.4	3	5.1	5	8.5	32	54.2	17	28.8	59	100
I can identify gaps in digital competence	3	5.1	6	10.2	15	25.4	23	39.0	12	20.3	59	100
Total	10	17	20	34	54	91.5	106	179.6	46	78	236	400

In the area of Communication and Collaboration (Area 2), the majority of participants fully agree that they have skills to share, interact, collaborate, engage, and use netiquette. Digital identity management is a competency that participants both agree and fully agree to possess.

In Area 3, a significant number of participants agree to have digital content creation skills, although when it comes to programming, the majority are situated between disagreeing completely and neither agreeing nor disagreeing, indicating knowledge gaps at this level.

In Area 4, the majority of participants agree that they have security competencies, particularly in protecting personal data and privacy.

In Area 5, Problem-solving, participants agree that they possess skills to identify technological needs and responses, creatively use digital technologies, and identify gaps in digital competence. However, 40.7% express insecurity in resolving technical problems.

Finally, students were asked to indicate their level of digital proficiency for each competency area. The results are shown in Table 2.

Table 2. Digital proficiency level.

Digital proficiency level	**Basic**		**Intermediate**		**Advanced**		**Highly specialized**		**Total**	
	N	%	N	%	N	%	N	%	N	%
1. Information and data literacy	12	28.6	28	22.8	14	14.6	5	15.6	59	81.6
2. Communication and collaboration	2	4.8	23	18.7	27	28.1	7	21.9	59	73.5
3. Digital content creation	10	23.8	19	15.4	23	24	7	21.9	59	85.1
4. Security	10	23.8	27	22	16	16.7	6	18.8	59	81.3
5. Problem-solving	8	19	26	21.1	16	16.7	6	21.9	59	78.7
Total	42	100	123	100	96	100	31	100	295	400

Overall, participants' level of digital proficiency is intermediate for competencies in Information and Data Literacy, Security, and Problem-solving. For Communication and Collaboration, and Digital Content Creation, participants consider their digital proficiency to be advanced.

4 Conclusion

As demonstrated throughout the development of this article, the main objective of this research was to determine, based on the European framework of digital competence for citizens (DigComp 2.2), the digital competencies that students at the Higher School of Education of the Polytechnic Institute of Bragança (Portugal), consider themselves to possess.

Considering the 5 competency areas of DigComp 2.2, we can conclude that: in Area 1, almost all students possess information and data literacy competencies; in Area 2, students seem confident in their abilities to communicate and collaborate digitally, but we believe it's important to reinforce the competency of "Managing my digital identity"; in Area 3, participants express doubts about their actual programming knowledge, thus indicating a competency that needs to be developed; in Area 4, contrary to our expectations, we did not identify limitations among participants in terms of security. However,

in Area 5, participants agree that they can identify technological needs and responses, creatively use digital technologies, and identify gaps in digital competence, yet they need to develop skills to solve technical problems.

Regarding the level of digital proficiency, participants are situated at the intermediate level (competency areas 1, 4, and 5) and advanced level (competency areas 2 and 3). The highly specialized level was the least chosen by participants, especially in Area 1.

In an overall assessment of the results, we can state that we did not observe significant differences between the level of proficiency and gender or country of origin, although females are in the majority and Portugal is the most represented country.

It is important to highlight these strengths and challenges to demonstrate the value of digital competence, as in today's society, it is one of the fundamental skills essential in virtually all areas of daily life. Therefore, we consider it vital to understand the reality regarding this competency of our students, to act and intervene in their empowerment during their academic training so that they become digitally competent individuals who will be the main drivers of the country's development in the future.

In conclusion, despite the positive results evidenced in this study, it is absolutely necessary to promote continuous learning in this area so that students progress in different levels of digital proficiency, as digital technologies have undoubtedly become one of the main tools of 21st century society.

5 Limitations and Future Research

We recognize that we had a limitation in the study, which is the fact that we were able to obtain only 59 responses from respondents. We assume that the investigation could be much more interesting with more answers from students. However, we recognize that students receive many questionnaire surveys to fill out and, perhaps because of this, due to saturation, they choose not to participate in this type of research. Despite this limitation, our study provides valuable insights into the digital skills of students today.

As future work, we believe it is important to expand the study and apply it to the entire institution and not just one school. In this way, it will be possible to understand more broadly and broadly students' level of digital proficiency at this higher education institution.

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