

# COMPETENCE DEVELOPMENT FOR THE EDUCATIONAL INTEGRATION OF DIGITAL RESOURCES

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## Abstract

In previous research work [1] where we studied the conceptions of teacher training defended in six references of digital competences for teachers, we recognized that the integration of digital technologies in the context of learning has been attempted since the last decades of the twentieth century. In fact, the central axis of the references was based on the development of digital skills for pedagogical integration. Moreover, we also know that the innovative potential of digital technologies can have a relevant role in transforming and enriching pedagogy and we are also aware that considerable effort in teacher training/education has been centred on the pedagogical exploitation of ICT in learning contexts. Aiming to ensure innovation in pedagogical practices, concerns with continuous transformation of technology-based learning seem necessary. In addition, research also points to the need to improve conditions for teacher educators' development with digital technology and professional digital competence [2]. In this context, the digital skills of teachers play a fundamental role in the students' learning process, but also in the development of skills related to critical thinking, innovation, collaboration, problem solving and others that are emerging, related to a society increasingly supported by artificial intelligence applications and services [3]. Training and professional development is something that must be continuously monitored in order to be able to react with the urgency necessary to fill any gap that may condition the preparation of students for the digital society. That bearing in mind, we designed a survey with the following objectives: (i) to verify and analyse the digital skills of Basic Education teachers in Portugal (1st to 3rd Cycles); (ii) to categorize the levels of teachers' digital competence; (iii) to assess the level of influence of digital competence in innovative learning practices in educational contexts. The survey was finished by 242 teachers who completed an online questionnaire asking for an individual self-evaluation of DigCompEdu [4] area 2 (digital resources) competencies: (i) *selection*; (ii) *creation and modification*; (iii) *management, protection and sharing of ICT*. Subjects were asked about their level of experience in the daily and professional use of ICT. As a first study that will serve as a basis for other more extensive studies in order to regularly monitor the evolution of Basic Education teachers' pedagogical integration skills with ICT, provisional findings show that teachers seem to feel able to: (i) use advanced strategies and resources comprehensively; (ii) adapt digital resources to the learning context; (iii) use interactive resources strategically. In this paper, we aim to fully present the collected data as well as to share the analysis we will be conducting, bearing in mind that teachers who participated in the survey have shown high awareness of the importance of their continuous professional development.

Keywords: Digital skills, teacher education, teaching and learning.

## 1 INTRODUCTION

The use of information and communication technologies in the school environment has been arousing the interest of research and educational public policies since the first decade of the 21st century [5][6] [7][8] [9] [10]. An issue that is evident in competencies frameworks is related to the initial and continuing training of teachers and the development of the digital skills necessary for the effective integration of ICT in learning contexts. This is because the fundamental role of the teacher, as a promoter of the development of future citizens of the current knowledge society, is highly recognized in these studies. The teacher is expected to have the necessary skills to make use of ICT and its communicational and pedagogical potential, promoting learning contexts more adjusted to the challenges facing the school.

The effective use of ICT intersects with the fundamental premises of digital competence. According to the European Digital Competence Framework [4]

*Educator's digital competence is expressed in their ability to use digital technologies not only to enhance teaching, but also for their professional interactions with colleagues, learners, parents and other interested parties, for their individual professional development and for the collective good and continuous innovation in the organization and the teaching profession (p. 19).*

In this context, being digitally competent is not limited to the ability to make use of the fruitful potential of digital technologies and overcome the challenges they impose on school environments, but also includes significant participation in the emerging knowledge society of the 21st century. Undoubtedly, the various technologies available today have been changing and influencing the lives of citizens, consumers and users around the world and can be strong allies of the educational process, if used for a more meaningful learning, enabling opportunities for collaborative work, problem-solving, communication, security and digital citizenship.

In previous research [1], we studied the concepts of teacher training defended in six references of digital teacher competences developed by Portugal [11], Spain [9], France [12], European Union [4], UNESCO [7] and ISTE [10] where we recognize that the integration of digital technologies in the context of learning has been attempted since the last decades of the 20th century. Based on this research, we expanded our studies with the following objectives: (i) to verify and analyze the digital skills of teachers of Basic Education in Portugal (1st to 3rd Cycle); (ii) to categorize the levels of digital competence of teachers; (iii) to assess the level of influence of digital competence in innovative learning practices in educational contexts. The survey included 242 teachers who responded to an online questionnaire requesting an individual self-assessment of the skills in area 2 (Digital Resources) of DigCompEdu [4]: (i) *selection*; (ii) *creation and modification*; (iii) *ICT management, protection and sharing*. The subjects were asked about their level of experience in the daily and professional use of ICT.

We believe that analyzing the digital skills of teachers, to regularly monitor the evolution of these skills and the pedagogical integration of ICT in Basic Education, makes this research a relevant study for contributing to discussions on digital teacher competence, for future researchers and projects in the area of teacher training in several countries. In this context, we intend to fully present the data collected in this research, as well as share the analysis carried out, taking into account that the teachers who participated in the survey have shown a high awareness of the importance of their continuous professional development.

## **2 TEACHER TRAINING AND STANDARDS OF DIGITAL SKILLS**

The skills acquired in initial training have, in today's times, an increasingly relative utility due to the advances produced by research, technological development, production and circulation of knowledge. The times when initial training could be thought of as a stage capable of providing a wealth of knowledge and skills for all professional life are long gone. Today, criticisms of initial training programs and their current limitation to prepare teachers to exercise a profession throughout their lives are frequent.

The growing emergence of the importance of continuing education as a fundamental stage of formation does not detract from the importance of initial formation, it is simply recognized that in addition to initial formation there is also a whole formative continuum. Thus, taking into account the implications of the development of digital teaching skills and the relevance in educational processes, reflects the emergence of creating competence references that can guide the initial and continuing training of teachers. This has been noticed since the first decade of the 21st century, a time when several countries and international organizations are beginning to show a growing concern regarding initial and continuous training for the development of digital skills, in order to make educators capable of integrating ICT into the curriculum and in educational processes, with a view of expanding learning opportunities and developing digital skills in students [8] [7] [4] [10]. Since then, international organizations such as the UE, OECD and UNESCO, have influenced the regulation of education and, consequently, the training of teachers.

Mendes and Martins [13] point to the *Lisbon Strategy* [14] as the starting point for the first educational intervention policies in the European space. Following this document, we find in the literature of the European Council and the European Commission, some important decisions regarding education and the need to develop digital skills, both for students and teachers. For example: i) in 2002, the European Commission defines European objectives, criteria and benchmarks in the area of education; ii) in 2004, the joint progress report of the Council and the Commission, on the progress made in

achieving the Lisbon objectives, in terms of education and training, required the development of a set of common European principles relating to the necessary skills and qualifications for teachers and trainers; iii) in 2006, the European Parliament and the Council of the European Union adopted a recommendation on key competences for lifelong learning created by the Member States which constituted the document *Key competences for lifelong learning - European Reference framework* [15], becoming an important reference for education, training and learning aimed at the development of skills.

In the analyzed UE documents, we find indicators and recommendations, with greater emphasis on teacher training and the need to improve that training, based on Communication from the Commission to the Council and the European Parliament - *Improving the Quality of Teacher Education* [16] and in the European Parliament and of the Council of 18 April 2018, about *Key competences for lifelong learning* [17]. It is notorious in these documents the references regarding the investment in the initial and continuous training of teachers, to expand and improve the level of digital skills and to guarantee them for all levels of education and training, therefore for all citizens.

The OECD's interest in education stems from exclusively economic interests. However, today, education is already part of an individualized area of interest to the OECD, which supports research, studies and international conferences on the global agenda on educational reforms in different countries [18]. Among the various resources used by this institution is PISA, an international evaluation process with periodic application, whose objective is to produce indicators related to the areas of Reading, Mathematics and Science, serving as a parameter of skills required by the knowledge society [19]. In the document *L'école de demain. Repenser l'enseignement: Des scénarios pour act* [20], the OECD emphasizes that education has not kept pace, with the required speed, with the transformations that are taking place in society and in the subsequent study carried out by the organization and which constitutes the document *Comprendre l'impact social de l'éducation* [21], the organization claims that education is a positive force for economic development and social progress. The scenarios highlighted in these documents highlight the importance of the role of teachers in the formation of young people. Since 2004, we have found in its documents the affirmative expression that policy towards teachers is at the forefront of concerns in OECD countries.

In turn, UNESCO has greatly influenced education worldwide through various initiatives, such as technical advice, document editing, sponsoring conferences, or even international cooperation actions for education. In the project *ICT competency standards for teachers* [7], we find a "broad political context of educational reform and sustainable development" that places education as a "central function of any nation or community" (p. 6). The project presents three documents: *Political Framework, Competency Standard Modules and Implementation Guidelines* in which the explicit relationship between Education and Economy is perceived. The intrinsic relationship between the role of the teacher and educational changes is evidenced in this project. For UNESCO, teacher training is a key factor in ensuring the effective use of technology in the educational environment, promoting more active learning so that students become creative users of technologies, be authors and reflective subjects who seek, analyze and evaluate information, solve problems and make decisions, work collaboratively and share knowledge, essential skills for the 21st century.

Overall, there are no conceptual and interest contradictions regarding the guidelines for the education and training of teachers in these references. We were able to verify that among the different regulations governed, there is a common concern with initial and continuous teacher training, and the urgency of developing technological skills that can contribute for teachers to use technology, effectively and efficiently, for the learning of the student.

For this study we take the *European Framework for the Digital Competence of Educators: DigCompEdu* [4] as a theoretical framework derived from the research on Learning and Skills for the Digital Era, carried out by the Joint Research Center of the European Commission (UE) whose studies started in 2005 to provide political support to the European Commission and member states to harness the potential of ICT to innovate education and training practices, improve access to lifelong learning and deal with the emergence of new digital skills needed for employment, personal development and social inclusion. With a model for the evaluation and development of digital pedagogical skills, *DigCompEdu* presents a common base of these skills to UE countries in order to capture and describe the specific digital skills that all citizens need so they can participate actively in a digital society. The document was organized into six areas that present a total of 22 digital skills that are centred on different aspects of the educators' professional activities, being: Area 1 - Professional involvement; Area 2 - Digital resources; Area 3- Teaching and Learning; Area 4- Evaluation; Area 5 - Training of learners; Area 6- Promotion of learners' digital competence\_(Fig. 1).

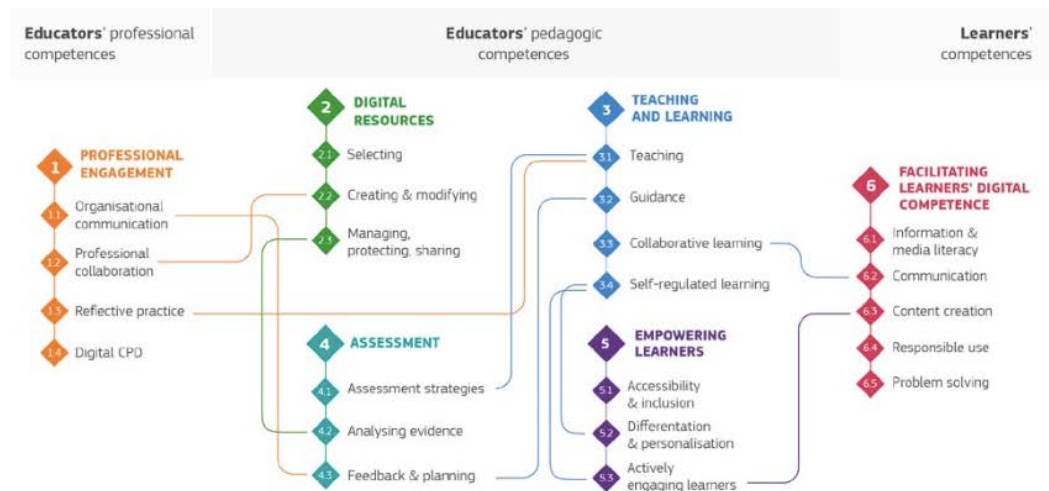


Figure 1: The DigCompEdu Framework (2017, p. 8).

This framework is particularly helpful since it offers a common frame of reference, with a common language and logic that are expressed in a set of digital skills specific to the teaching profession, also offering a structure that allows the educator to understand what it means to be digitally competent, evaluate and further develop their digital competence. Furthermore, the European Union is promoting educational policies for the transition to digital, in the social, economic and educational sphere.

### 3 METHODOLOGY

The present study is an interpretative investigation based on an online questionnaire as a data collection technique. This questionnaire was standardized, administered and managed by the electronic research platform, LimeSurvey, from the Polytechnic Institute of Bragança, Portugal, which focused on the area 2 (Digital resources) of the *DigCompEdu* framework (i) to verify and analyze the digital skills of Basic Education teachers in Portugal (1st to 3rd Cycle); (ii) to categorize the levels of digital competence of teachers; (iii) to assess the level of influence of digital competence in innovative learning practices in educational contexts. The questionnaire was prepared by the authors of this research and divided into four blocks: (1) Identification of the Respondent; (2) Selection of Digital Resources; (3) Creation and Modification of Digital Resources; (4) Management, Protection and Sharing of Digital Resources. For each of the categories, questions were organized with information and variables related to digital competence, according to *DigCompEdu* [4] (p. 45, 47 and 49). Firstly, the questionnaire was validated by professors with a doctoral degree and researchers from higher education, in the area of teacher training for digital technologies and some of the changes indicated were made to make it more suitable. It was subsequently validated by a sample of teachers with the profile of the respondents. The questionnaire was improved based on these assessments and adapted to the context and characteristics of the research participants. The objectives and purposes of the study were clarified on the first page of the questionnaire, along with the form for "Informed Consent".

We asked the participants to be as precise as possible in terms of how they saw themselves in terms of digital competence and the ability to deal with various technologies. In this way, the questions for data collection in this research were not an exam, but rather, questions with a self-assessment character and the participants answered according to their experiences about common processes and areas of use of ICT. Digital competence was measured based on *DigCompEdu* Area 2 - Digital Resources [4] operated in a total of three competencies (i) *select*, (ii) *create*, (iii) *share digital resources*. The choice of this area was made in the context of verifying the educator's digital competence necessary to (i) effectively identify, select and evaluate the resources best suited to their learning objectives and methodological approach; (ii) modify, add and develop digital resources to support your practice; (iii) be aware of how to use and manage digital content responsibly.

The questionnaire was sent by e-mail to Basic Education teachers from all regions of Portugal. A return of 242 complete responses was obtained; data were treated and analyzed using *DigCompEdu* indicators [4] as a parameter. For each of the three measurement competencies, the participants responded on a Likert-style scale, with an intensity between (1) Never do/use to (6) I always do/use, to each of the 29 competence descriptors covered in that area, organized according to the progression of *DigCompEdu*'s six skill levels A1 to C2 (Figure 2).

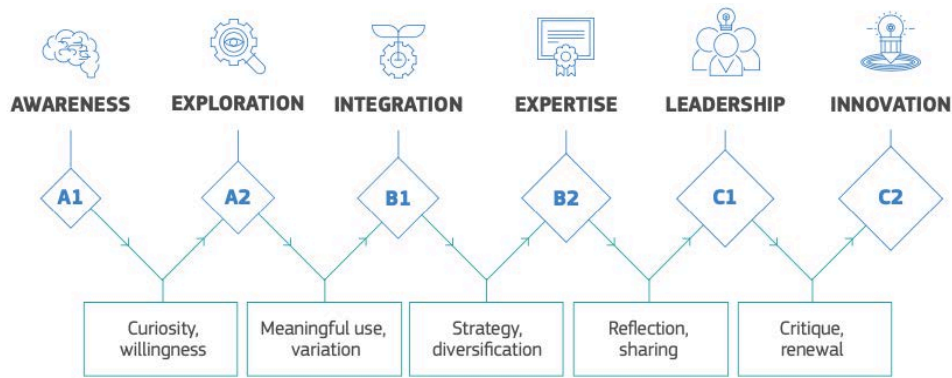


Figure 2. DigCompEdu progression model (2017, p. 29)

#### 4 PROCEDURES AND DATA DESCRIPTION

The demographic data of the participating population, relating to Block 1 - Respondent Identification, are organized in Table 1.

Table 1. Respondent demographics

<i>Data</i>	<i>Category</i>	<i>Number</i>	<i>%</i>
Sex	female	187	77,27
	male	55	22,23
Age	less than 31 years	2	0,83
	from 31 to 40 years old	11	4,55
	from 41 to 50 years old	96	39,67
	from 51 to 60 years old	105	43,39
	over 60 years old	28	11,57
Academic qualifications	Bachelor	4	1,65
	Graduation	169	69,83
	Master's degree	59	24,38
	Doctorate degree	10	4,13
Specialization in digital technologies and education (level)	specialization / graduate	21	8,67
	master's degree	19	7,85
	doctorate	2	0,83
	none	203	83,88
Number of hours attended training in the last 10 years	0	16	6,61
	less than 51	65	26,86
	from 51 to 100	63	26,03
	from 101 to 150	32	13,22
	from 151 to 200	21	8,68
	from 201 to 250	9	3,72
	Over 250	36	14,88
What is most important formation within the digital skills	Initial formation	45	18,60
	Advanced training (specialization, master's, doctor's)	34	14,05
	Continuous formation	206	85,12
	Self-taught training	83	34,30
	Other	4	1,65

The majority of participating teachers were women (77,27%). Taking into account age, it appears a majority from 51 to 60 years old (43.39%), followed by 41 to 50 years old (39,67%). Regarding the academic level, we had a greater number of teachers with a Graduation degree (69,83%).

Bearing in mind that the survey respondents demonstrated a high awareness of the importance of their professional development, we observed that, despite this awareness, most of them responded to having participated in training, in the last 10 years, for less than 51 hours (26,86%), followed of training from 51 to 100 hours (26,03%); only 14,88% accounted for over 250 hours and 6,61% said they had not participated in any training in that period. These data lead us to believe that research participants, in general, seek training in order to train them in the use of ICT and place greater emphasis on continuing education courses (85,12%), and self-training (34,30%).

## 5 DISCUSSION AND ANALYSIS OF RESULTS

After the demographic analysis of the participants, we started to analyze the digital competences, the focus of our study. Table 2 presents the data regarding the teaching skills for (i) *selecting*, (ii) *creating and modifying*, (iii) *managing, protecting and sharing digital resources* and their respective objectives.

Table 2. Competencies self-assessed by participants

Competencies	Teacher self-assessment %					
	1	2	3	4	5	6
<b>(i) Selecting.</b> Have the competence to identify, select and effectively evaluate the resources best suited to the learning objectives and methodological approach.	4,8	4,9	11,3	13,7	30,0	<b>35,3</b>
<b>(ii) Creating and modifying.</b> Have the competence to modify, add and develop digital resources to support pedagogical practice.	11,7	12,8	15,2	17,5	<b>24,6</b>	18,2
<b>(iii) Managing, protecting and sharing digital resources.</b> Be aware of how to use and manage digital content responsibly.	11,6	8,6	12,6	13,5	19,2	<b>34,5</b>
<b>TOTAL</b>	<b>28,1</b>	<b>26,3</b>	<b>39,1</b>	<b>44,7</b>	<b>73,8</b>	<b>88,0</b>

In the analysis of the results, we adopted a statistical description of the answers given to each question of the three blocks of competence, which allowed us to have the total percentage of answers for each level of development of digital competence. In this way, we were able to obtain the levels of proficiency classified by the participants in the three categories evaluated.

The findings revealed that teachers vary considerably in their level of digital competence. In the (i) *selecting* category, we found that between 30,0% to 35,3% of teachers indicate *leadership and innovation* (levels C1 and C2), having the digital competence to identify, select and effectively evaluate the most appropriate resources for the objectives of learning and methodological approach they use in the classroom. However, it is clear that, even within this category (i), regarding the ability to organize, annotate and classify digital resources in a specific repository and share with fellow teachers, there is an expressive number of respondents between 12,4% and 19,8% who rated themselves as *awareness and integration* (levels A1 and B2), respectively.

Statistical analysis showed that the majority of survey participants self-rated themselves at the C1 level *leadership* within the category (ii) *creating and modifying*. This can be seen in question 2.4 *I create digital resources (example: presentations) and I integrate animations, links, multimedia and interactive elements*, which had 24,4% of the teachers answering "(6) I always do/use", against 9,5% who answered "(1) I never do/use it". The same can be seen in question 2.5 *I make changes to the digital learning resources that I use, in order to adapt them to the learning objectives*, which had 34,3% of statements "(6) I always do/use", against 2,1% who rated themselves as "(1) I never do/use it".

Within the category (iii) *managing, protecting and sharing digital resources*, it was found that more than half of the teachers were aware of copyright and the need to protect private content, according to the answers to questions 3.4 and 3.5 *I am aware that some resources distributed on the internet are protected by copyright* and *I protect access to private content, such as exams, student reports*, 65,7% and 57,2%, respectively. However, when asked about the application of these skills, we found that

only 31,0% identified themselves at level C1 and C2, against 33,1% who consider themselves at level A1 and A2 and 37,1% at level B1 and B2. In the general statistics of this category, we see that most of the participants evaluated themselves at the C2 (innovation) level, with 34,5% of responses selected at that level, out of the 7 questions presented in the category.

The survey results reveal that, although many teachers are at the leadership (73,8%) and innovation (88,0%) levels, these numbers do not reflect the ability to apply these competences in school contexts. Many responses at these levels reveal the domain of certain digital skills and not necessarily their effective application in educational practice (questions 2.5, 2.7, 2.9; 3.3, 3.7, 3.8; 4.3, 4.6, 4.7 - Appendix 1).

According to Ferrari [22], digital competence has multiple definitions categorized in the following areas: (1) learning areas - digital competence is the set of knowledge, skills, attitudes, strategies and values; (2) tools - which are necessary when using ICT and digital media; (3) areas - to perform tasks, solve problems, communicate, manage information, collaborate, create and share content and build knowledge; (4) modes - in an effective, efficient, appropriate, critical, creative, autonomous, flexible, ethical and considerate manner; and (5) objective - for work, leisure, participation, learning, socialization, consumption and empowerment. According to this definition, digital competence does not only imply the possession of such skills, knowledge and attitudes, but the ability to put them into action, mobilize them, combine them and transfer them, to act consciously and effectively with a view to a purpose.

In this context, Hall et al.[23], state that a digitally competent teacher must have the skills, attitudes and knowledge necessary to promote effective learning within a context enriched by technology. To do this, teachers must be able to use ICT to improve and transform classroom practices and to enrich their own professional and personal development [23].

## 6 CONCLUSIONS

This research sought to verify, analyze and categorize the digital competences of Basic Education teachers in Portugal in order to assess the level of influence of digital competence in innovative learning practices in educational contexts, according to the European reference *DigCompEdu* [4]. According to the results, the vast majority of teachers considered themselves to be quite or very capable for the performance of the skills of selecting, managing, protecting and sharing digital resources. In relation to the skills related to ICT pedagogical integration for the promotion of innovative learning practices, the results showed that teachers seem to feel capable of using and adapting advanced strategies and resources in a comprehensive and strategic way (35,3%), resulting in the categorization of the participants as belonging to levels C1 and C2 of competences [4]. When assessed on the skills to create, modify, add and develop digital resources to support pedagogical practice, 24,6% of teachers indicate to be capable, but when asked about collaborative work with other colleagues to create learning resources, the majority of respondents rated themselves between levels B1 and B2 of competences (42,6%) and a significant number, indicated levels A1 and A2 (36,0%). The study showed many responding teachers with skills in the field of digital citizenship and responsible use of data, which was expressed when asked to be able to (i) *manage and store information and digital resources they search on the internet*; (ii) *sharing this information and resources through different digital media*; (iii) *be aware of copyright*; (iv) *knowing how to use data protection resources* (34,5%).

Another factor of great importance collected in this study and that must be taken into account, is the high awareness that teachers have of the importance of their continuous professional development, which was quite expressive in the initial section of the questionnaire (identification of the respondent). There, continuous professional development was the choice of 206 respondents (85,1%) to reply to the question about *the most important way for the development of their competences in the field of digital technologies and education*, which leads us to reiterate the value of continuing education, attributed in the references of digital competence studied by these researchers [1]. We can hypothesize that this awareness may have been increased due to the whole pandemic context that we have been experiencing since the beginning of 2020. This evidence could serve as a basis for the continuation of this study, as well as to guide the urgency of contributing for the development of continuing education, based on teaching needs.

This study had the participation of 242 teachers of Basic Education in Portugal, a considerable sample for a first study that will serve as a basis for other more extensive studies, in order to regularly monitor

the evolution of the pedagogical integration skills of teachers of Basic Education with ICT, aiming to guide and boost their professional development.

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## APPENDIX 1

### Issues: Area 2- Digital Resources

#### Block 2. Selection

- 2.1. I rarely use the internet to find resources for teaching and learning.
- 2.2. I use simple internet search strategies to identify digital content relevant to teaching and learning.
- 2.3. I use educational platforms that provide digital resources.
- 2.4. I adapt my research strategies based on the results I get.
- 2.5. Filter the results obtained to find resources appropriate to my goals.
- 2.6. I evaluate the quality of digital resources based on criteria such as: place of publication, authorship, comments from other users.
- 2.7. I select resources that my students may find interesting, such as: videos.
- 2.8. I combine my research strategies to identify resources that I can modify and adapt. Example: Search and filter by license, file type, date, user comments, etc.
- 2.9. I value the reliability of digital resources, their suitability for my group of students and the specific learning objective.
- 2.10. I evaluate and make recommendations on the resources I use.
- 2.11. I use a variety of internet search sources. Example: collaborative platforms, digital resource repositories, etc.
- 2.12. When I use the resources in the classes, I explain their origin and refer to any biases.
- 2.13. I advise colleagues on internet research strategies, repositories and resources appropriate to education.
- 2.14. I organize my own repository of links to resources, duly annotated and classified, and share it with other colleagues.

#### Block 3. Creation and modification

- 3.1. I use digital resources, but I do not modify them or create my own resources.
- 3.2. I use editorsoftware to create and modify content. Example: worksheets, proofs, presentations, spreadsheet.
- 3.3. I create simple digital resources (e.g. presentations).
- 3.4. I create digital resources (example: presentations) and integrate animations, links, multimedia and interactive elements.
- 3.5. I make modifications to the digital learning resources I use to suit them to learning objectives.
- 3.6. I create digital, complex and interactive learning activities, for example: online assessments (quizzes, forms, etc.), online collaborative learning activities (wikis, blogs), games and applications.
- 3.7. I create learning resources together with other colleagues.
- 3.8. I create applications or games to support my educational goals.

#### Block 4. Management, protection and sharing

- 4.1. Store and organize digital resources for my future use.
- 4.2. I share educational content by sending attachments in an email or through links.

- 4.3. I share educational content by linking or incorporating it into virtual learning environments, e.g., on a website or blog, staff or educational institution.
- 4.4. I am aware that some resources distributed on the Internet are protected by copyright.
- 4.5. I protect access to private content, e.g. exams, student reports.
- 4.6. I compile comprehensive repositories of digital content and make them available to students or other educators by applying their licenses to resources.
- 4.7. I keep the resources that I share digitally and allow others to comment on, classify and modify them.