THE DIGITAL COMPETENCE ACTIONS FRAMEWORK

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Abstract

Various definitions have been proposed regarding digital skills, digital competence and related terms. However, there is confusion as to what abilities these terms actually refer to and what a person should study in order to develop these abilities. This paper provides a solid definition of digital competence as well a framework that describes these fundamental digital competences based on the Actions that the person should be capable to do using digital technologies. This paper defines digital competence to be the person's knowledge, skills and attitudes to 'efficiently' access, use, create and share digital resources, as well as communicate and collaborate with others using digital technologies in order to achieve specific goals.

Keywords: Assessment, DiCAF, Digital Competence, Digital Literacy, Digital Skills, Evaluation.

1 INTRODUCTION

The European authorities point out that today 90% of jobs require some kind of digital skills, while almost half (44%) of the EU workforce has low basic digital skills, of which 22% has no digital skills at all [1]. Consequently, educating Europeans on digital skills is a priority to prevent the digital divide. Therefore, European Commission [2] decided to promote digital literacy and digital skills in all forms of education and life-long learning. Furthermore, the European Council [1] recommended the following:

"2.1 raising the level of achievement of basic skills (literacy, numeracy and basic digital skills) and supporting the development of learning to learn competence as a constantly improved basis for learning and participation in society in a lifelong perspective;

2.4 increasing and improving the level of digital competences at all stages of education and training, across all segments of the population".

The concepts of 'Digital Skills' and 'Digital Competence' have passed through various phases and corresponding definitions. Initially, researchers and policy makers concerned with 'Information Literacy' and 'Media Literacy'. Later, they extended these concepts to 'Digital Literacy', 'ICT Literacy' and 'Digital Skills'. Recently, the concept of 'Digital Competence' has attracted a lot of attention. However, there is still confusion what exactly these concepts describe. Initially, the concepts were connected to the person's use of computers and applications. Later, the person's digital skills were also considered. Recently, the person's attitude and disposition were also added.

Zurkowski was the first to use the term information literacy [3]. The American Library Association (ALA) defined that "to be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" [4]. The Chartered Institute of Library and Information Professionals (CILIP) defined information literacy as "knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner" [5]. The Association of College and Research Libraries (ACRL) emphasized the person's dynamism, flexibility, individual growth, and community learning and defined information literacy to be "the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" [6].

The combined concept "media and information literacy (MIL)" was also proposed by United Nations Educational, Scientific and Cultural Organization (UNESCO) [7]. "A media- and information-literate person must not only be a consumer of information and media content, but also a responsible information seeker, knowledge creator and innovator, who is able to take advantage of a diverse range of information and communication tools and media". MIL is defined "as a set of competencies

that empowers citizens to access, retrieve, understand, evaluate and use, create, as well as share information and media content in all formats, using various tools, in a critical, ethical and effective way, in order to participate and engage in personal, professional and societal activities". The National Association for Media Literacy Education (NAMLE) defined Media literacy as the ability to access, analyze, evaluate, create, and act using all forms of communication [8]. Also, the International Association for the Evaluation of Educational Achievement (IEA) defined "computer and information literacy" to be "an individual's ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace and in society" [9].

Regarding the term "digital literacy", Gilster was the first to use it and define it as the "ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers." [10]. In addition to just technical skills, he extended the concept to also include critical thinking skills. He proposed four key competencies: i) assembling knowledge, ii) evaluating information, iii) searching, and iv) navigating. In the DigEuLit project, Martin and Grudziecki [11] defined digital literacy as the "awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process".

The Futurelab [12] defined that "to be digitally literate is to have access to a broad range of practices and cultural resources that you are able to apply to digital tools. It is the ability to make and share meaning in different modes and formats: to create, collaborate and communicate effectively and to understand how and when digital technologies can best be used to support these processes." In All Aboard! [13], the digital literacy term is used to integrate knowledge, attitudes and skills, and so it includes the basic ability to use digital devices and applications as well as critical, reflective and strategic capability in various areas.

Regarding the term ICT literacy, the Educational Testing Service (ETS) [14] defined it as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society". Also, the Australian Curriculum, Assessment and Reporting Authority (ACARA) [15] defined ICT literacy as the "ability of individuals to use ICT appropriately to access, manage and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society". In addition, ICT Capability includes the effective and appropriate use of ICT in order to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school and in their lives beyond school. Recently, the feasibility study for the PISA ICT literacy assessment defined ICT literacy as "the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge and communicate with others in order to participate effectively in society" [16].

Regarding digital skills, the International Telecommunications Union (ITU) [17] defined digital skills as the ability to use ICTs in ways that help individuals to achieve benefits in everyday life for themselves and others, now and in an increasingly digital future. In other words, they encompass the ability to increase the positive outcomes of ICT use and reduce the negative outcomes associated with digital engagement. Furthermore, ITU classified "digital skills at three levels [18]:

- Basic digital skills (for individual digital literacy): These are skills that are required by every individual to become "digitally literate", including skills in using digital applications to communicate, and using basic Internet searches with awareness about security and/ or privacy concerns. They are foundational skills for performing basic tasks. Basic skills cover hardware, software, and basic online operations.

– Intermediate digital skills (for the general workforce in the digital economy): These skills include all basic digital or ICT skills, and additionally skills required in the workplace that are generally linked to knowledge about the use of different applications which have been developed by ICT professionals. Intermediate skills enable us to use digital technologies in even more meaningful and beneficial ways, including the ability to critically evaluate technology or create content.

– Advanced digital skills (for ICT professions): These skills are targeted at more complex jobs in the ICT sector, including deployment of networks and services or development of new ICT/digital technologies. Such skills January refer to application or service development, network management or data analysis."

Ferrari defined digital competence as a "set of knowledge, skills, attitudes, strategies and awareness which are required when ICT and digital media are used to perform tasks, resolve problems, communicate, manage information, collaborate, create and share content, and build knowledge in an effective, efficient and adequate way, in a critical, creative, autonomous, flexible, ethical and a sensible form for work, entertainment, participation, learning, socialization, consumption and empowerment" [19].

All these definitions cause a confusion and misunderstanding with regards to their actual meaning. A common language and understanding is needed in order to define, teach, and assess such skills of students, citizens, or employees. "This will make it easier for citizens and employers to see what digital competence entails and how it is relevant to their jobs and lives more generally." [20]. This paper proposes a new definition for Digital Competence and a new Digital Competence Framework based on the person's actions using digital technologies. Instead of describing the digital competence across ad hoc areas, this paper considers the fundamental actions that a person can do using digital technologies.

2 POPULAR DIGITAL COMPETENCE FRAMEWORKS

Various frameworks have been proposed to describe Digital Competence. One of the most respected and widespread framework is DIGCOMP (Table 1) that was proposed by European Commission [21, 22]. UNESCO extended it by adding the following competence: i) Devices and software operations, and ii) Career-related competences [23]. The UK National Standards for Essential Digital Skills proposed the Essential Digital Skills Framework (EDSF) [24], while the International Association for the Evaluation of Educational Achievement (IEA) proposed the International Computer and Information Literacy Study (ICILS) [9]. In parallel, the European Skills, Competences, Qualifications and Occupations (ESCO) defined the Digital Competencies [25] and the Irish Government proposed the Digital Skills Framework [13].

All these frameworks are built on the basis of fundamental areas that a person should be able to deal with. Such areas include Information Handling, Digital Content Creation, Communication and Collaboration. However, in many cases, these frameworks mix similar actions in different areas. For example, in DIGCOMP, managing information is performed both in 1.3 (Managing data, information and digital content) and in 2.6 (Managing digital identity). Also, protecting information is performed both in 3.3 (Copyright and licenses) and 4.2 (Protecting personal data and privacy). Also, some of the areas are restricted to a special type of digital resource. For example, area 3 (Digital content creation) could be expanded to any digital resource creation. Furthermore, area 5 (Problem solving) could be part of an area on "Digital resource creation", which would also contain the solution creation (development, generation) to a problem. Similarly, area 4 (Safety) could be part of an area on "Digital resource creation", that also contains the safety (creating safety and security). Similarly, the areas of the other frameworks could be re-arranged accordingly. In the next section, we take a different approach.

Table 1. Popular Digital Competence Frameworks.

DIGCOMP	EDSF	ICILS
1 Information and data literacy	**1 Using devices and handling information**	**1 Understanding computer use**
1.1 Browsing, searching and filtering data, information and digital content	1.1 Using devices	1.1 Foundations of computer use
1.2 Evaluating data, information and digital content	1.2 Finding and evaluating information	1.2 Computer use conventions
1.3 Managing data, information and digital content	1.3 Managing and storing information	**2 Gathering information**
2 Communication and collaboration	1.4 Identifying and solving technical problems	2.1 Accessing and evaluating information
2.1 Interacting through digital	1.5 Developing digital skills	2.2 Managing information
	2 Creating and editing	**3 Producing information**
		3.1 Transforming information

technologies

2.2 Sharing through digital technologies

2.3 Engaging in citizenship through digital technologies

2.4 Collaborating through digital technologies

2.5 Netiquette

2.6 Managing digital identity

3 Digital content creation

3.1 Developing digital content

3.2 Integrating and re-elaborating digital content

3.3 Copyright and licenses

3. 4 Programming

4 Safety

4.1 Protecting devices

4.2 Protecting personal data and privacy

4.3 Protecting health and well-being

4.4 Protecting the environment

5 Problem solving

5.1 Solving technical problems

5.2 Identifying needs and technological responses

5.3 Creatively using digital technologies

5.4 Identifying digital competence gaps

2.1 Creating and editing documents

2.2 Creating and editing digital media

2.3 Processing numerical data

3 Communicating

3.1 Communicating and sharing

3.2 Managing traceable online activities

4. Transacting

4.1 Using online services

4.2 Buying securely online

5. Being safe and responsible online

5.1 Protecting privacy

5.2 Protecting data

5.3 Being responsible online

5.4 Digital wellbeing

ESCO

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1 ICT safety

2 problem-solving with digital tools

3 digital communication and collaboration

4 digital content creation

5 digital data processing

3.2 Creating information

4 Digital communication

4.1 Sharing information

4.2 Using information responsibly and safely

ALL ABOARD!

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1 Find and Use

2 Create & Innovate

3 Identity & Well-Being

4 Communicate & Collaborate

5 Teach & Learn

6 Tools & Technology

3   DICAF

If we look carefully at all these definitions given in the Introduction, we remark that they include action verbs regarding the person's ability to do something using ICT. The following verbs have been used in these definitions: identify, seek, search, navigate, investigate, find, locate, access, gather, study, analyze, use, perform, manage, decide, interpret, integrate, assemble, synthesize, process, solve, design, create, build, communicate, collaborate, participate, share, evaluate. So, instead of building a framework on ad hoc areas, we build a new framework on the basis of the possible actions that a person should be able to do using digital technologies.

In a previous paper [26], we had proposed the "Open FASUCICESA-CPT" Framework for Open Education. That framework was used in order to describe and evaluate the Openness of Massive Open Online Courses (MOOCs) and Open Educational Resources (OERs). Inspired by that framework, we develop a new definition for Digital Competence and a new Digital Competence Framework.

In order to keep the proposed definition and framework simple, compact, solid and easy-to-use, we group together under a common Action the verbs that have similar meaning. Although the verbs belonging in a specific Action are not synonymous, for 'economy' reasons we refer to them under the name of the specific Action. So, we define the following Digital Competence Actions Framework (DiCAF) (Table 2):

Table 2. The Digital Competence Actions Framework (DiCAF).

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1 Access

1.1 Search (also, Seek, Navigate, Browse) using digital technologies;

1.2 Find (also, Locate, Identify, Detect, Discover, Retrieve) using digital technologies;

1.3 Access (also, View, Watch, Monitor, Sense, Read, Listen, Hear) using digital technologies.

2 Use

2.1 Store (also, Save, Curate, Archive, Retain, Bookmark, Download, Install, Copy, Duplicate, Backup, Print) using digital technologies;

2.2 Analyse (also, Examine, Investigate) using digital technologies;

2.3 Use (also, Operate, Manipulate, Handle) using digital technologies;

2.4 Evaluate (also, Assess, Review, Critique, Rank, Compare) using digital technologies;

2.5 Manage (also, Control, Organize, Select, Choose, Decide) using digital technologies;

2.6 Delete (also, Quit, Terminate, Drop Out, Leave, Depart, Abandon) using digital technologies.

3 Communicate

3.1 Interact & Communicate (also, Participate, Discuss, Question-Answer, Argue, Debate, Negotiate) using digital technologies;

3.2 Collaborate & Cooperate using digital technologies;

3.3 Share (also, Disseminate, Distribute, Teach, Publish, Upload, Display, Present, Demonstrate, Show, Describe, Explain) using digital technologies.

4 Create

4.1 Develop (also, Produce, Write, Edit, Code -Program, Construct, Build, Generate, Implement, Design, Process, Calculate) using digital technologies;

4.2 Apply (also, Process, Execute) using digital technologies;

4.3 Modify (also, Transform, Convert, Alter, Change, Adapt, Revise, Translate) using digital technologies;

4.4 Integrate (also, Combine, Synthesize, Compose, Assemble) using digital technologies;

4.5 Solve Problems using digital technologies;

4.6 Protect (also, Secure) using digital technologies.

Also, we define the following terms:

Content to include data, information, knowledge, news, message, article, picture, photo, audio, song, video, movie, map, infographic, presentation, spreadsheet, database, blog, website, OER, course, practices, methods, procedures etc.

Digital resources to include Content, SW (e.g. software applications and tools, media); HW (e.g. devices); and Networks (e.g. WiFi, Cellular);

Others to include persons, groups of persons, avatars (digital agents), organizations.

Efficiently to include effectively, appropriately, responsibly (e.g. legally, ethically), securely (e.g. safely, healthy), critically, reflectively, creatively.

Then, we propose the following definition: *"Digital competence is the person's knowledge, skills and attitudes to 'efficiently' access, use, create and share digital resources, as well as communicate and collaborate with others using digital technologies in order to achieve specific goals"*.

Some examples of digital competence follow: i) the ability to find an OER legally in order to study and learn coding in Python, ii) the ability to collaborate creatively with colleagues in order to solve a mathematical problem, iii) the ability to abandon a social network safely in order not to be addicted, iv) the ability to install an application on her smartphone in order to arrange her scheduling, v) the ability to use and control a 3D-printer effectively in order to develop an artifact for homework.

4   CONCLUSIONS AND FUTURE RESEARCH

Despite the availability of digital infrastructure and resources, people do not exploit all available opportunities in the digital society. One main reason for this waste is that they miss the required digital skills. Furthermore, a new digital divide is created between digital competent and digital illiterate people. So, there is an emerging need to educate all people on becoming digital competent. However, what actual digital skills do they need to possess? The proposed framework hopes to become a guideline for developing training programs and curricula on digital competence, for self-assessment of a person's digital competence, for setting goals on developing a person's digital competence, for recruiting people with desirable digital competence, for developing curricula and programs on digital competence and for many more uses.

This paper proposed a new definition and a new framework for Digital Competence. They are based on a person's abilities to do fundamental actions using digital technology. More specifically, digital competence is the person's knowledge, skills and attitude to 'efficiently' access, use, create and share digital resources, communicate and collaborate with others using digital technologies in order to achieve specific goals. In another paper [27], we propose an instrument that can be used by anyone in order to self-evaluate her ability to do specific actions in the digital society using digital technology.

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