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**SEZIONE A TEMA LIBERO**

## **Digital competences: what they are and how they are perceived.**

### **Competenze digitali: cosa sono e come sono percepite.**

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#### **ABSTRACT ITALIANO**

Lo sviluppo di Internet e i cambiamenti relativi lo scambio e l'accesso alle informazioni hanno portato a quella che viene chiamata la "rivoluzione digitale" che caratterizza l'odierna società dell'informazione e della conoscenza. Lo sviluppo di Internet e dei servizi offerti dalla rete, oltre a cambiare i metodi di accesso all'informazione, ha portato a cambiamenti nell'evoluzione della tecnologia stessa. Questi cambiamenti, infatti, richiedono l'acquisizione di nuovi tipi di competenze che vadano di pari passo con lo sviluppo tecnologico. Le competenze digitali sono attualmente al centro di un dibattito sulla loro classificazione e su come possono essere insegnate ed apprese con riferimento anche all'ambivalenza dei termini "informatica" e "digitale". Ciò che viene riportato sottolinea la natura complessa e aperta di questo concetto, in cui conoscenze, competenze e atteggiamenti appartenenti a più dimensioni si fondono. Questo contributo ha lo scopo di analizzare i diversi aspetti legati alle competenze digitali cercando di individuare tendenze nell'evoluzione teorica su alcuni dei principali quadri presenti nella letteratura scientifica.

#### **ENGLISH ABSTRACT**

The development of the Internet and the changes relating to the exchange and access to information have led to what is called the "digital revolution" that characterizes today's information and knowledge society. The development of the Internet and the services it offers, in addition to changing the methods of accessing information, has led to changes in the evolution of technology itself. These changes, in fact, require subjects to acquire new types of skills that go hand in hand with technological development. Digital skills are currently at the center of a debate mainly concerning their classification and how they can be taught and learned, with reference, as well, to the ambivalence of the terms "computer science" and "digital". What is reported underlines the complex and open nature of this concept, in which knowledge, skills and attitudes belonging to multiple dimensions merge. This contribution aims to analyze the different aspects related to digital skills by trying to identify some general trend in the theoretical evolution of the concept through reflection on some main frameworks present in the scientific literature.

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### **Introduction**

One of the most relevant technological innovation in recent years is the Internet. The development of the Internet has changed the way of communicating between human beings and the access to information. It also led to what is called the "digital revolution" that can be synthesized in the transformation of the human society in the information and knowledge society (Soete, 2000).

The "digital revolution" began in the industrialized countries at the end of the '50s with the proliferation of computers and is still happening in present days by means of the development of modern digital technologies. This period of change is also referred to with the expression "computer revolution" to indicate the socio-economic changes deriving from ICT developments (Sichel, 1997). It is precisely the ambivalence of the terms "informatics" and "digital" associated with the competences in the use of digital tools which underlies the reflections of this contribution.

The development of the Internet in addition to changing the methods of access to information has also led to changes in the evolution of the technology itself: with the introduction of hypertext and Web 2.0 there has been a shift from static and monofunctional technology to a multi-purpose and participatory technologies.

At the same time, it is in the interest of researchers to investigate the changes that this digital transformation has brought both on the psychological and cultural level, both on the social and professional level. These changes require the acquisition of new types of skills: today humans co-evolve with technology but at different speeds (Longo, 2001). This kind of considerations has led many authors to deepen the concept of "digital divide" that is the situation that divides the population into accessing the Internet (Van Dijk, 2005). This difference may concern both the ability to physically access computers and the Internet, and the ability to use these tools. This phenomenon amplifies the distance between those who live in the "information age" and those who are excluded (Webster, 2003). In the literature there are many studies related to this topic and several levels related to the digital divide have been identified (Norris, 2001). According to the most accredited classification on the subject it is possible to distinguish three types of digital divide: global, social and democratic (Srinuan & Bohlin, 2011). The first affirms the differences between developed countries and poor countries; the second concerns inequalities within a single country; the third focuses on the conditions for participation in political and social life based on the use or not of new technologies. Recent studies have included socio-economic, institutional and physiological factors in order to gain a greater understanding of the digital divide. Among other findings, they show that technological determinism is not sufficient to explain the emergence of the digital divide (Srinuan & Bohlin, 2011).

Digital skills are currently at the centre of a debate concerning especially their classification and the way they can be taught and learned. In recent years, several theoretical frameworks have been developed with the aim of understanding the evolution of skills in relation to the diffusion of digital tools between the different segments of the population. The aim of this contribution is to analyse the different aspects of digital competences and identify some general tendency (in the theoretical evolution of the concept) through the reflection on some main frameworks present in the scientific literature.

The reflection proposed in this contribution, based on what emerged from the analysis of various sources, starts from the following considerations:

1. The concept of "digital competence" is often generalized: it is necessary to reflect on the different aspects of the concept (Ilomäki et al., 2011).

2. The main conceptual frameworks related to digital competences can be divided into different types, for example those related to the skills possessed by all individuals and those related to ICT professionals.
3. There is a need to reflect on the differences in the classification of these competences and how they can be taught, learned and improved.

Based on the above, it is appropriate to try to answer the following questions:

1. Are there different meanings of the concept of “digital competence”?
2. Is it possible to make a distinction between digital competences and computing (informatics) competences?
3. Can common aspects be found in the analysis of the main frameworks related to digital competences?

To answer the previous questions in this paper the following topics are addressed:

1. Contributions reported in the scientific literature on digital competences.
2. Analysis of the main frameworks related to digital competences.
3. Reflection on any differences or similarities emerging from the analysis of the frameworks considered.

### Defining digital competence: a complex and multidimensional concept

Research on digital skills is part of a broad debate on defining the new skills needed to actively participate in the digital age. It is not possible to generalize the concept of “digital competence” that is difficult to explore due to the variety of areas, skills and attitudes it encompasses. As part of the research, over the years, various terminologies have been used in reference to the skills related to the diffusion of Internet and ICT: for example, Internet skills, digital skills, computing skills, digital competences, etc. This contribution does not intend to deepen the semantic aspect of the term, but these multiple definitions underline the complexity of the reference area. At the same time, the notion of “digital literacy” is also complex to define. Researchers and policy argue that the classic forms of oral and written literacy should be accompanied by new forms of literacy related to the development of skills and competences in the ICT field.

Bawden (2001) has identified several concepts that are used as synonyms for new forms of literacy related to ICT diffusion:

- *Computer literacy*: related to IT, information technology and computer literacy.
- *Information literacy and network literacy*: related to the Internet and hypermedia literacy.
- *Digital literacy*: related to digital technology.
- *Media literacy*: related to the literacy of new media.

There's a range of definitions: from the tautological one (e.g., computer literacy is “the ability to use” computers and the Internet) to the idealistic one (e.g., “the term literacy is shorthand for cultural ideals as eclectic as economic development, personal fulfilment, and individual moral fortitude” Tyner, 1998). Bawden (2001) distinguished between skills-based literacies (such as computer literacy) which essentially indicate skills in hand ling

information in a particular setting, context, or format and more general literacies (Van Deursen, 2010).

The present contribution does not propose to deepen the different forms of ICT literacy but intends to underline its conceptual complexity.

In 2006 the European Parliament and the Council released the Recommendation on the Key Competences for Lifelong Learning (2006/962/EC), including digital skills among them. The emerging idea is clear: the traditional framework centred on literacy and numeracy, which have represented over the years the minimal goal that educational institutes had to accomplish to prepare citizens, needed to be redefined in a more complex way. It had to encompass other new competences among which a relevant role has to be played by digital competence.

The definition of digital competence in the abovementioned document is as follows:

Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet.

Essential knowledge, skills and attitudes related to this competence have been identified:

Digital competence requires a sound understanding and knowledge of the nature, role and opportunities of IST in everyday contexts: in personal and social life as well as at work. This includes main computer applications such as word processing, spreadsheets, databases, information storage and management, and an understanding of the opportunities and potential risks of the Internet and communication via electronic media (email, network tools) for work, leisure, information sharing and collaborative networking, learning and research. Individuals should also understand how IST can support creativity and innovation and be aware of issues around the validity and reliability of information available and of the legal and ethical principles involved in the interactive use of IST. Skills needed include the ability to search, collect and process information and use it in a critical and systematic way, assessing relevance and distinguishing the real from the virtual while recognizing the links. Individuals should have skills to use tools to produce, present and understand complex information and the ability to access, search and use internet-based services. Individuals should also be able to use IST to support critical thinking, creativity, and innovation. Use of IST requires a critical and reflective attitude towards available information and a responsible use of the interactive media. An interest in engaging in communities and networks for cultural, social and/or professional purposes also supports these competences.

The importance given by political actions to digital competence has led to the development of some theoretical frameworks for the classification of this competences. In the following paragraphs the most relevant aspects of the main frameworks for digital competences will be highlighted.

## Reference frameworks for digital competence

In recent years, several frameworks have been developed with the aim of understanding how skills change in relation to technological development and the diffusion of digital tools between different population segments.

Proceeding with the analysis of the main frameworks dedicated to the classification of digital skills, it is necessary to underline that it is possible to divide these into different categories:

1. Frameworks for ICT professionals (for example: e-CF).
2. Frameworks for all citizens (for example: DIGCOMP).
3. Frameworks for the certification of digital skills (for example: EiPass, ECDL).

It is possible to deduce that the first type of framework aims to set the skills necessary for professionals working in the ICT field, while the second type aims at detecting digital skills related to all users. It is possible to make distinctions also in this last type of framework based on the different segments: some have been created specifically for the school (Gui & Argentin, 2011; Calvani et al., 2012), others are designed for the general population (Hargittai & Hsieh, 2012; Van Deursen et al., 2014; Gui & Fasoli, 2017).

Observing the further distinction made previously (frameworks dedicated to all users and those related to the certification of digital competences) it is necessary to clarify a further aspect regarding digital competences. Van Deursen & Van Dijk (2014), identify two different macro-areas of digital competences:

- *Medium related* (or "operational skills")
- *Content related* (or "critical skills")

The first are technical skills, while the second are competences of a transversal nature and in many ways independent of technological means (Gui, 2009).

Social sciences consider above all the skills related to the second dimension, which refers to the informative and communicative processes offered by the network, regardless of the technical aspect. Most of the frameworks for the certification of digital competence, however, are focused on technical or operational skills (Gui & Fasoli, 2017).

In the European context, numerous projects have been developed to define the concept of digital competence. DIGCOMP (Ferrari, 2013) and its subsequent versions represent an important reference model for the classification of competences. The framework for digital competences within which the semantic areas have been defined is DIGCOMP 2.0 (Vourikari et al., 2016); in this update the following dimensions have been defined:

- Competences areas (5 areas)
- Competences pertinent to each area (21, with their titles and descriptors)
- Proficiencies levels for each competence
- Examples of the knowledge, skills and attitudes applicable to each competence.

In the last version, DIGCOMP 2.1, 8 levels of proficiency were included. In Table 1 the whole framework is reported.

TAB. 1

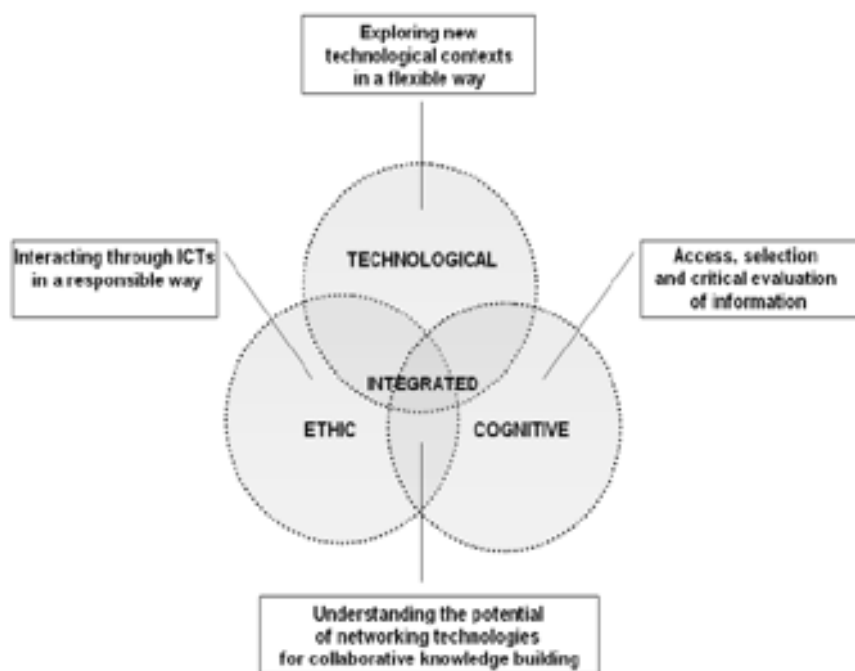
1. Information and data literacy	<p><i>1.1 Browsing, searching and filtering data, information and digital content</i> To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies.</p> <p><i>1.2 Evaluating data, information and digital content</i> To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content.</p> <p><i>1.3 Managing data, information and digital content</i> To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment.</p>
2. Communication and collaboration	<p><i>2.1 Interacting through digital technologies</i> To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.</p> <p><i>2.2 Sharing through digital technologies</i> To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices.</p> <p><i>2.3 Engaging in citizenship through digital technologies</i> To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.</p> <p><i>2.4 Collaborating through digital technologies</i> To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.</p> <p><i>2.5 Netiquette</i> To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.</p> <p><i>2.6 Managing digital identity</i> To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.</p>
3. Digital content creation	<p><i>3.1 Developing digital content</i> To create and edit digital content in different formats, to express oneself through digital means.</p> <p><i>3.2 Integrating and re-elaborating digital content</i> To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.</p> <p><i>3.3 Copyright and licences</i> To understand how copyright and licences apply to data, information and digital content.</p> <p><i>3.4 Programming</i> To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.</p>
4. Safety	<p><i>4.1 Protecting devices</i> To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.</p> <p><i>4.2 Protecting personal data and privacy</i> To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used.</p> <p><i>4.3 Protecting health and well-being</i> To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion.</p> <p><i>4.4 Protecting the environment</i> To be aware of the environmental impact of digital technologies and their use.</p>



5. Problem solving	<p><i>5.1 Solving technical problems</i> To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems).</p> <p><i>5.2 Identifying needs and technological responses</i> To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).</p> <p><i>5.3 Creatively using digital technologies</i> To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.</p> <p><i>5.4 Identifying digital competence gaps</i> To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.</p>
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Important research related to the measurement of digital skills has led to the development of interesting conceptual models. A significant research was conducted by Van Deursen & Van Dijk (2009). Van Deursen & Van Dijk (2009) identify four types of digital skills:

- *Operational internet skills*. These are derived from concepts that indicate a set of basic skills in using internet technology.
- *Formal internet skills*. These relate to the hypermedia structure of the internet which requires the skills of navigation and orientation.
- *Information internet skills*. These are derived from studies that adopt a staged approach in explaining the actions via which users try to fulfil their information needs.
- *Strategic internet skills*. These are the capacity to use the internet as a means of reaching particular goals and for the general aim of improving one's position in society.



**FIG.1 - THEORETICAL MODEL FOR MEASURING DIGITAL SKILLS**

- The emphasis lies on the procedure through which decision-makers can reach an optimal solution as efficiently as possible.

In Italy, a first important tool for measuring digital competences was developed by Calvani et al., (2012). This is the Instant DCA, a test for measuring digital competences that has been tested in Italian schools. The test is based on a theoretical model that includes three large macro-areas as shown in Figure 1.

One of the most important projects of the last years concerning the measurement and classification of digital skills was developed by Fastweb SpA (company that financed the project) together with the University of Milano-Bicocca. The project started in 2015 with the aim of validating a new tool for measuring digital competences. Two research groups worked in parallel: one focused on digital *content-related skills* or "*critical*" digital competences; another about skills related to the digital world. For the development of the Fastweb-Bicocca digital competence test a conceptual framework was built. For the construction of the reference framework, five of the most important models related to digital skills were chosen for their relevance in the scientific world and public policies (Gui & Fasoli, 2017). In Figure 2, the five frameworks are compared.

Van Dijk (2005)	Helsper, Eynon (2013)	Vuorikari et al. (DIGCOMP 2.0, 2016)	Van Dijk, Van Deursen (2014)	Van Deursen, Helsper, Eynon (2015)
Operational	Technical skills	Information and data literacy	Medium related	Operational
Formal	Social	Communication and collaboration		Information navigation
Information	Critical	Digital content creation	Content related	Social
Strategic	Creative	Safety		Creative
		Problem Solving		Mobile

**FIG. 2 - THE FIVE FRAMEWORKS**

From the comparison of frameworks, Gui & Fasoli (2017) noted a continuity of the *informative dimension* that appear in all the frameworks except in that of Helsper, Eynon (2013), where that dimension is called "critical". A convergence on the dimensions of interaction via the web ("*communication*" or "*social*") and on the *creation of content* was also noted. Other convergences were detected on the dimension related to security and on a "strategic" area, considered similar to what Vuorikari et al., (2015) define "problem solving".

Another interesting aspect that emerges from this comparison is the inclusion of a specific competence dedicated to *mobile* in one of the most recent frameworks (Van Deursen et al., 2014). This seems to reflect the massive increase in the spread of the



smartphone in the last five years. The difference between the digital skills required by the smartphone and those required by the PC is manifested above all in terms of GPS applications (use of navigation systems), augmented reality and creation of multimedia content (Fasoli, 2016). In Figure 3 the framework resulting from the Fastweb-Bicocca project is proposed.

<b>INFORMATION</b>	Evaluating and archiving information
<b>COMMUNICATION</b>	Collaborating with others, netiquette and linguistic registers
	Social identity
<b>CREATION/ ELABORATION</b>	Copyright and licenses
	Content creation
<b>SECURITY</b>	Self-protection
	Cyberbullying and troll defence
<b>DIGITAL EFFICACY AND WELLBEING</b>	Innovatively and creatively using technology
	Communication overload and technostress prevention

**FIG. 3 - FRAMEWORK RESULTING FROM THE FASTWEB-BICOCCA PROJECT**

The comparison made by Gui & Fasoli (2017) reveals an interesting issue: in all the analysed frameworks, the operational dimension is clearly distinguishable from the others.

The research shows that while the operational skills, also called "medium related", can be acquired and consolidated through frequent use of the tools, the critical digital skills seem to be less sensitive to the frequency of use in general and more difficult to acquire (Van Deursen & Van Dijk, 2014). It should be noted that in all cases it is not possible to distinguish the digital critical from the operational in a clear way, because sometimes some skills seem to require a combination of capacities of both types. If the digital operational skills related to the use of increasingly user-friendly interfaces seem to fall behind, the critical skills needed to search for information or publish content are increasingly in demand. The latter, however, require new and more advanced digital operational skills.

A further evident element is the total absence of the operational competences in DIGCOMP, one of the most widespread and authoritative frameworks (as mentioned above, it is an official document of the EU on the competences of digital citizenship) (Fasoli, 2016). It has been noted that the lack of interest shown by social research towards *operational competences*, probably, derives from the interfaces of digital devices that are increasingly user-friendly.

## Conclusion

Based on previous considerations, the complexity in the theorization of a framework that considers the multiple aspects of the concept of digital competence is evident. Regarding the comparison made between the various frameworks in the scientific literature, some important aspects emerged. These aspects make it possible to respond, even if only partially, to the questions posed in the introduction of the following contribution, in particular:

- Common aspects can be found in the various frameworks for digital competence: from the studies carried out by Gui & Fasoli (2017) a continuity of the "informational" area has been noted. This dimension is present in most of the considered frameworks. Furthermore, there was a convergence in the dimensions concerning the "interaction via the web" and the "creation of contents". Other convergences have been found on "safety" and "problem solving" dimensions.
- A clear division emerged between "operational" skills and "critical" skills: most of the studies carried out in the field of digital competences have shown a prevalent interest in the so-called "*content related skills*". In many of the frameworks considered the operational aspects concerning the use of digital tools have been omitted. (*medium related skills*). "Operational" skills (medium related skills) are not included in one of the most relevant frameworks for digital competence, i.e. DIGCOMP.
- Studies in the scientific literature have shown that "operational" skills can be learned and taught in ways that are different from "critical" ones, but the two types of skills are inter-related. For these reasons, it would be useful to deepen the relationships between the two types of competences.
- Finally, it is necessary to consider the recent changes introduced by the "mobile" area devices. "Operational" skills are also changing due to the widespread diffusion of tools related to the "mobile" area. It would be interesting to analyse the effects of the use of new mobile devices regarding both *critical* and *operational skills*.

These considerations lead us to reflect on the possible relationships and influences existing between "critical" and "operational" skills that could open new and interesting scenarios in the study of digital competence. All this without neglecting the aspects related to digital transformation and sustainable development.

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