THE EVOLUTION OF DIGITAL COMPETENCE MODELS IN A 4.0 ERA

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ABSTRACT
This paper focuses on the evolution of digital competence in the last 15 years, and its development in order to face the challenges of the spread of social media and, on the other hand, to better deal with the Industry 4.0 trends. We will contextualize the issue within the debate on the importance of soft skills for today workers (which was stressed by several associations), in a framework obeying to logic of competence.
In the early 2000’s, indeed, digital competence was seen as a point of interaction between IT literacy, information literacy, media literacy and visual literacy; in this decade, however, while young people become “authors” very early, it should be integrated as well with some elements coming from social literacy and, also, from the communication in the mother tongue, as it has been defined by EU.
We will then describe the Digital Competence models that inspired the Italian Digital School Action Plan, linked to the 2015 school reform, analyzing the way those models address the evolution of the media scenario from an ecological, social and authorial viewpoint.
KEYWORDS: Digital competence, digital Competence model, industry 4.0, soft skills

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TODAY’S LANDSCAPE

While speaking of acquiring digital competence in the second decade of the 21st century, we must focus on two phenomena.
From a working point of view, a transformation – maybe an actual fourth revolution – is taking place in industry. Several countries – Germany overall, and Italy as well – are adopting policies called “Industry 4.0” aiming at dealing with the major changes occurring in the secondary sector.
In this scenario, ‘Technology is empowering the development of IOT (Internet of Things) and the Machine-to-Machine (M2M) Systems’ (Costa, 2018a, p. 1007). Jobs are therefore changing. The first important issue is that men are no more controlling machines, while they are more interacting with them and their Artificial Intelligence (AI):

“…with digitalization, machines are self-controlling, self-evaluating and AI is able to build machines, as well as to process information and communication addressed to humans.
It is therefore clear that, in working, the relationship changes, for example, we can speak about ‘collaboration’ or ‘symbiosis’ between workers and machines” (Mari, 2018a, p. XXIII).

Another important issue is the one regarding information (big data) with an accent on symbolical knowledge and language (Mari, 2018b). More generally speaking, workers (overall, taking into account their emotional, relational and personal dimensions as well) must acquire a new central
position in working and, thus, in their learning processes (Costa, 2018b). The second phenomenon we want to focus on involves mainly (though not only) the young, and this is the reshuffle of the social media scenario, which is no longer limited to “sites and services (...) that allow participants to create and share their own content”, since it also includes Internet-based social platforms in a broader sense, namely online messaging systems, used on smartphones connected to Internet (Boyd, 2014, p. 6). Therefore people must no longer deal only with ‘content’ but also with ‘contacts’ (Livingstone, Bulger, 2013) – meaning other people to interact with on a daily basis by means of technological devices. According to Rivoltella, these are ‘authorial media’, as people use them not only to find information but also to propose their own in a public space (Rivoltella, 2015).

These changes imply a major shift when speaking of digital competence. By this phrase in 2006 we meant “the confident and critical use of Information Society Technology (IST) for work, leisure and communication”, focusing more on the critical use of pre-existing information than on producing new information - even though this was mentioned - (EU, 2006, p. 6). In the next sections we first declare what we mean by competence (with specific focus on transversal or key competence) and we then concentrate on digital competence.

**What are we calling ‘competence’?**

In the last few years, and namely from the early 2000s, education and work are more and more ‘competence-oriented’. For example, OECD proposed a Definition and Selection of Competencies (De.Se.Co.), establishing the basis of the international survey PISA, while the EU recommended a set of 8 Key Competences for Lifelong Learning to be adopted by the National Education Systems of EU Countries (Rychen, Salganik, 2003; EU, 2006). Even Higher Education outcomes must be stated in terms of competences () according to the so-called ‘Berlin descriptors’ (Zaggia, 2007). But what do we mean by ‘competence’ (or sometimes ‘competency’)? There are actually several theoretical frameworks, differing even in the terms being used; moreover, these terms may change from one language to another. For instance, the Italian word ‘competenza’ sometimes refers to the English word ‘competence’ as in the European Qualification Framework – EQF and sometimes it refers to the English word ‘skill’, typically in speaking about ‘hard skills’ or ‘soft skills’(EU, 2008); for example, the WHO ‘Life skills’ are often translated as ‘Competenze per la vita’.

The approach may thus change from country to country and from theoretical framework to theoretical framework (Delamare Le Deist, Winterton, 2005). We therefore need to clarify which one we choose for this paper. We actually adopt a dynamic definition referring to the ‘mobilization’ of one’s resources when facing a problem-situation or fulfilling a task. In working contexts we may refer to the French scholar Guy Le Boterf, according to whom ‘being competent’ means being able to act with competence and relevance mobilizing an appropriate mix of resources in a working situation, while in an educational context we may quote a well-known definition by an Italian scholar, Michele (Le Boterf, 2008; Pellerey, 2004):

“…[Competence is the] ability to face a task, or a set of tasks, succeeding in putting in motion and orchestrate his/her own internal resources (cognitive, affective and volitional), and using the available external ones, in a coherent and fruitful way” (Pellerey, 2004, p. 16).
According to such an approach, competence does not lie within the resources but in their mobilization, so that we may call those resources abilities, skills, knowledge or even competences, in the countable sense of a number of different competences (Le Boterf, 1994). We can then identify some ‘specific skills’: in the working context we may speak about ‘job specific skills’, while in education contexts it is more about a matter specific skills, coming from disciplinary knowledge. Nonetheless in the scientific educational literature, and in EU and OCSE policies, in the last two decades great attention was paid to the so-called transversal competences. Again there are several words referring to them: Maria Lucia Giovannini listed some of them coming from international documents: general skills, key competences, cross-curricular competences, transversal or transferable competences, soft skills, life skills, transferable skills (Giovannini, 2016, p. 41).

Among those phrases, some clearly refer to educational contexts (when speaking about cross-curricular competences, we implicitly state that we are in a curriculum-based context), while others are more popular in working contexts. For instance, a report of Assolombarda, an important regional association of northern Italy enterprises, linked to the National Industry Association – Confindustria, stated that the demand of competences linked to Industry 4.0 strongly focuses on soft skills, namely the ability to work in a team, problem solving, relational and communication skills and flexibility (Assolombarda, 2015).

Even if the boundaries between those phrases are often blurred, we can nonetheless identify two main categories: key competences, according to the 2006 EU definition, are offered by initial education institutions in order to form ‘a basis for further learning’ (EU, 2006, p. 2) while transversal or transferable competences are acquired in a context – typically a working one – and may be mobilized in another one. The Italian Institute of Job Training and Guidance (ISFOL), in the nineties, classified them into relational competences, decision-making competences, diagnostic competences (ISFOL 1993; Di Francesco, 1998).

As we saw above, in 2006 when defining the 8 Key Competences for Lifelong Learning, the EU stated that digital competence is ‘the confident and critical use of Information Society Technology (IST) for work, leisure and communication’ (EU, 2006, p. 6). In that historical period – 12 years, when speaking of ICT, is quite an era! – the aim was to underline the distance from a purely technological approach. Maria Ranieri (2010, p. 25) proposed an effective schema of synthesis of the different traditions that merged into this concept, adopting yet another word: Literacy (1)!

- IT Literacy: being able to choose and use technologies relating to aims
- Information Literacy: being able to find, evaluate, select and manage information
- Visual Literacy: being able to read and interpret images and visual content
- Media Literacy: being able to analyze, understand and critically interpret media

She then associated 4 transversal abilities to this new concept: critical thinking, research abilities, problem solving and collaboration abilities. This latter was actually present in the EU definition, but was more stressed in another Key competence: the ‘social and civic competences’.
The construction of such a framework went along with the concept of media as an ecological environment that started from the ‘80s, while in the last decade we may see media as a connective tissue: ‘Media are our social synapsis: they make us contact other people, they allow to set up and manage social networks’ (Rivoltella, 2016, p. 20).

Many recent digital competence/literacy frameworks refer to a social dimension. For instance, Anne Collier (2012; Third, Forrest-Lawrence, Collier, 2014), referring to the 2009 Safer Internet Forum, states that there is a Social Literacy alongside Technical Literacy and Media Literacy. We found the Canadian Media Smarts framework particularly interesting: the Canadian media experts, “…draw on a conceptualization of digital literacy that rests upon three building blocks: the skills and ability to use digital tools and applications; the capacity to critically understand digital media tools and content; and the knowledge and expertise to create and communicate with digital technology” (Hoechsmann, DeWaard, 2015, p. 4)

We especially like the vocabulary being used: in order to ‘use’ technology, you must possess an ability or a skill; in order to ‘critically understand’ media messages, you have to acquire a capacity in order to create and communicate, i.e. to behave in this new media environment, you have to possess a knowledge and an expertise. So, even if there is not an explicit reference to a ‘social’ building block, the greatest importance is granted to the communication dimension, which is considered at a higher level than the first one (somehow matching to the Ranieri IT Literacy) and the second one (better fitting the Ranieri Media Literacy and Information Literacy), especially in its definition:

“Creation with digital media means more than being able to use a word processing program or write an email, it includes the ability to: adapt communication to various contexts and audiences; create and communicate using rich media such as images, video and sound; and effectively and responsibly engage with Web 2.0 user-generated content such as blogs and discussion forums, video and photo sharing, social gaming and other forms of social media” (Ranieri, 2010, p. 5).

The EU also proposed an evolution of Digital Competence after the 2006 definition, with the publication in 2013 of an updated framework: DIGCOMP (Ferrari, 2013). In this framework, Digital Competences is composed of five competence areas: Information, Communication, Content-creation, Safety and Problem Solving. The foundation of all these areas is still to be found in IT Literacy (particularly true regarding the Problem Solving area, which includes making ‘informed decisions on most appropriate digital tools according to the purpose or need’ (Ivi, p. 11) which clearly recalls the Ranieri definition) and Information and Media Literacy (namely for the Information area).

Some aspects of a more mature approach can nonetheless be found in several hints that are present in the document, especially within the Communication Area; even if not stated in the summarized definition, it encompasses some behavior norms and the so-called Netiquette. We will analyze these issues in the next paragraph.
As we introduced at the beginning of this paper, Rivoltella (Ferrari, Rivoltella, 2010; Rivoltella, 2015) states that the new social media are authorial media due to the extreme ease in producing and publishing content. He then underlines the risks it may entail in youth. In 2010, he explicitly linked this issue to the cyberbullying (according to him, one of the reasons for cyberbullying and similar phenomena is to be found in the ‘low awareness of what being authors implies’ (Ferrari, Rivoltella, 2010, p. 49)), while in 2015 he pointed out:

“The problem is that occupying the public space requires reason to have achieved ‘adult age’, referring to Kant, meaning that we have to be aware of the implications in terms of responsibility to take the floor in such space” (Rivoltella, 2015, p. 19).

This transformation then implies an evolution of the media ethics issue, as stated also by Henry Jenkins in 2009, who explicitly highlights the link between the lowering of the ‘barriers of entry into a communication landscape’ – and therefore ‘to expression and civic engagement’ – and the ethics challenge for a new Media Education concept:

“One important goal of media education should be to encourage young people to become more reflective about the ethical choices they make as participants and communicators and about the impact they have on others” (Jenkins, 2009, p. 26).

We must say that, within an empirical research they conducted for UNICEF, Amanda Third, Delphine Bellerose, Urszula Dawkins, Emma Keltie and Kari Pihl noted that this aspect is often recognized by children: they especially noticed that a ‘surprising number of children – especially older children – talked about the interrelationship between rights and responsibility’ (Third et al., 2014, p. 42).

For this reason, we agree with those Media Education approaches that actually focus on a proper balance between risks and opportunities of the Internet (AGCOM, 2014), affording youth both protection and empowerment. In terms of Children’s Rights, this may imply a balance between protection and provision, granted, for instance, by the UN Convention of the Rights of Child that Sonia Livingstone and Brian O’Neill interpret in the online environment (Livingstone, O’Neill, 2014). In the pedagogical framework he outlined, Pier Cesare Rivoltella prefers to call upon the ‘virtue’ construct, adapting the seven cardinal and theological virtues to the online environment (Rivoltella, 2015).

We appreciate all of these frameworks, even though they are different one from the other, because they all consider new media and technologies as an environment that implies an appropriate behavior within it, rather than a set of tools to be used, or even from which to be simply protected. If we adopt this empowerment approach, it clearly involves Digital Literacy/Competence Education. We investigated this issue in a former article, looking at the references made in the Italian Government ‘Digital School’ Action Plan (Ugolini, 2016; MIUR, 2015). As we pointed out, the Canadian MediaSmarts Center has as one of its beliefs: “We believe in promoting both rights and responsibilities to guide children and youth in becoming ethical and reflective media users” (2).

In analyzing the DIGCOM framework, even if there is a specific competence called ‘Netiquette’ within the ‘Communication’ Area referring an environmental approach to media, we observed that
we can find maybe the most interesting hints in the Annex that shows the ‘relevance’ of Digital Competence for the other EU Key Competences (Ferrari A., 2013, pp. 43-44). The ‘Netiquette’ competence is relevant to the ‘Communication in the Mother Tongue’ one, as there is ‘Need to understand and use language in a positive and socially responsible manner’ (Ferrari A., 2013, p. 43). At the end of this paragraph we may then conclude that in today’s scenario Digital Competence should further stress the communication aspects, even if those of Information and IT must not be abandoned. In the Ranieri schema, we should probably add a ‘Communication Literacy’ referring not only to a social and civic area, but also to a linguistic one, as communicating with smartphones is more a language than a complex technology as intended even 10 years ago. Under this aspect, we think that Prensky’s well-known metaphor of the Digital Native, in its original meaning of ‘native speaker of the digital language’ may maintain its significance (Prensky, 2000, p. 1).

**DIGITAL COMPETENCE AND INDUSTRY 4.0**

Within the Industry 4.0 transformation:

“...today’s students and tomorrow’s workers will be expected to have not only the ability to produce but also the capacity to define problems and solve them, to question both the real and the virtual world in order to define new processes and experiment new solutions” (Costa, 2018, p. 1007 referring to Alessandrini, 2014).

A ‘4.0’ Digital Competence framework must then first of all stress the ‘creative’ dimension. The DIGCOMP framework appears to pay much attention to this aspect in defining a ‘content creation’ competence, with some relevance to ‘cultural awareness and expression’ Key Competence (Ferrari A., 2013, p. 44).

But probably the most interesting phenomenon interlaced with Industry 4.0 which involved the educational contexts, even primary school, is the growing focus given to the ‘computational thinking’ developing programs. For instance, in Italy’s ‘Digital School’ Action Plan there is not only an explicit mention of it and of the need for the students to be ‘producers, creators, designers’, but also a specific action called ‘bringing the computational thinking into the whole primary school’ ((MIUR, 2015, p. 29, 81).

The central position acquired by this issue in the Italian educational debate can be of some use, provided that ‘computational thinking’ is intended in a correct way and not only – as often happens – merely looking at the operational aspects, related to the ‘coding’. The DIGCOMP framework itself identifies a competence called ‘programming’ “to plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task” (3).

Nonetheless, as Giorgio Olimpo pointed out, when Jeannette M. Wing brought to our attention the concept of ‘computational thinking’, she was clearly focusing on the attitude everyone should have in facing problematic situations, and not only on the ability to code (Olimpo, 2017; Wing, 2006).
Computational thought actually refers to:

“Conceptualizing, not programming. (…) Thinking like a computer scientist means more than being able to program a computer. It requires thinking at multiple levels of abstraction (…)”.

“A way that humans, not computers, think. Computational thinking is a way humans solve problems; it is not trying to get humans to think like computers. Computers are dull and boring; humans are clever and imaginative. We humans make computers exciting. Equipped with computing devices, we use our cleverness to tackle problems we would not dare take on before the age of computing and build systems with functionality limited only by our imaginations” (Wing, 2006, p. 35).

Then Olimpo cites some authors stating that computational thought involves processes of analysis and decomposition of problems that precede coding and the ability to manage complexity and to face problems that are open or not yet formalized (Bocconi et al., 2016; Barr, Harrison, Conery, 2011; Weintrop et al. 2015).

Such an approach better fits the 4.0 revolution for two main reasons: first of all, as we recalled at the beginning of this paper, in the new digital era we have to interact with machines rather than simply control them, and we thus have to know the way they face problems and the way we can tell them to do so; but secondly each of us needs to better outline the boundaries between the way humans think and the way machines do. We do not have to learn how to code machines in order to think like them, as Wing stated, but rather to somehow emancipate ourselves (Dufva T., Dufva M., 2015, Ferrari S. et al., 2017).

The new Digital Competence frameworks must therefore include a kind of Computational Literacy related more to the issue of facing original and complex problems and co-operating and interacting with AIs to confront and solve them, rather than to the merely technical ability in programming and coding, however important the latter may be in enhancing such literacy.

Notes

(1) The evolution of the concept of digital literacy was investigated further by Sonia Livingstone in 2009
(2) mediasmarts.ca/about-us/mission-beliefs
(3) https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework, even if the definition in the 2013 DIGCOMP document appears to be more mature, while stating the need ‘to understand the principles of programming, to understand what is behind a programme’ (Ferrari A., 2013, p. 30)
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