“Learning by being”: integrated thinking and competencies to mark the difference from AIs

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Abstract. In this position paper, starting from the concept of competence and highlighting how competence frameworks always underlie a model of the individual's operativeness in a specific context, an educational model is proposed in which scientific thinking and design thinking - both of which can be enhanced by computational thinking - are integrated. This model is associated with an integrated competence space and the development of a new paradigm - '*learning by being'* - aimed at the harmonious development of the learner; a competency-based paradigm that could favor the transformation of the “*factory-school*” model introduced following the industrial revolution and help the human to mark its difference with the “*artificial intelligences*” (AIs).

Keywords: Integrated thinking, Integrated space of competencies, Learning by being, Competence-based learning.

1 Introduction

Competence-based learning is a paradigm that developed over time and by successive steps [1,2] following the emergence of the concept of competence in the field of organisational psychology. In 1973, indeed, McClelland [3] argued that it was appropriate to use, for personnel selection, the assessment of candidates' competencies rather than intelligence tests since, he argued, tests of aptitude for schooling and qualifications were not able to predict professional success. However, this paradigm, which initially developed following a relatively simple behaviourist pattern - based on a clear definition of objectives, selection of appropriate training experiences, their sequential organization, and the direct assessment of the achieved objectives understood as observable and measurable behaviours - has been rendered, over time, increasingly complex to understand and apply. This has been caused by both the number of implications and facets that have been associated with the concept of competence - contexts, psychosocial factors, distinction from the concept of performance, etc. - and by the proliferation of reference frameworks, often characterized by a lack of clarity in explaining their necessity and, as well, that of adequate comparative analyses among frameworks.

It is not by chance that Le Boterf's statement defining competence as a "conceptual chameleon" can still be considered relevant today [4], and it is not surprising either that still very recently has been published a research report [5] entitled "*What is competence? A shared interpretation of competence to support teaching, learning and assessment*" in which it is stated that there is no unanimously agreed definition among scholars, professionals, and policymakers so that each adopts a different perspective on competence and acts accordingly.

In the following of this article, without claiming to be exhaustive or to provide universally accepted definitions of the concept of competence, we will try to identify some fixed points that seem to be widely shared. From them we will address the issue of defining competence frameworks and how those already defined should be analyzed in depth to unveil the model of the individual and/or context underlying them. Emphasising the relevance of inspirational models will pave the way for us to illustrate what we believe could be the goal of learning processes - and implicitly the basis of an inspirational model: *the development of the "integrated thinking" in the individuals.* We will see, therefore, how this goal should be associated with an *integrated competence space of reference* – that includes all competencies that would be useful to develop during the aforementioned learning processes. Processes that, if set on *being,* rather than *knowing* or *doing*, could deploy their transformative power to overcome the *school-factory* model developed to meet the needs of the industrial revolution [6,7].

2 Competence and competence frameworks

2.1 Notes on the concept of competence

Competence is nourished by *knowledge*, including procedural knowledge, from which *'know how'*, usually referred to as skills, can be developed, involving the application of specific procedures (e.g., solving a mathematical problem, within a class of known problems, through the application of given rules and steps). It is the ability to readapt knowledge and 'know how' to operate in unfamiliar contexts and in unfamiliar ways that make us competent, i.e. makes us *'know how to be'*. The *competence*, therefore, is what enables the production of new *perspectives* and *'cultural objects'* [55], and ultimately advances our knowledge [49].

Obviously, the level with which the individual's competence is made explicit depends on the *situation* and *context* which may stimulate competent actions. In this framework, the *capability* is to be understood as an individual's initial potentiality (largely innate and, perhaps, partly activated by early experiences) that can give rise, when appropriately stimulated, to an expression of competence at a more or less high level.

The fact that competence is the "sine qua non" for the advancement of our knowledge is what currently (and probably for a long time) makes us different from *'artificial intelligences'* (AIs) [49]. If, for example, we ask ChatGPT (one of today's most advanced and open conversational artificial intelligences) whether it considers itself competent, the answer we get, in all languages, is something like this:

> "*I am a language model developed by OpenAI, so I do not have the ability to be competent in a given context. However, I have been trained on a large body of text covering many areas of knowledge, and I have the ability to provide information and answers to questions on a wide range of topics. My goal is to help users find the information they need and support their understanding on a wide range of topics*."

2.2 Notes on the competence frameworks

Usually, after having defined the concept of competence, the next step is the definition of what competencies are needed for the harmonious development of an individual, often in relation to a specific field of operation, i.e. an individual who is able to develop complex and integrated thinking (see section 3) that enables her/him to articulate her/his competent 'how to be' in any context and situation of the life, including work situations and those in which s/he assume civic and social responsibility. In other words, we are referring to the definition of the so-called *competence frameworks*. Rarely the description of such frameworks is accompanied by an explicit and exhaustive explanation of the reasons that have led to the inclusion and/or definition of the competencies included in the frameworks, and this makes the adoption of such reference frameworks a sort of act of faith for the most.

However, behind each of these frameworks, there is always a model - more or less conscious - of the individual and/or of her/his operativeness/role within a given context. To substantiate and make this statement clearer, let us take three examples, the first one having students as its reference subject and the other two having teachers as its reference subject.

The first of these refers to the framework of *key competences for citizenship* which, in Italy, have been defined by DM (Ministerial Decree) 139 of 2007 [9] following the transposition of the European recommendations on key competencies for lifelong learning [10]. Neither a reading of the list of the eight competencies indicated in the DM, nor of the annex containing the relevant descriptors, clarifies the purposes underlying this list. On the other hand, if one organises such competencies according to the scheme in Fig. 1, it is possible to unveil the model of citizen that those who drew up the list most probably had in mind (author's hypothesis): a citizen capable of developing design processes in a collaborative and participatory manner. In practice, an individual who, starting from the acquisition and interpretation of information, phase by phase, would be able to develop projects aimed at solving the problems identified and defined in the first phases of such processes. These processes, moreover, should act as a driving force for continuous learning (learning to learn) and, require the development of a few 'life skills' (transversal competencies): autonomy, responsibility, and team working as well as the capability to communicate properly at each stage of the process.

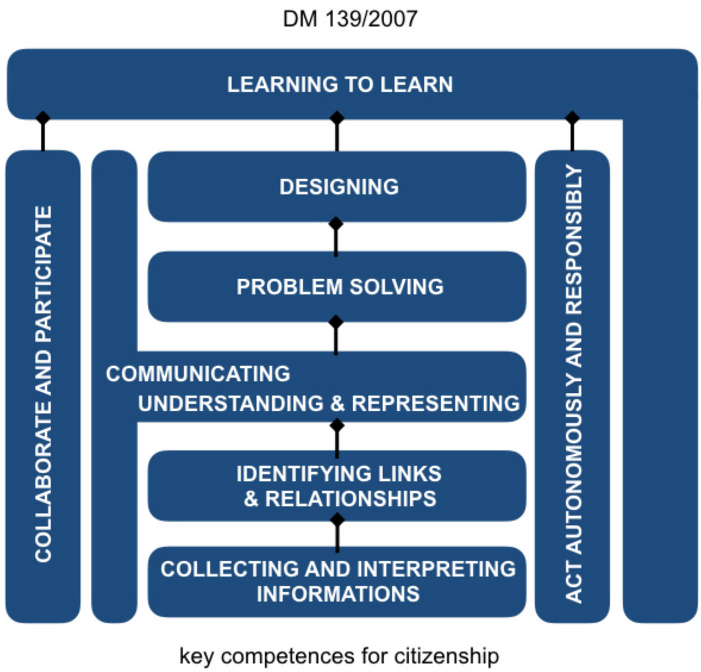

Fig. 1. Outline of the key competencies for citizenship listed in the DM 139/2007 organised by the author on the basis of their possible dependencies.

	KNOWLEDGES	SKILLS	COMPETENCES
THE UNESCO ICT COMPETENCY FRAMEWORK FOR TEACHERS			
	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
UNDERSTANDING ICT IN EDUCATION	Policy awareness	Policy understanding	Policy innovation
CURRICULUM AND ASSESSMENT	Basic knowledge	Knowledge application	Knowledge society skills
PEDAGOGY	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
ORGANIZATION AND ADMINISTRATION	Standard classroom	Collaborative groups	Learning organizations
TEACHER PROFESSIONAL LEARNING	Digital literacy	Manage and guide	Teacher as model learner

Fig. 2. The Unesco ICT Competency Framework for Teachers [11].

The second example concerns the Unesco digital competence framework for teachers [11], shown in fig. 2. The columnar organisation of this framework was, in the author's idea, determined by an implicit reference to knowledge (technology literacy - knowing), skills (knowledge deepening - knowing how to do), and competencies (knowledge creation - knowing how to be), therefore The scheme has been HERE supplemented with the addition of amaranth labels highlighting this implicit reference. The representation in Fig. 3 showing the items listed in the first column of Fig. 2 organised by the author on based on their possible dependencies. This is to bring out the model of educational context underlying the framework that, hypothetically, might have inspired those who drew up the table shown in figure 2. In practice it is a *learning ecosystem* [50-53] whose digital maturity [25-27] is defined by digital competencies used in the organisation and management of the context itself, as well as in the implementation of the didactic process and in the assessment practices; all aspects that require continuous professional development of the teachers, as well as basic knowledge in the pedagogical and ICT domains, together with adequate awareness of the policies affecting the educational context. Although this frame of reference is more specifically concerned with the digital competencies of teachers, it is nonetheless clear that in the underlying model of educational context, *students* are considered but as an external element.

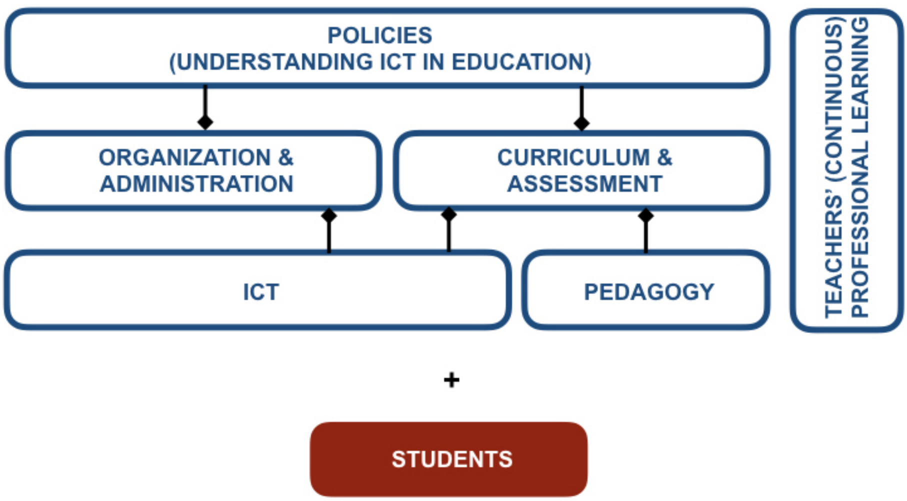

Fig. 3. Outline of the domains listed in the second column of figure 2.

In contrast, in the framework called DigiComp EDU [12] shown in fig. 4, students are represented as part of the ecosystem. The addition by the author of the same labels used in fig. 3 (derived from fig. 2) is intended to facilitate the comparison between DigiComp EDU and the model developed by UNESCO.

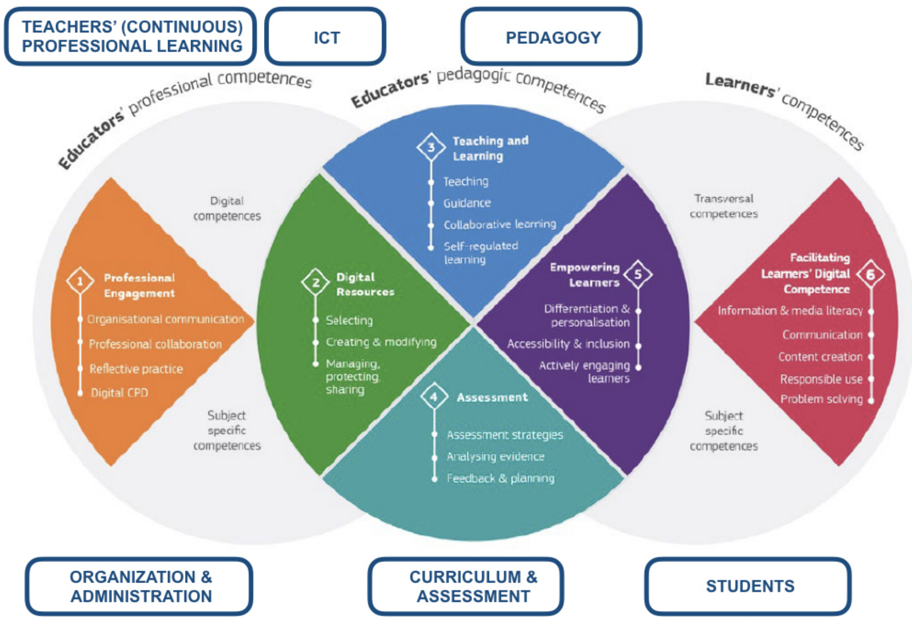

Fig. 4. Representation of the DigiCompEdu framework [12].

Critically analysing a competence framework to understand its inspiring models can also lead to the highlighting of possible flaws, e.g. analysing the DigiComp Edu framework one realises that the transversal competencies are considered relevant for students but, apparently, not for teachers; as if the competencies needed by the latter refer to a reduced competence space, a space in which the relevance of digital competencies is particularly emphasised instead.

This observation introduces us to a key point of this article: namely, the need for a competence space of reference that could be as universal and comprehensive as possible. This theme will be addressed in section 4, after having introduced, in the next section, the educational goal that requires the definition of such a holistic competence space.

3 Educating to the "integrated thinking"

The evaluation of the success of the today school system is focused essentially on 'reading, writing and arithmetic' (e.g. PISA [13] and for the Italian case INVALSI [14]), i.e. only on the *'liberal arts'* considered necessary to be able to enter the world of the *'mechanical arts'* [15] and to be able to cope with the progressive specialisation of the arts that, over the centuries, has enabled the understanding and, above all, an increasingly punctiform dominion of the natural world. This 'reductionist' view of knowledge – centred almost exclusively on knowledge and skills - tends to be at the expense of more sophisticated (e.g. dialectical) and integrative (e.g. philosophical) modes of thought.

Among the 'arts' aimed at the 'pure' knowledge of the world, the 'hard sciences' such as physics are still highly considered because the *'experimental thinking'* associated with the scientific method, is deemed an indispensable foundation of the 'mechanical arts' and, as Dewey pointed out [16], allows bridges to be built towards technological developments, and thus innovation. Experimental thinking is also at the basis of the need/intentionality to proceed from *thought experiments* [54] toward *field experiments* and the eventual falsification of the models elaborated [17]. The success and diffusion of the scientific method, together with the increasing specialisation-parcelling out of the topics pertaining to the 'mechanical arts' have pushed scientists to progressively increase the level of complexity of the problems to deal with, but still remaining within the *comfort zone* represented by the so-called *well-defined problems*.

Out of this evolution remain, of course, the *ill-defined problems*.

But what is the difference between well-defined problems and ill-defined problems?

Well-defined problems. To put it simply, in the well-defined problems one knows: a) all the elements that make up a more or less complex system and play a role in a given phenomenon under study; b) the rules that determine the interaction between these elements; and c) the boundary conditions that help determine the system's evolution. It is important to emphasise that the approximations made in defining a problem may be more or less satisfactory depending on the precision with which one intends to describe a phenomenon. Sometimes, however, even if they are satisfactory, they do not make it possible to predict the evolution of a system that, depending on the boundary conditions, may assume unpredictable yet repeatable configurations, as happens in some chaotic systems. In some cases, the number of elements is so great that it is necessary to accept one's own ignorance, i.e. the impossibility of predicting the evolution of all the parts of a system, as in the case of a fluid system so that one must limit oneself with predicting the system evolution in terms of average values of given physical variable (e.g. temperature).

The purpose of science, therefore - confirming its nature as a liberal art - is to understand and describe the 'natural world' through the development of increasingly detailed and, as far as possible, increasingly 'operationalisable' models. This latter is a need that has become increasingly important with the bursting development of computers, to be able to use increasingly sophisticated numerical and statistical approaches that cannot be implemented by the human mind. The consequence of this has been the progressive delegation of tasks to computational machines that, over time, have acquired the capacity to analyse and operate on enormous masses of data in a very short time. We can say, therefore, that it is in the context of finding solutions to complex but still well-defined problems that *'computational thinking'* was born and developed, together with the virtual representations of the evolution of complex systems (e.g. 3D dynamic evolutions). Where the human mind cannot arrive, therefore, we arrive with *'artificial intelligences',* made so by man's ability to transform algorithms into executable codes.

Ill-defined problems. The other side of the coin is represented by problems with undefined contours, in which it is not possible to identify all relevant variables and/or the relationships that determine the dynamic evolution of a given system (e.g. all the social problems). In other words, such systems - or rather ecosystems - escape operationalisation. In such cases, it is the constant and continuous observation of the traces left behind by the components of the ecosystems that make possible to carry out *'problem setting'* or, even, to identify undiscovered problems. It should be emphasised that in the 'problem setting' phase, it is possible to carry out a reduction in the level of indefiniteness of the problem description, but it will never be possible to eliminate it altogether (otherwise one would fall back into the typology of well-defined problems). It is most probably because of this that Claude Lévi-Strauss said: "scientist is not the one who knows how to give the right answers, but the one who knows how to ask the right questions."

It is worth noting that in disciplines where one has to deal with well-defined problems, the competence of 'problem setting' is scarcely practised and there is a tendency to favour the competence of *'problem solving'* involving students in the identification of the correct solution (i.e. the elaboration of a falsifiable model) in case of already identified and described problems.

In ill-defined problems, there are no *right or wrong* solutions but only *worse or better* ones [18], solutions that can therefore only be 'verified' for the effects they produce on an ecosystem or parts of it, effects that one can attempt to predict, while being fully aware that one cannot imagine all possible evolutions of the geodetics of the ecosystem. This is a logical consequence of the impossibility of identifying ‘a priori’ all relevant variables and relationships. In other words, summarizing, ill-defined problems force us to accept, without drama, indeterminacy.

To the category of ill-defined problems belong all problems capable to favor the development of *'design thinking'*, i.e. all those problems that require as a solution a project aimed at the 'optimal' modification of the 'status quo' of a given ecosystem, or parts of it, in a given situation (*locality and uniqueness of the solution*).

Marking the differences and the integrated thinking. Three aspects are important to highlight in this regard

(a) the difference in purpose between a hard science, such as physics, and the design; as we have already seen, the goal of the science is the identification of solutions to problems with the aim of *understanding and explaining the 'natural world'*, while in the case of the design the goal is to provide answers to problems through *the modification of the 'natural world'*;

b) design, therefore, is the sphere in which the *'artificial'* [19], the possible, is imagined and realised and, for this reason, is also of fundamental importance for innovation;

c) given that ill-defined problems are always characteristic of 'complex' ecosystems and that the setting and solving phases of such problems almost always require the use of methods belonging to various mechanical and liberal arts, *'design thinking'* must be considered as an *integrative mental framework;* one of the few, if not the only one, capable of recomposing, at least partially, under a single umbrella the fragmentation of knowledge that has resulted from the demand for a continuously increasing specialisation.

‘Design thinking', thus, looks like as the perfect complement (fig. 5) to the *'experimental thinking'* for the development in the individuals of an *integrated thinking*

through which to tackle all sorts of problems For this reason, schools should stimulate the development of the *design thinking* in all students from an early age [20]. In this way, as side but not minor effect, the individual would be accustomed to considering *indeterminacy* (and therefore *imperfection)* not as an insurmountable limit beyond which it is not possible to go but, rather, as a stimulus for continuous improvements, whether incremental or disruptive (i.e. by mean step-by-step approach or by a veritable change of paradigm/perspective).

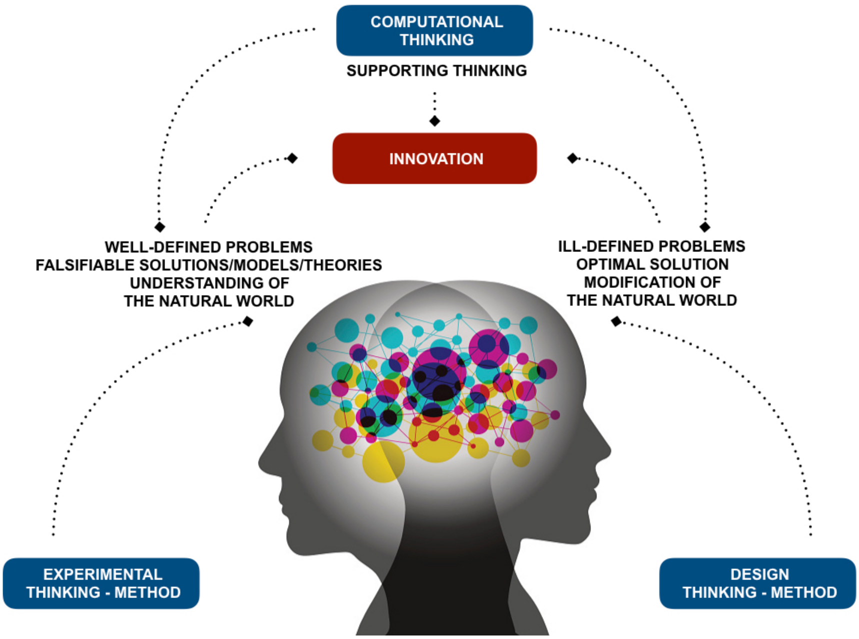

Fig. 5. Representation of *integrated thinking* and of the relationship that its components have with *computational thinking*.

To close the circle, it is necessary to reflect on the positioning of the *'computational thinking'* in relation to the harmonious whole of *'experimental thinking'* and *'design thinking'*.

In the case of 'experimental thinking' we have already seen how 'computational thinking' tends to become a ‘sine qua non’ as the complexity of the problem increases; in the case of 'design thinking', on the other hand, it is never indispensable but always useful. In other words, in the latter case 'computational thinking' assumes an instrumental role that can contribute either to making the problem definition more precise, or to improving the conceptualisation of a solution or, finally, to optimising the design process as a whole.

In such a framework, digital competencies - the introduction of which in school curricula has become, at present, the main objective for many policymakers - should not be seen as a goal but, rather, as a mean; a tool through which other competencies, other mental frameworks, can be amplified. It would also be appropriate to make a clear distinction between 'soft' digital competencies (useful for amplifying other competencies) and hard digital competencies (i.e. useful and meaningful for professionals).

And it would be even more opportune to define and constantly refer to an integrated space of competencies (see next section) to be used as a framework of reference to support the harmonious development of individuals. A development in which *'experimental thinking'* and *'design thinking'* coexist, integrating and complementing each other, and are supported, when needed, by *'computational thinking'*.

4 The integrated competence space needed in the development of the integrated thinking

Fig. 6 shows a representation of the integrated competence space referred to at the end of the previous section. In this representation, supported by the base competencies/skills (reading, writing - also in other languages - and counting) a three-dimensional space of competencies [21] develops, which includes: the so-called *"life skills"* (or transversal competencies) [22-24] that define the *individuals' how to be in a social*

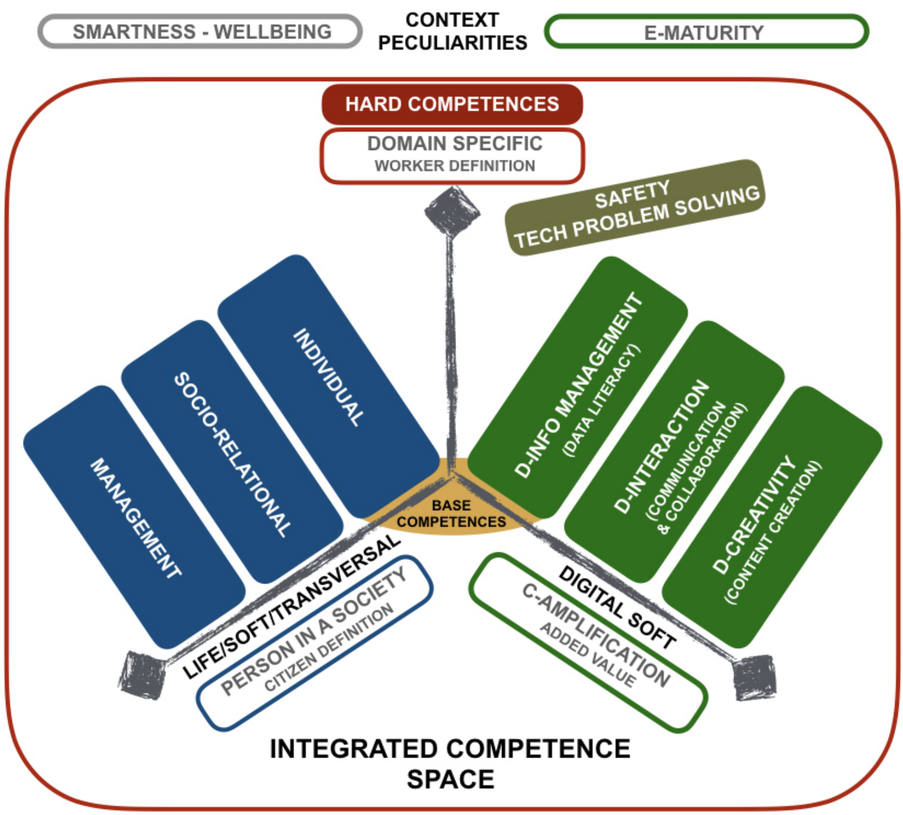

Fig. 6. The integrated competence space.

context; the *"soft" digital competences* that act as amplifiers of the transversal and base competences and *project the citizens into the digital dimension*; the "hard" competencies - specific to each given sector - that define the characteristics of the individual working in such sector with competence. It is important to highlight that the integrated competence space should be placed, then, in relation to the specificities of the context which can be characterised by its own e-maturity (defined, for example, by digital infrastructures or smart processes [25-27]) and by the level of wellbeing (smartness/wellbeing) that generates in all the actors operating within it (see for example [27] and references therein for the case of learning ecosystems). This is because, as discussed in the introduction, the level of competence that can be expressed by an individual may be stimulated by the specific context and situation.

Getting into the definition of the hard competencies is obviously not possible due to their sector-specificity. Regarding digital competencies, as shown in fig. 6, one can refer to the macro-areas defined by the DigiComp 2.2 digital competence framework [28] (although there exist plenty of frameworks generated to systematise digital skills in many ways [29]). In fig. 6, however, the competencies related to *"security"* and *"technical problem solving"* have been placed in an intermediate space between "soft digital competencies" and "hard competencies", due to their DigiComp 2.2 descriptors which makes them rather ambiguous in terms of collocability. In any case, are the *'life skills'* those that cause the greatest level of disorientation. Because of this, in Fig. 7, we have provided a macro-subdivision of the *'life skills'* into *individual*, *socio-relational* and *management or process-related competencies* (given the relevance of the *process,* and its management, that underpin any human experience [30]). Macro areas have also been subdivided in sub-areas: *individual* competencies have been broken down into competencies needed in *problem setting*, *problem-solving*, and competencies that contribute to determining what is usually defined as the *personality* of the individuals; *socio-relational* competencies, in turn, are broken down into those linked to *team working*, *leadership and group management, individual reliability* and *communication*; finally, *process- related* competencies are broken down into those useful for *defining the process*, for its *management* and for its *monitoring*.

Figure 7 is also enriched by coloured underlining indicating the competencies most desired by UK companies in 2015 [31]; the orange frames indicate, instead, the competencies most in demand by Italian companies according to a survey carried out in 2019 by the ‘Unione Industriali di Roma’ (the industrial union of Rome) [32]. Other symbols make it possible to compare the diagram in Fig. 5 with two other quite popular competence sets: the light blue frames identify the competencies considered in formulating the LifeComp framework (extrapolated from the descriptors of 9 generic competencies belonging to three areas) [33], while the amaranth circles indicate the set of competencies that the World Economic Forum (WEF) believes will be crucial in 2025 for entering the labour market [34].

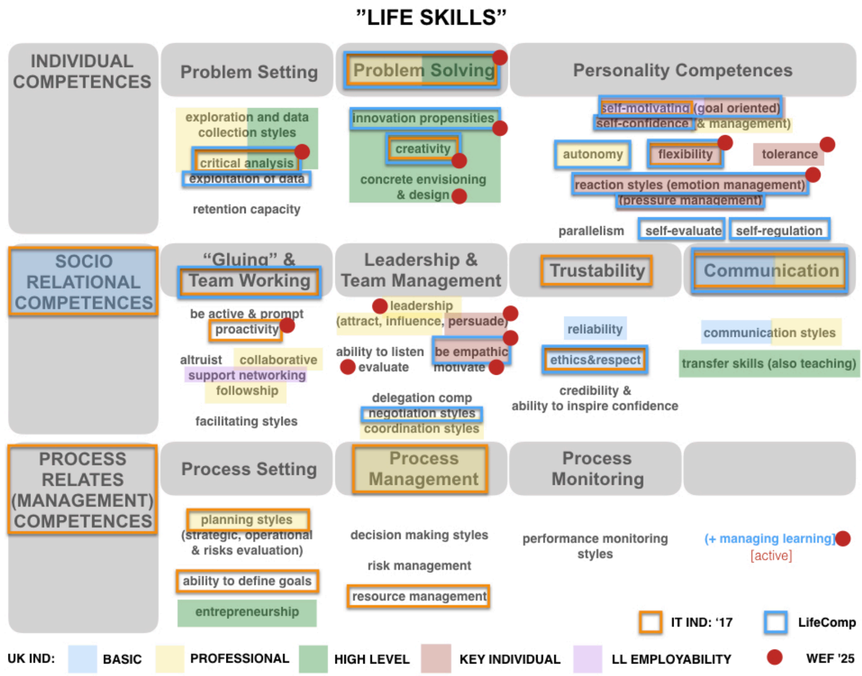

Fig. 7. *"Life skills"* (transversal competencies) grouped by the author into macro-areas and areas (2015), first published in [21].

As can be seen, LifeComp has a strong focus on individual/personal competencies (particularly those that define an individual's personality) and on some competencies related to the social/relational sphere. A further area considered in LifeComp is the management of one's own learning from a Lifelong and Lifewide Learning perspective. This area in Fig. 7 has not been exploded and has been assimilated with management and process-related competencies, albeit exploited on an individual scale.

More limited is the area of interest considered in the WEF document [34]. In this report, future workers are imagined as creative problem solvers with basic analytical skills, very flexible and capable of adapting themselves to stress, and, as far as the socio-relational area is concerned, individuals with the characteristics of a proactive leader, capable of also managing her/his own lifelong learning.

It is interesting to note that neither in the investigations that involved companies [31,32] nor in the cited framework [33,34] does *problem setting/posing* emerge as a relevant competence. It seems that individuals should develop themselves only as problem solvers while problems should be identified and described by other undefined "entities". It is also interesting to note that *ethics and respect*, as well as *communication*, are considered relevant in all documents except for the WEF one. It is also interesting to highlight that the mentioned competence frameworks do not include any focus on the area of *process-related competencies* which, instead, are considered of great interest by Italian companies and, as well, of some interest by UK companies. In general, we can observe that companies show more holistic attention to “life skills” than the mentioned competence frameworks. These latter tend to focus on specific areas and subsets of competencies, which is equivalent to making a choice of perspective on the development of individuals.

5 Beyond the "learning by doing": "learning by being"

A learning ecosystem and, more in general society as a whole, should take responsibility for the harmonious development of individuals along the entire process that they undergo in almost twenty years from primary school to the end of higher education. For this reason, a learning ecosystem should foster, through appropriate learning processes and activities, the development of *integrated thinking* and, therefore, of the necessary supporting competencies that can only be as comprehensive as possible, at least for what concerns the 'life skills' area.

Unfortunately, however, in a large part of the world the learning processes delivered by learning ecosystems are organized according to the *school-factory* model [6-7], i.e. processes organised like an assembly line in which 'quality', as already mentioned above, is measured through standardised tests focused only on base - linguistic and mathematical - knowledge and skills - more rarely competences.

In such a model, at least in Italy, the transmissive approach, aimed at the acquisition of knowledge, is dominant at all levels. In a significant percentage of cases, however, it is supplemented by *'learning by doing'* approaches aimed at the development of skills, in particular base skills, with the aim to foster a good performance of the students in the standardised tests [14]. These approaches are so ingrained that they have not been undermined even by the recent pandemic period in which there has certainly been an increase in digital knowledge and skills, but which have largely served to reproduce in virtual environments the teaching practices already in place face-to-face [35,36]. In a few cases, however, it has been possible to detect the integration of transmissive practices with collaborative approaches that have the advantage of stimulating at least relational interaction and, thus, some of the 'life skills'. Processes enabling learners to develop real competencies, however, are rarely put in place, and only in some niches are realized systematically and consciously learning processes aimed at identifying solutions to ill-defined problems and/or at the development of 'life skills'.

In order to foster a harmonious development of individuals, thus, it would be appropriate to adopt the P3BL (i.e. "problem, project and process based learning") as the preferred approach to learning [37], in which emphasis should be placed on well-defined problems when the development of *experimental thinking* is aimed at, while the focus should be shared between all three P's in the case of the goal would be the development of the *design thinking*, combined with the acquisition of an adequate *design & meta-design literacy* [20]. The development of *design thinking* would also require the full recovery of the dialectical, critical, and integrative dimensions. It is no coincidence that the activities related to the development of *design thinking* are also the most appropriate for the development of *life skills*, which can only partially be developed by the 'liberal arts' (or what remains of them in school curricula). It is quite clear, therefore, that a P3BL approach would be in perfect harmony with a competence-based learning organisation.

All this suggests the need to go beyond the *learning by doing* to develop what we can define a *learning by being* paradigm, i.e. learning processes and approaches that allow for the progressive development with the age of the *how to be*, i.e. of *being competent*.

The transformative power of such a paradigm shift on the *school-factory* model could be disruptive. In fact, in parallel to classes organised by age, one could attend, possibly on a free-choice basis, classes organised by competence. Students could be certified for the development of these latter (as is the case in all language schools) rather than getting a single grade per subject, and being subjected to a progression based solely on age in all subjects. A *learning by being* paradigm could support the harmonious development of individuals and of their *integrated thinking* according to their natural inclinations. In such a new organisation of learning the progression of learners could be accompanied by the enrichment of their competence e-portfolios in which they would keep track not only of the levels of knowledge, skills, and competencies attained but also of the roles - associated with the competence sets developed - that learners would be able to fulfill.

This would make both the choice of a tertiary study pathway less problematic - in fact, selection exams could disappear - and entry into the labour market less so. It is no coincidence that for years now companies, when recruiting their employees/consultants, have no longer relied exclusively on qualifications, but rather on the demonstration of *know-how* and, above all, of the know of *how to be*, which, as seen in Fig. 7, increasingly extends beyond the hard competences, needed in a given sector, to encompass a large part of the integrated competence space.

6 Overcoming the school-factory model

The harmonious development of individuals, discussed in the previous section, would require the questioning of the *school-factory* model and the adoption of a new pedagogical and didactic paradigm - *learning by being* - which would require adequate policies and an adequate level of social co-responsibility that at least in Italy, as revealed also by the events of the pandemic period [38], has not yet been achieved.

Actually, in Italy, the Law 107 of 2015 [39], subsequently amended by the PCTO guidelines [40], has sanctioned the obligation for students in the last three years of high school to follow didactic pathways aimed at either the development of transversal competencies and at the orientation (PCTOs), but too often this obligation, formally respected, is disregarded in substance and PCTOs are used only for orientation purposes. Moreover, in no case are the skills and/or roles developed by the students certified, apart from the experience we carried out in two high schools in Rome that ended with the issuance of blockchain-anchored e-certificates [41]. It appears now very clear that the PCTOs - as well as the territorial pacts that should make the entire community responsible for the harmonious development of young people [42] – are not enough to start the transformation of the *school-factories*, and this also due to the lack of a collective awareness of society about the relevance of the education and, in particular of a *learning by being* education. Much more consistent and radical political action would therefore be required, and not only by national governments but also by the European Union which, actually, very recently has drawn up, at least, recommendations on micro-credentials [43].

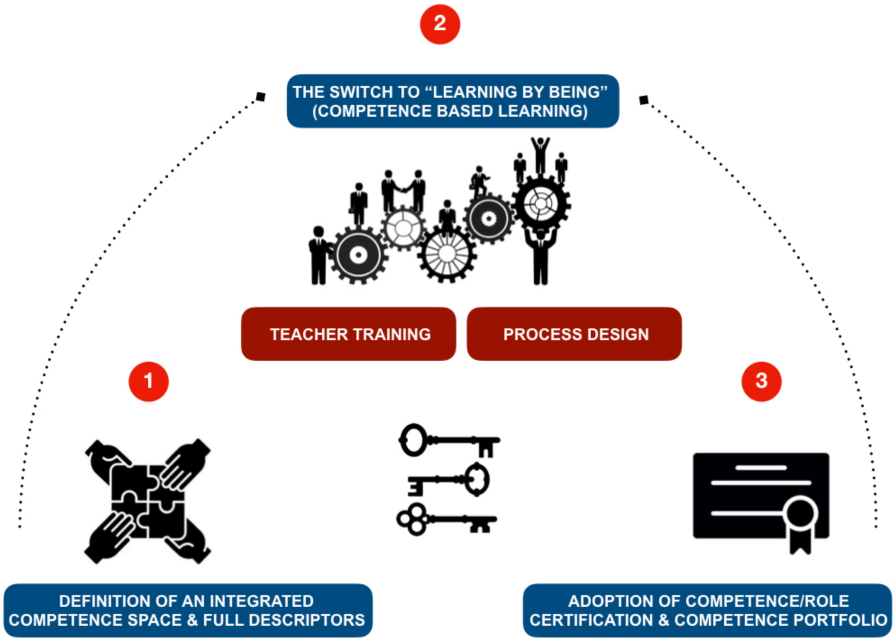

Fig. 8. Representation of the three key elements necessary for overcoming the school-factory model

The first needed step is the definition of an *educational objective* (see section 3) together with that of an *integrated competence space* and *full descriptors* (see section 4) that should not only describe competencies levels but also include the underlying knowledge and skills, as well as the interrelationships between various types of competencies (hard, transversal and digital). It is obvious that this first step should be followed by policies aimed at reforming learning ecosystems and, as well, teaching and assessment practices. This is of paramount importance to support the switch to a *learning-by-being* approach (second step). Such an approach, see fig. 8, would also require EU funding for a teacher upskilling program to enable teachers to learn how to redesign the learning processes for which they are responsible. Finally, it would require – third step - the revision of the entire assessment process to introduce the certification of competencies as a European standard [44] together with the adoption and enhancement of the e-portfolio of certificated competencies and roles, see for example [45, 46]. The physical spaces of learning should also be restructured but this would require too much funding and even longer-term plans, although some best practices are already there and can inspire the future [47,48].

7 Conclusions

In this article, after emphasising the relevance of the concept of competence - useful also in marking the difference between artificial intelligence and the humans - we addressed the issue of the definition of competence frameworks, which too often has complicated the adoption of competence-based educational approaches due to the difficulty of understanding their purpose and the relationships between the various frameworks and, as well, to relate such frameworks with the aim of supporting the harmonious development of individuals, also as responsible and participative smart citizens [21].

To try to help bridge this gap, we started with the definition of what should be the primary purpose of the learning process: *the development of integrated thinking*. Thinking that enables both well-defined and ill-defined problems to be tackled using either the *experimental* or the *design thinking*, and which to this end requires the development of an adequate set of hard, transversal ('life skills') and soft digital competencies. Due to that an *integrated competence space* has been proposed. In particular, the dimension concerning 'life skills' was explored to help the reader to become aware of the positioning of some of the most popular transversal competence frameworks, also in relation to the expectations of UK and Italian companies, taken as examples.

Final warning: in spite of the effort made in this article to put some order and justify an education based on the harmonious development of *integrated thinking* and an associated integrated space, the definition of a competence framework still remains one of the *worst-defined* problems among those one may have to deal with in the course of one's life and the invitation, therefore, is not to take the proposal of any framework - even the integrated one discussed in section 3 - as the *solution* to the problem. It is only one of the possible solutions, perhaps the best one at present, but certainly it might contain a few critical issues within it.

When faced with a proposed solution to an ill-posed problem, the advice is always to activate one's capacity for critical analysis and consider the proposed solution as upgradeable, either as a result of a better definition of the problem itself or the possible use of a different perspective … otherwise all that remains would be its uncritical adoption, albeit one might be aware that is not using her/his own expertise to produce new or improved *objects of knowledge* and, thus, contribute to the growth of a sharable knowledge base!

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