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Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DIGCOMPEDU)

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Abstract

Teachers need to update their competence profiles for 21st century challenges. Teaching strategies need to change and so do the competences teachers need to develop so as to empower 21st-century learners. The European Framework for the Digital Competence of Educators (DigCompEdu) represents a paradigmatic example of this endeavour, taking stock of these needs. Defining the requirements of education professionals by teacher competence frameworks can serve multiple purposes at different levels in education systems. At the micro level, it can support and guide teachers' practice and continuous professional development. At the meso level of local education governance, it can support the development of school institutions as learning organisations, providing common ground for dialogue, collaboration and reflection in professional communities of practice. At the macro level of quality assurance, it can provide reference standards for initial teacher education, and for education professionals' quality along the career continuum. The European Framework for the Digital Competence of Educators was designed to align with institutional and contextual requirements in different countries, whilst remaining open to adaptation and updating. It links teachers' and

students' digital competence development, and can be linked to institutional capacity building. At the same time, the framework is generic enough to apply to different educational settings and to allow for adaptation as technological possibilities and constraints evolve.

1 | TACKLING DIGITAL REVOLUTION CHALLENGES IN EDUCATION SYSTEMS

The digital revolution has transformed the way children and people play, access information, communicate and learn. Pre-schoolers are already familiar with digital devices. Young people today are more connected than ever, using the Internet for gaming, chatting and social networking, with a significant increase in its usage among young children (up to 8 years of age) (Schleicher, 2019).

Research on brain plasticity (which is particularly high in childhood) associates the use of technology with short-term changes in mood and arousal, as well as with long-term alterations in brain and behaviour (Schleicher, 2019). However, the type of technology and what it is used for may determine its effects (Bavelier, Green, & Dye, 2010)—e.g., ICT use in the classroom or at home for schoolwork; mobile phone use for social interaction or gaming; watching TV or videos for relaxation. Understanding how and why technology is used and the variety of devices that are available to children and young people are necessary to help educators and families to take informed decisions on technology use in childhood and adolescence (Gottschalk, 2019).

The digital revolution has not yet been matched by mainstream transformations of education systems, teaching and learning in schools. Research at the Massachusetts Institute of Technology suggests that students' brain activity while listening to teacher lecturing in the classroom is lower than while sleeping (Fullan & Langworthy, 2014). Moreover, mixed findings on the impact of technology use on learner outcomes flag the need to rethink the way teachers are using technology to support learning (Fullan & Langworthy, 2014). This underscores the need for new pedagogies that use technologies to tackle 21st-century challenges, promote peer learning across education systems globally and catalyse the development of indispensable transversal competences—problem solving, collaboration and creativity. Such pedagogies should rely on learning partnerships of students and teachers, tapping on their intrinsic motivation and integrating system-change knowledge, pedagogy and technology (Fullan & Langworthy, 2014).

It is teachers' responsibility to set up environments and opportunities for deep learning experiences that can uncover and boost pupils' capacities. Teachers are called on to be activators of meaningful learning, not just facilitators, being creative in choosing from a wide palette of strategies to be mixed and adjusted to context and learner. Mentors who build relationships of trust with pupils; orchestrators of individual and group learning; alchemists who compound strategies, techniques and resources to spark pupils' creativity; welders who connect bits and pieces of knowledge and activities into a meaningful whole; team players, understanding and deploying their own and others' potential to the full—teachers need to span all these roles (Caena, 2017).

Helping students to take ownership of their learning through ongoing assessment and reflection on their progress is essential. If they are asked to create, share and connect knowledge to the world, deploying the information and collaboration opportunities offered by digital tools, this can catalyse meaningful learning and increase student motivation (Fullan & Langworthy, 2014). Such learning, boosted by the use of technologies, has the potential to develop creative, collaborative participants in a knowledge-based, interdependent world (Hewlett Foundation, 2012; National Research Council, 2012). For such meaningful learning to thrive, teachers need to be excellent lifelong learners, both individually and collectively. It is crucial to build up their pedagogical capacity in relation to the pervasive, enabling role of technologies in the new pedagogies model—to focus on the learning process, help

students to discover and master knowledge and enable using it in the world through exploration and connectedness. In this perspective, learning outcomes that matter are not only students' capacities to build new knowledge and lead their own learning, but also the development of lifelong learning citizens (Fullan & Langworthy, 2014).

2 | ALIGNING TEACHER PROFILES TO 21ST-CENTURY COMPETENCES

Twenty-first century competences can be seen as necessary to navigate contemporary and future life, shaped by technology that changes workplaces and lifestyles. They underscore new skills, but also lay new emphasis on old ones, thus equipping individuals for new *ways of thinking*, *ways of working*, *tools for working* and *living in the world*, as outlined in the Assessment and Teaching of Twenty-First Century Skills (ATC21S) framework (Binkley et al., 2012). ATC21S is an international project consortium comprising academic institutions, policymakers, technology businesses (Cisco, Intel, Microsoft) and coordinated by the University of Melbourne which aimed to promote education assessment reform, for direct impact on teaching and learning 21st-century skills (Griffin, Care, & McGaw, 2012).

The ATC21S framework was based on the analysis of 12 relevant frameworks from different countries and organisations (e.g., the European Commission, the US, Japan, Australia, England, Scotland, Northern Ireland) and worldwide consultations with policymakers, academics and assessment organisations (e.g., OECD, and International Association for the Advancement of Educational Achievement) (Griffin, Care, & McGaw, 2012). In the ATC21S framework, *ways of thinking* include creativity and innovation, critical thinking, problem-solving, learning-to-learn and metacognition. *Ways of working* span communication, collaboration and teamwork; *tools for working* concern information and ICT literacy. *Living in the world* places emphasis on local and global citizenship, life and career development, personal and social responsibility (Griffin, Care, & McGaw, 2012). The framework defines competence as the ability to adjust the skill performance to the demands of the situation. This view encompasses the quality and transferability of skills over time and context, acknowledging the fact that no one performs a skill at the same level, or operates at their maximum every time (Griffin & Care, 2014).

There follows the need for powerful shifts in teaching/learning processes and in the assessment of learning, with related challenges. The ATC21S perspective on 21st-century competences recommends new *ways of learning and ways of teaching* which need to be considered for the development of suitable assessment strategies (Griffin et al., 2012).

US Partnerships 21 expresses similar views on how to catalyse education for the 21st century. They endorse merging traditional academic disciplines with the 'Four Cs' (critical thinking, communication, creativity, and collaboration) integrated by life/ career skills, technology and media skills (Kilvert, 2001). Both the OECD 2030 Learning Compass position paper and the 2018 European Council Recommendation foreground learning-to-learn and higher-order thinking, socio-emotional skills and creativity. The OECD 2030 paper defines these competences as key to meet the challenges of a volatile, uncertain, complex and ambiguous world, harnessing digital tools and artificial intelligence (European Council, 2018; OECD, 2018).

Furthering pupils' 21st-century competences poses fresh challenges for teachers, particularly in the assessment of learners and more widely in teacher professional development (Griffin & Care, 2014). An example of the competence of collaborative problem-solving can help to understand these challenges, which require huge methodological shifts in institutional practices, together with educators' resilience and commitment to ongoing learning. The OECD's 2015 PISA survey measured collaborative problem-solving, conceptualised as the ability to engage in a process where two or more agents attempt to solve a problem by pooling understanding, knowledge, skills and efforts to come to a solution (OECD, 2016). ATC21S further described collaborative problem-solving as a joint activity where two or more people contribute knowledge, skills, materials and procedures and move through a series of cognitive states (collection and analysis of information; formulation and joint testing of hypotheses). Collaborative problem-solving is thus viewed as arising from links between critical thinking, problem-solving, decision making and collaboration (Griffin & Care, 2014).

ATC21S proposes an innovative, tech-based approach to the assessment of collaborative problem-solving which considers its dual nature (social and cognitive). It focuses on individual skills development contributing to the collaborative endeavour and relies on technology to measure complex interactions (Griffin & Care, 2014). Such approaches require a paradigm shift in teachers' mindsets, with a focus on interdisciplinary approaches to assessment of competences in interaction, rather than on individual acquisition of discrete content knowledge units. Likewise, the importance of interpersonal and (meta)cognitive skills is stressed by the European Recommendations on Key Competences for Lifelong Learning which view a series of core transversal aspects as embedded throughout the eight Key Competences: critical thinking, problem solving, teamwork, communication and negotiation skills, analytical skills, creativity, and intercultural skills (European Council, 2006, 2018). Furthermore, the 2018 Recommendation puts forward a new Key Competence (Personal, Social and Learning to Learn). It intertwines the meta-competence of learning-to-learn (adjusting to change, managing and selecting from huge information flows) with personal and social development (European Council, 2018).

It follows that teachers who are required to understand, deploy, assess, model and promote such key competences and 21st-century skills need interdisciplinary collaboration and problem-solving competences related to PTCK (Pedagogical Technological Content Knowledge) (European Commission, 2013; Mishra & Koehler, 2006). This also calls for education institutions as professional learning organisations, with communities of school practitioners engaged in ongoing dialogue to promote development and reflection cycles in pupils and teachers. That is where teacher competence frameworks can stand all education stakeholders in good stead.

3 | DESIGNING AND IMPLEMENTING TEACHER COMPETENCE FRAMEWORKS

Discussions about the competences that are needed by teachers are inevitably linked with assumptions on learning and education, context-specific education cultures, expectations and the professional status of teachers (Conway, Murphy, Rath, & Hall, 2009). The concept of competence in teaching involves tacit and explicit pedagogical subject knowledge, cognitive and practical skills and dispositions (motivation, beliefs, value orientations and emotions), as the OECD DeSeCo programme for PISA surveys points out (Rychen & Salganik, 2003). Competence means that teachers act professionally and appropriately in a situation (Koster & Dengerink, 2008) and ensures teachers' undertaking of tasks effectively (achieving the desired outcome) and efficiently (optimising resources and efforts). Finally, competence can be mapped at different levels along a continuum of development (González & Wagenaar, 2005).

Frameworks of teacher competences need to rely on stakeholders' agreement on what shapes quality teachers—which competences they require and how they are understood and described (European Commission, 2013). This ought to consider the multi-faceted roles of the teacher at multiple levels—of the individual, of the school, of the local community, of professional networks (OECD, 2009). Attitudes for reflection and ongoing professional development, as well as analysis of practice, innovation and collaboration play a decisive role in teacher competences (Caena, 2011). Such aspects stand out in relation to the development of pupils' 21st-century competences.

A useful conceptualisation of teacher competences as a dynamic mix of cognitive and meta-cognitive elements (González & Wagenaar, 2005) spells out four fundamental aspects: *learning to think, know, feel and act as teachers* (Feiman-Nemser, 2008). *Learning to think* as teachers implies critical examination of one's beliefs and pedagogical thinking. *Learning to know* as teachers requires deep subject and pedagogical content knowledge (PCK), as well as the knowledge of new technologies applied to subject teaching (PTCK-Pedagogical Technological Content Knowledge) (Mishra & Koehler, 2006). These three knowledge sets need the support of metacognitive skills (learning and knowledge management; reflection strategies) for teachers to retrieve and use knowledge effectively (Feiman-Nemser, 2008). *Learning to feel* as teachers is linked with professional identity: intellectual and emotional aspects (Hagger & McIntyre, 2006). *Learning to act* as teachers entails integrating thoughts, knowledge and dispositions in practices informed by consistent principles (Feiman-Nemser, 2008).

A wider view of teacher expertise embedded in the education ecosystem spans the interlocking areas of reflexivity, professional awareness, individualisation, cooperation and personal mastery (Schratz et al., 2007; Schratz & Wieser, 2002). *Reflexivity* means developing professional thinking and discourse, based on situated pedagogic issues and experiences (Bastian & Helsper, 2000). *Professional awareness* is the conscious expertise of the teacher (subject-based and transversal, individual and organisational) (Bauer, 2000). *Individualisation* entails the knowledge, skills and attitudes to deal with diversity and inclusion (Prengel, 1995). *Cooperation* implies the teacher's actions and attitudes for dialogue and interaction in social contexts and professional communities; it is viewed as an aspect that is most in need of development in school organisations (Bastian & Helsper, 2000; Terhart & Klieme, 2005). Teachers' competences in cooperation (knowledge, skills and above all attitudes) are bound to be reflected in pupils'. They are also crucial for co-planning and co-enacting suitable pedagogies for the development of 21st-century competences in digital natives. *Personal mastery* is a pre-requisite for previous competences and entails creativity and vision in effective professional thinking, knowledge and action (Reh, 2004). *A sixth area* combines all into a whole—the teacher's action in context, with responsibility in shaping it and developing knowledge (Senge, 1996).

Across this broad range of perspectives on teacher expertise, a few staple requirements stand out. Teachers need *adaptive expertise*—the ability to adapt plans and practices to meet students' learning needs (Hatano & Oura, 2003; Vogt & Rogalla, 2009). They also require *reflective practice*, that is systematic assessment of professional knowledge and action against criteria from practice, theory and research (Hagger & McIntyre, 2006). Finally, they should have *critical, responsive attitudes to innovation and professional improvement* (Hagger & McIntyre, 2006). Reflective practice and adaptive expertise are both indispensable for 21st-century educators interacting with digital natives in VUCA (Volatile, Unpredictable, Complex, Ambiguous) worlds. The image below provides an overview of teacher competences, embedded in complex systems in ongoing change (Caena & Margiotta, 2008).

A comparative view on approaches used in European countries suggests that, to be successfully implemented, a teacher competence framework should include the following features:

- rely on clear statements of the underlying educational philosophy;
- accommodate all dimensions of teachers' professional work;
- acknowledge that teaching involves a cycle of self-evaluation and improvement;
- be consistent with (but not limited by) the desired learner outcomes;
- the key attributes of stability, durability and flexibility (European Commission, 2013).

Building flexibility into the framework allows for local interpretations, leaves room for creativity, and refrains from limiting professional agency (European Commission, 2013). This aspect is fundamental for the profiles of teachers as adaptive professionals—a core requirement in forward-looking education contexts.

The process of defining and reaching agreement on teachers' professional competences is not simple or straightforward, neutral or universal, but culturally bound and subject to change or contestation. Competence statements thus need to be clear and not over-elaborate, to recognise the complex nature of teaching, acknowledge the role of values and follow a holistic rather than an instrumental approach (Conway et al, 2009). Competence descriptors should use language that teachers can relate to themselves and their school reality. Language should be unambiguous, understandable by all users, consistent, empowering, and action-oriented—with examples of applications to teachers' daily work (European Commission, 2013). A ETUCE (European Trade Union Committee for Education) policy paper suggests that competence frameworks be based on high-level, broadly-defined statements of the characteristics of teachers at different career stages. Teacher competence statements should also build on a concept of teaching as interwoven theory, practice and critical reflection—on one's own and others' practices (ETUCE, 2008).

Teacher competence frameworks can serve three main purposes: defining outcomes of teacher education, criteria for teacher recruitment and selection, and teacher professional development needs (European Commission, 2013).

They can provide teachers with a clear image of their roles, promoting attitudes to professional reflection and autonomy along teachers' careers. Then, as reference points for key professional knowledge and skills, they can support effective professional development at individual and institutional level, by helping focus on learning priorities and needs at different career stages (European Commission, 2013).

Providing shared standards for professional profiles, teacher competence frameworks can also contribute to ensuring effective teacher education provision. Finally, depending on context features, teacher competence frameworks can also help acknowledge achievement in education practitioners' careers (European Commission, 2013). Overall, teacher competence frameworks can support teacher quality, empowerment and responsibility if they have a formative focus and have been shaped promoting teachers' ownership (European Commission, 2013).

4 | MOTIVATION FOR DIGCOMPEDU

Policymakers and teachers alike are aware that our education systems have not kept pace or come to terms with the changes brought about by the digital revolution. In many cases, teachers are unsure about how digital technologies can and should be integrated into education. Education authorities are cautious about the use of a medium that they perceive as potentially dangerous in such a sensitive and protective context as the education of minors, considering that it can lead to undesirable effects, such as cyberbullying. Yet, they equally realise that schools must prepare the young generation for life in a digital society and equip them with the necessary competences to use the Internet responsibly, critically and creatively to enhance their social interactions and life opportunities. Hence, there is a general consensus that digital competences are key for all citizens to engage in lifelong learning, to facilitate personal fulfilment and development, employability, social inclusion and active citizenship (European Council, 2018).

Curricula, guidelines or standards for digital education in schools have recently become common in most European Member States. At the European level, the European Digital Competence Framework (DigComp) was published in 2013 and revised in 2016 and 2017 as a means of offering a common frame of reference. It describes the digital competence every citizen should develop for a successful life in a digital society, breaking it down into five areas: information and data literacy; communication and collaboration; digital content creation; safety; and problem-solving (Carretero, Vuorikari, & Punie, 2017; Ferrari, 2013; Vuorikari, Punie, Carretero, & Van Den Brande, 2016). In several European Member States, the framework has been used as an explicit reference for national guidelines, particularly in guiding school education. In Germany, for example, the Kultusministerkonferenz (KMK) refined it for their framework of students' digital competence (Kluzer & Pujol Priego, 2018; KMK, 2016).

To better understand the digital competences teachers need to develop to meaningfully integrate digital technologies in education and support the acquisition of students' digital competences, the European Commission's Joint Research Centre published the European Framework for the Digital Competence of Educators (DigCompEdu) with a focus on the digital competences that are specific to the teaching profession (Redecker, 2017). It is based on extensive expert and stakeholder consultations and aims to structure existing insights and evidence into one comprehensive model that is applicable, in principle, to all educational contexts. The generation and dissemination of this framework illustrate how frameworks can contribute to innovation in education and teacher professional development.

5 | FRAMEWORK GENERATION

Designing a transnational framework requires that one understands existing national and transnational instruments already in use, as well as a methodology for learning from these instruments to develop a common frame of reference that resonates with existing policies and, at the same time, goes beyond cultural and contextual specifics. Hence,

the methodological approach for the development of DigCompEdu was based on two major stages: (i) The in-depth analysis, clustering and mapping of existing frameworks, self-assessment tools, guidelines, conceptual models and instruments used for the development of educators' digital competence; and (ii) a series of expert and stakeholder consultations to refine, re-arrange, correct and validate the conceptual model developed in the previous stage.

At first, on the basis of extensive desk research, more than 50 instruments were identified as relevant and analysed in their basic components. 32 of these were finally selected as a basis for the generation of a first draft framework. The remaining instruments were excluded as not sufficiently sound or detailed, or substantially different in focus and scope. The basic elements in the selected instruments were then mapped to form compe-tences and clustered to form competence areas. The competences and areas thus defined were then mapped onto the original frameworks to validate their coherence and consistency. The result was submitted to a series of stakeholder consultations: face-to-face meetings with teachers, researchers and policy makers, as well as open online stakeholder consultations on subsequent framework drafts. Initially, consultations had been conceived as a means of refining and validating the conceptual model; however, stakeholder discussions foregrounded a clear need for a framework that did more than synthesise existing tools. There was overall consensus among experts and representatives of the European Member States that a European framework should include important aspects of innovation underlying European education policy initiatives. As a result, the DigCompEdu fulfils its purpose of providing a common reference frame for national, regional and local initiatives. It also invites policy makers and practitioners to re-consider the role of technology in education as an enabler for innovation and describes educators' digital competence as a professional (rather than digital) competence, conducive to creating learning experiences that reflect and address the changed skill needs and working patterns in a digital age.

6 | CONTENT AND STRUCTURE OF THE FRAMEWORK

The European Framework for the Digital Competence of Educators (DigCompEdu) details 22 educator-specific digital competences, organised in six areas (Redecker, 2017) (Figure 1).

Applied to the context of school education, Area 1 (*Professional Engagement*) describes teachers' efficient, appropriate use of technologies and digital learning opportunities for communication and collaboration with col-leagues, students, parents and others. In addition, it emphasises the importance for teachers to individually and
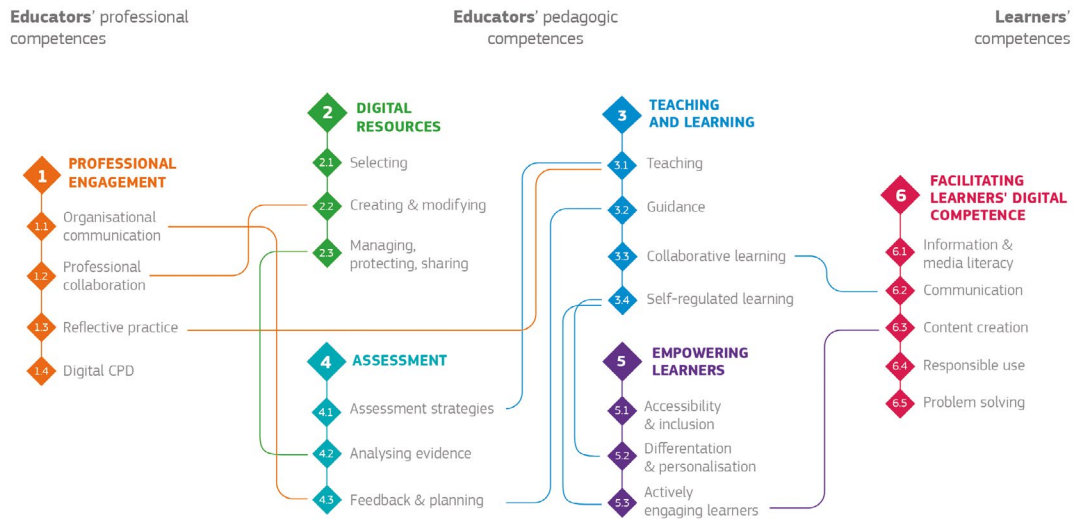

FIGURE 1 DigCompEdu framework overview
Source. Redecker (2017). [Colour figure can be viewed at wileyonlinelibrary.com]

collectively reflect on their teaching practices, to critically assess the effectiveness and appropriateness of their digital teaching strategies and to actively develop them further.

The core of the DigCompEdu framework is represented by areas 2 to 5 in which technologies are integrated into teaching in a pedagogically meaningful way. Area 2 (*Digital Resources*) focuses on the selection, creation, modification and management of digital educational resources. This includes the protection of personal data in accordance with data protection regulations and compliance with copyright laws when modifying and publishing digital resources.

The third area (*Teaching and Learning*) deals with planning, designing and orchestrating the use of digital technologies in teaching practice. It focuses on the integration of digital resources and methods to promote collaborative and self-regulated learning processes and on the need to accompany these learner-led processes with effective guidance and support measures.

Area 4 (*Assessment*) addresses the concrete use of digital technologies for assessing student performance and learning needs to comprehensively analyse performance data and provide targeted, timely feedback to learners.

Area 5, *Empowering Learners*, emphasises the importance of creating learning activities and experiences that address students' needs and allow them to actively develop their learning journey. Teachers are able to use digital technologies to foster differentiation and personalisation by allowing different levels and speeds, individual learning pathways and objectives. They encourage students' active engagement in digital activities, ensuring equal access to technologies.

Area 6 (*Facilitating Learners' Digital Competence*) maintains that digitally-competent teachers should facilitate their students' digital competence, enabling them to manage risks and use digital technologies safely and responsibly. Teachers should be able to promote information and media literacy and integrate activities to enable digital problem solving, digital content creation and digital technology use for communication and cooperation.

Each individual competence of the DigCompEdu framework is described along six proficiency levels (from A1 to C2) with a cumulative progression, similar to the Common European Framework of Reference for Languages (CEFR).

Teachers at the first two levels (A1-A2) have started to use technology in some areas and are aware of the potential of digital technologies to enhance pedagogical and professional practice. Those at the intermediate level (B1-B2) already integrate digital technologies in a variety of ways and contexts. At the highest levels (C1-C2), they share their expertise with peers, experiment with innovative complex technologies and develop new pedagogical approaches and assessment strategies. The description of levels for each competence is intended to help teachers to reflect and understand their personal strengths and weaknesses.

Other educator-specific competences—e.g., subject-specific competences, general digital competence as defined by the DigComp framework—are important prerequisites for the development of DigCompEdu. However, these are beyond the scope of the framework, which focuses on educator-specific digital competence. While the TPACK framework (Mishra & Koehler, 2006) views technological (T), pedagogical (P) and content (C) knowledge as required to integrate technology in teaching, the DigCompEdu framework is wider in scope, considering educators' digital competences as a combination of knowledge, skills and attitudes, with the skill dimension dominating over the knowledge dimension. It explicitly includes considerations of the educators' professional working environment and the multiple interactions with learners, colleagues and external stakeholders.

At the same time, for teaching and learning processes (i.e., Areas 2 to 5), DigCompEdu is narrower in scope than TPACK, as it focuses on the pedagogical dimension (PK). It does not contemplate the specificities and constraints of different subjects, i.e., the content dimension (CK), which it assumes is described in curricula and teaching guidelines. Similarly, it takes the technological dimension (TK) as sufficiently described by other frameworks, e.g., the DigComp framework, and only considers this dimension where it overlaps with the pedagogical dimension.

This focus on the pedagogical dimension allows DigCompEdu to supply detail and still be applicable across all subjects in a continuously changing technological landscape. Thus, it explicitly describes how digital technologies can be effectively integrated into teaching and learning, how they can be used to enhance teaching and learning

strategies, which key objectives should guide their implementation and how their use can, with growing experience and competence, lead to innovation in education.

7 | FRAMEWORK IMPLEMENTATION AND SELF-ASSESSMENT TOOL

Competence frameworks are primarily targeted at national, regional, local authorities and stakeholders (including initial and in-service teacher education providers, as well as school leadership) that are responsible for the design, implementation and evaluation of policy initiatives, guidelines, curricula and practices. Consequently, in some Member States and regions, DigCompEdu has already been integrated in training courses and guidelines for teachers, such as in the region of Saarland in Germany (http://tiny.cc/medienkurs), or is being contemplated to be included in future guidelines, such as in Portugal and Croatia. In Spain, the CRUE network of higher education institutions is planning to use it as part of CPD activities for their academic staff, while in Germany the German Adult Education Association (Deutscher Volkshochschul-Verband e.V.) and the Goethe Institut are interested in using the framework for the training of their lecturers. In many instances, the framework report has been translated by national or local actors into different target languages to facilitate the take-up by national and regional actors (https://ec.europa.eu/jrc/en/digcompedu/supporting-materials). Experiences with DigComp show that the level and speed of integrating a European framework in official national guidelines and curricula largely depend on national specificities, needs and policy cycles. It is therefore to be expected that, over the next five to ten years, more and more guidance documents will make reference to DigCompEdu. However, in the case of DigCompEdu, the formal adoption and integration of a European framework at the national or regional level are not the main avenues in which the framework aims to foster innovation and change in education. More and more evidence recently points out that digital education policies are only successful if and where it has been possible to obtain the teachers' buy-in, participation, engagement and, eventually, ownership of the process (Conrads, Rasmussen, Winters, Geniet, & Langer, 2017).

Hence, to acquaint educators with the DigCompEdu framework and integrate its concepts in their own practical theories about digital teaching competence, an online self-assessment instrument has been developed which is freely accessible in a number of languages (https://ec.europa.eu/jrc/en/digcompedu/self-assessment). The development and implementation of the tool were accompanied by the setup of a stakeholder community in which experts and practitioners contributed to the conceptual design of the tool and were invited to exchange their experiences with deploying the framework and the tool in different contexts (https://ec.europa.eu/jrc/communities/en/community/digcompedu-community).

At the conceptual level, the development of the tool was guided by three principles: (i) to condense and simplify the key ideas of the framework, (ii) to translate competence descriptors into concrete activities and practices that teachers can relate to, and (iii) to offer targeted feedback to teachers according to individual levels of competence for each of the 22 indicators. Following these principles, 22 items were developed, one per competence. Each consists of a statement describing the core of the competence in concrete, practical terms, and five possible answers which are cumulatively structured and mapped onto the proficiency levels. Teachers are asked to select the answer that best reflects their practice.

The instrument development followed an iterative process of expert consultations, pre-piloting and item revision (Benali, Kaddouri, & Azzimani, 2018; Ghomi & Redecker, 2019). The main changes to the initial version entailed creating versions for different educator audiences and a stronger alignment of the answer scale with the DigCompEdu framework progression. This was deemed to be necessary because the use of terminology that is specific to different educational sectors would improve the user experience, especially when comparing school, higher and adult education. It also allowed for targeted and actionable feedback, taking into account different educational contexts and their specific constraints.

TABLE 1 Example for proficiency levels of DigCompEdu competence 3.1 (teaching) and item 3.1

Level	DigCompEdu framework: *3.1 Teaching* To plan for and implement digital devices and resources in the teaching process, so as to enhance the effectiveness of teaching interventions To appropriately manage and orchestrate digital teaching interventions To experiment with and develop new formats and pedagogical methods for instruction	Item 3.1: I carefully consider how, when and why to use digital technologies in class, to ensure that they are used with added value.	SCORE
A1: Newcomer	Making little use of digital technologies for instruction	I do not or only rarely use technology in class	0
A2: Explorer	Making basic use of available digital technologies for instruction	I make basic use of available equipment, e.g. digital whiteboards or projectors	1
B1: Integrator	Integrating available digital technologies meaningfully into the teaching process	I use a variety of digital resources and tools in my teaching	2
B2: Expert	Using digital technologies purposefully to enhance pedagogic strategies	I use digital tools to systematically enhance teaching	3
C1: Leader	Orchestrating, monitoring and flexibly adapting the use of digital technologies to enhance pedagogic strategies		
C2: Pioneer	Using digital technologies to innovate teaching strategies	I use digital tools to implement innovative pedagogic strategies	4

Initially, a common answer scale was used with options ordered by frequency, ranging from 'I have never done this' to 'I comprehensively/systematically do this'. Following expert consultation, it was decided to map the answer options more closely on DigCompEdu competence descriptors and progression. Experts agreed that each competence should be represented by only one item and that the total digital competence should consist of all 22 items. Therefore, in some cases, a choice had to be made between different aspects that were crucial to a given competence. However, care was taken to select the most generic and basic concept. For example, for competence 2.3—*Managing, protecting, sharing*, it was decided to focus on data protection rather than on copyright rules or the use of shared content repositories.

Similarly, the framework's competence progression in six stages was transformed into a five-point-scale—considering progression stages that were expected to be prevalent among current teachers. The scales underlying the framework are based on the assumption that digital competence development involves the following stages: *no use—basic use—diversification—meaningful use—systematic use—innovation*. In some cases, the categories of meaningful and systematic use were merged, as it was deemed difficult for users to differentiate between the two (see Table 1). In other cases, where current usage patterns were unlikely to display innovative strategies, the highest competence level was left out.

The resulting instrument employs five answer options for which points ranging from 0 to 4 are scored. In the feedback report, the total score—ranging from 0 to 88 points—is mapped onto the six proficiency levels of the framework. Further modifications will be made, once more data on the different language and sector versions of the tool are available and analysed.

The analysis of a preliminary set of data collected by means of the German version of the tool, with teachers in school education (Ghomi & Redecker, 2019), shows high levels of validity and reliability. Usage rates are increasing rapidly for all versions of the existing tools and new language versions are continuously being added. Once more data have been collected and analysed on different language and sector versions of the tool in the course of 2019, the tool will be revised and made available to all European teachers.

Already now, with only a test version available, it has become evident that the tool is a useful means of engaging teachers in developing their digital teaching competence. CPD providers are already integrating the tool into the training offered as a means of providing structure and engaging teachers in individual and collective reflection. Schools are integrating it into collaborative efforts to develop the digital competence of their staff. Especially in Germany and Portugal where a greater number of educators have been involved in different local implementations of the tool, it has become evident that, while it does serve its initial purpose of helping individual teachers to identify their strengths and training needs, its real power as a catalyst for change is displayed in collective applications.

8 | CONCLUSIONS—LOOKING FORWARD

The European Framework for the Digital Competence of Educators (DigCompEdu) illustrates how a framework can contribute not only to setting official targets or standards for teachers' digital competence development, but also to engaging teachers themselves in the reflective process of understanding their competence levels and professional development goals. It shows that a well-designed framework is able to reconcile different stakeholders' purposes and act as a booster of innovation in 21st-century pedagogies.

From a scientific point of view, it must be based on thorough research, on a clear understanding of professional learning needs, accompanied by an effort to conceptually mould the different aspects into a consistent, concise, flexible and intuitively understandable model. To support the communication of policy objectives and professional requirements to practitioners, it must be accompanied by clear descriptors and indicators for different progression levels for each competence.

However, to become a catalyst for change, the framework must also engage its end-users from grassroots levels. Only if teachers perceive the framework as a useful guideline for their professional development will they be willing to work on their competence. The use of a self-reflection tool that translates framework indicators into professional activities to which teachers can relate, accompanied by detailed feedback on possible avenues for enhancing their competences, can contribute to transforming an overarching framework which could otherwise be perceived as externally imposed in a bottom-up, participatory movement. Through the availability of an anonymous self-assessment tool, teachers can experience their self-assessment process as self-determined and individually-owned. Its frequent use in training courses or other collective development exercises and the ensuing discussion among participants further underscore the framework's role in inciting professional dialogue, engagement and activity rather than measuring or stratifying existing competence levels. This has a transformative power for pedagogies to promote learning partnerships of teachers and learners within and across education contexts. It has the potential for promoting teacher motivation, agency and voice, effectively harnessing the potential of digital technologies to empower 21st-century learners as resilient, reflective and responsible global citizens.

DISCLAIMER

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