Erasmus+
Enriching lives, opening minds.
Co-funded by the European Union

POSITIVE LEARN

R2.1 POSITIVE LEARN Competency Framework (Final version)

Editor: Jan Pawlowski (HRW)

Date: January 2025

Distance learning positification: technostress relief and wellbeing (POSITIVE LEARN),
Grant Agreement Number: 2021-1-EL01-KA220-SCH-000027978

Contributors

	Name	Organisation
	Seyma Kocak	HRW
	Sofoklis Sotiriou Dimitra Dimitrakopoulou Myrto Kyriazopoulou	EA
	Kati Clements Saana Mentala	JYU
	Dimitra Pappa	NCSR

Amendment History

Version	Date	Author	Description/Comments
1.0			
1.1			

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The primary aim of POSITIVE LEARN project is to address this skills gap in school education, to

- develop the competencies of teachers to ensure wellbeing and health,
- provide learning scenarios and materials to include well-being across subjects,
- create a unique open exchange platform to allow competency development and collaboration across Europe.

This report presents the finalized competency model for the POSITIVE LEARN project.
The model was validated and refined during the project, and this document showcases the final version.

1 INTRODUCTION

It is evident that new technologies have become an integral part of our lives. As early as 2010, young people were spending more time on electronic devices than with their families or at school (Rideout, Foehr, & Roberts, 2010). Today, with the rapid advancement of technology, many of our everyday activities have transitioned online or are closely tied to our devices. Smartphones have become essential in our daily routines, influencing both work and leisure activities (Carter & Grover, 2015).

This significant growth in technology necessitates the development of skills to navigate the digital world effectively. Particularly during and after the pandemic, technology allowed us to stay connected and adapt to online education. However, this shift revealed several challenges regarding our preparedness to use these technologies, and new adaptation strategies had to be developed.

As we evaluate what has been effective and what requires improvement, it is essential to bolster our society—particularly schools and educators—so they can adeptly navigate this digital transformation now and in the future.

Furthermore, the recent Covid-19 pandemic has had a profound impact on schooling. Widespread lockdowns have disrupted traditional school operations. According to the OECD (2021), lockdowns in the first year of the pandemic left 1.5 billion students in 188 countries unable to attend school in person. As a result, schools had to massively switch to online-only learning. Overnight, teachers and students had to adapt to the use of distance learning platforms and other technology-based forms of learning delivery. This has put digital learning in the spotlight, including AI, highlighting its strengths while also revealing some key weaknesses. A specific term has been coined to describe the nature of teaching in these urgent circumstances: emergency remote teaching (Hodges et al., 2020).

One of the key lessons learned from the pandemic was that many teachers and students were unable to deal with technology in a healthy way, resulting in various psychological effects such as anxiety and stress (Pressley et al., 2021; Robinson et al., 2023). It became clear that a new "normal" is emerging in school education. Schools are reopening to a new reality in which digital learning will continue to play an important role. Managing this digital transformation requires developing digital readiness, resilience, and capacity. There is a need for profound overhauls and changes that address wellbeing and mental health. Well-being needs to be addressed in the context of the use of technology, and as teachers play a crucial role in the educational process, it is crucial that teachers become active agents of change in implementing technological innovations.

Consequently, the effective take up of digital technologies and innovative pedagogies in education calls for a rethinking of the portfolio of digital competences of educators, namely competencies and skills to (a) move seamlessly towards digital learning scenarios and (b) react to psychological effects such as technostress, depression, or isolation.

In this project, our guiding theoretical stance is based on positive computing (Pawlowski et al., 2015), that derives from positive psychology. Following this paradigm, we want to create an education for flourishing, not just surviving or coping. Years of research in psychology have shown that a positive mood produces better attention and enhances creative thinking (Seligman, 2012). The key is how to adapt and use the current technology to achieve individual flourishing. We aim at moving beyond not being depressed or not being stressed to having meaning in life, maintaining good relationships and enjoying positive emotions; from correcting deficits to building strengths. We envisage a positive education that focuses on strengthening the digital competencies and the wellbeing of students and teachers.

In order to achieve these goals, we are working on bridging the gap of the current digital competence frameworks for teachers and rethinking the priorities of competences in relation to positive psychology and positive computing. The main focus on this report is not on the basic digital competencies, since they have been deeply analyzed and structured in the DigComp frameworks, but rather on the emotional aspects and positive solutions that have been scarce and not explicitly addressed.

In this Project Result 2 report, we present results of literature review on competence frameworks against the backdrop of the emerging reality in digital education. Furthermore, we focus on the development of a competency framework. We aim at connecting our framework to existing work, in particular the DigComp framework as the main competency framework for citizens as well as educators in Europe.

In an overview, the aims of the R2.1(Competency Framework) report are:

- To develop a pedagogical framework that will elaborate on positive computing interventions.
- To develop a competence framework that will elaborate on digital competencies for teachers with a focus on positive solutions, addressing emotional aspects.
- To develop a complete competence scheme and guideline that will address the training of teachers for positive solutions, including wellbeing across subjects and curricula.

2 BACKGROUND: DIGITAL COMPETENCES FOR TEACHERS

In this chapter, we present the highlights of a literature review for the development of digital competence for teachers. We start by defining competence and competency in order to have a clear common understanding throughout the document. Next, we review the most prominent and relevant digital competence frameworks in education with an emphasis on teachers. Meanwhile, in the following section, we analyze the competencies that belong to the area of digital wellbeing. In the last section, we review assessments, the existing categories, the purpose, the focus, and the tools that can potentially be utilized.

2.1 Competence and competency: Our understanding

The terms of competence and competency are understood rather differently and sometimes even used as synonyms. The European Qualification Framework (European Parliament and the Council, 2018) defines competence as "the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development".

Also other terms such as literacy are used as well leading to some confusion on the key concepts (Brockmann et al, 2009, Wong, 2020). Wong (2020) states that the concepts are used interchangeably depending on the context - as an example, he argues that competency is favorably used in the US whereas the UK prefers competence. Another distinction is focusing on job tasks (competence) vs. personal attributes (competency). In many contexts, competence focuses on the "what" (e.g., programming an app), whereas competency focuses on the "how" (e.g., knowing programming languages, programming techniques). As most European Frameworks such as the European Qualification Framework or the DigComp framework use the term competence, we will follow this terminology.

The recent communication of the European Parliament and Council on Key Competences for Lifelong Learning (2018) uses the following definitions:

*"**Competences** are defined as a combination of knowledge, skills and attitudes, where:*

- ***knowledge** is composed of the facts and figures, concepts, ideas and theories which are already established and support the understanding of a certain area or subject;*
- ***skills** are defined as the ability and capacity to carry out processes and use the existing knowledge to achieve results;*

- ***attitudes*** *describe the disposition and mind-sets to act or react to ideas, persons or situations." (European Parliament and Council, 2018)*

Additionally, the more specific concept of **digital competence** is defined as
"[...] the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking." (European Parliament and Council, 2018)

The European Parliament and Council (2018) noted that digital competence is one of the key competences that every person needs for "personal fulfilment and development, employability, social inclusion, sustainable lifestyle, successful life in peaceful societies, health-conscious life management and active citizenship".
In recent decades, numerous competence frameworks have been proposed, outlining teachers' required digital competences. Table 1 provides an overview of the most pronounced frameworks.
The term "competence framework" needs to be clarified. Generally, a framework refers to a structure, overview, outline, system, or plan made up of various descriptive categories, such as concepts, constructs, or variables, along with the relationships between them that are believed to explain a phenomenon (Nilsen, 2020). Thus, a competence framework organizes and describes the competences relevant to our field. It should also include a proficiency level, indicating the extent to which a competence has been mastered. For example, the DigCompEdu framework (Redecker, 2017) utilizes six levels that are similar to those in the CEFR framework for language learning (Council of Europe, 2020).
As a summary, we have decided to use common definitions in line with the terminology in EU policies and publications. This will lead to easier incorporation and mapping of our work to existing frameworks and guidelines.

2.2 Digital competence frameworks

There are a variety of **competence frameworks for digitalization / digital transformation** (Vial, 2019). The underlying common goal of all digital competency frameworks is to improve the quality of teaching of teachers in the digital age, i.e., to meet the demands of the digital age.

They differ regarding the target group (e.g. students, teachers), generalization (e.g. citizen vs. specific role) and sector (e.g. industry, Higher Education). From the vast research on the teacher digital competences or "Digital Literacy" (Reddy et al, 2020), in the following section we will review the frameworks that relate to teachers and are the most pronounced (DigComp; TPACK; PfDK; ISTE framework for educators; DigCompEdu) (Table 1).

These frameworks provide an understanding of what it means to be digitally competent as an educator from different perspectives. It is widely recognised that digital literacy requires more than just technical knowledge and encompasses a wide range of interrelated skills and attitudes. Digital competence frameworks consider multiple dimensions of digital competences, including technical skills, pedagogical knowledge, critical thinking, information literacy, digital citizenship, and collaboration. In addition, they typically organise competencies into different areas, such as e.g. digital literacy, digital communication, digital content creation, digital collaboration, digital assessment, etc. The variety of facets examined illustrates the complexity of the task. As technology plays an increasingly important role in education, educators must not only be able to leverage technology but also effectively integrate new tools and applications into the classroom to teach 21st-century skills. The pedagogical autonomy of educators in the use of technology is essential. Teachers must understand and master the pedagogical use of digital technologies as well as their potential and limitations.

Table 1: Digital competence frameworks for educators

Name	Author	Focus Areas	Scope
Digital Competence Framework for Citizens (DigComp)	European Union (2022)	The DigComp framework identifies the key components of digital competence in 5 areas: Information and data literacy, Communication and collaboration, Digital content creation, Safety, Problem solving.	DigComp aims to be an enabling, descriptive, and non-prescriptive reference framework for digital competence.
European Framework for the Digital Competence of Educators (DigCompEdu)	European Union (2017)	The "DigCompEdu" framework provides a reference framework for the digital competence of educators, focusing on twenty-two competences organised into six areas: Professional engagement, Digital resources, Teaching and learning, Assessment, Empowering learners, and Facilitating learners' digital competence.	DigCompEdu is aimed at educators at all levels of education, from early childhood to higher and adult education, including education and training, special education, and non-formal learning contexts.
UNESCO ICT Competency Framework for Teachers (ICT-CFT)	UNESCO (2018)	The UNESCO ICT-CFT addresses all aspects of a teacher's work: Understanding ICT in education, Curriculum and assessment, Pedagogy, ICT, Organisation and administration, and Teacher professional learning. The Framework identifies three successive stages of a teacher's development: Technology Literacy, Knowledge Deepening, and Knowledge Creation.	The aim of the UNESCO ICT-CFT is to inform education policy makers, teacher trainers, professional learning providers and working teachers about the role of ICT in education reform.
Technological Pedagogical Content Knowledge (TPACK)	Schmidt et al. (2009)	The TPACK framework identifies three primary forms of knowledge that need to be integrated to effectively teach specific content using technology: Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK).	TRACK describes the knowledge and skills required for effective technology integration in teaching. Other important relationships between knowledge forms include: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK).
The Norvegian Professional Digital Competence Framework for Teachers	Kelentrić et al. (2017)	The Norwegian Professional Digital Competence Framework for teachers describes seven key competence areas of: subjects and basic skills, school in society, ethics, pedagogy and subject didactics, leadership of learning processes, interaction and communication as well as change and development.	Each of the seven competence areas describes the knowledge, skills and competence to meet the requirements of each competence area and/or to action plan how to reach the described requirements.
The International Society for Technology in Education (ISTE) Standards for educators	ISTE (2015)	The ISTE framework for educators includes seven competencies – profiles of the teacher as Learner, as Leader, as Citizen, as Collaborator, as Designer, as Facilitator and as Analyst.	The educator section of the ISTE Standards provides a road map to helping students become empowered learners. Digital skills are implicit in every profile/role.
Educators' digital competence framework (EDC)	Siina, C. (2022)	The EDC framework identifies twenty competencies organised into four sections: Knowledge development, Knowledge application, Knowledge sharing, Knowledge communication.	The EDC framework focuses on 'mobilising digital technology for improving inclusive and quality education for all children, with an explicit focus on the most vulnerable'.

One of the most prominent frameworks that has been the paradigm for digital competence frameworks is the **DigComp framework**, including DigComp 1.0, DigComp 2.0, DigComp 2.1, and the most recent DigComp 2.2 (Carretero et al, 2017; Vuorikari et al, 2022). It is a tool developed by the European Commission to support the development and assessment of digital

competences. It consists of five areas of competencies, each of which is further subdivided into specific competencies and levels of proficiency:

- Information and Data Literacy: The ability to search, find, evaluate, manage, and store digital information and data.
- Communication and Collaboration: The ability to communicate effectively and collaborate with others using digital tools and platforms.
- Digital Content Creation: The ability to create and edit digital content using various digital tools and platforms.
- Safety: The ability to understand and manage online risks, protect personal data, and ensure security in digital environments.
- Problem-Solving: The ability to use digital tools and platforms to solve complex problems and make informed decisions.

Each area of competence is further subdivided into specific competences, such as "using search engines effectively" under Information and Data Literacy or "creating multimedia presentations" under Digital Content Creation. Additionally, each competence has several levels of proficiency, ranging from basic to advanced, allowing individuals to assess their current level of proficiency and identify areas for improvement. Overall, the DigComp framework provides a comprehensive and flexible tool for individuals and organizations to assess and develop digital competences, which are essential for success in today's digital age. However, our project mainly aims at schools, therefore we focus on the **educational perspective**. In this paper, we focus solely on teachers and students in schools. In the following section, we discuss digital competence frameworks for teachers. We also discuss how our focus - wellbeing, technostress and social media - is covered by each framework.

Technological Pedagogical Content Knowledge

One rather prominent approach is the **TPACK** (Technological Pedagogical Content Knowledge; Koehler & Mishra, 2008; Koehler et al, 2014; Mishra, 2019). It is a framework that describes the knowledge and skills required for effective technology integration in teaching. The framework emphasizes the importance of integrating three main knowledge areas: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) to effectively teach specific content using technology. It also recognizes the importance of integrating these knowledge areas to form three additional areas of knowledge: Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological

Pedagogical Content Knowledge (TPACK). TPACK highlights that technology integration is not just about using technology in the classroom, but rather, it is about understanding how technology can be used to support effective teaching and learning. By integrating all three knowledge areas, teachers can effectively design technology-rich learning environments that meet the needs of their students.

This model has quite a strong focus on knowledge which is needed to provide good, technology enhanced learning and teaching. However, it remains quite vague on specific technologies and related challenges. This model can serve as an orientation but it is too generic and does not include wellbeing or technostress-related competencies. Moreover, Zembylas (2007) has introduced the concept of emotional ecology and argues that pedagogical content knowledge includes both cognitive and emotional components, where the latter have been continuously disregarded. He strongly supports that pedagogical frameworks for teachers need to include emotional knowledge and states that "*to teach well, teachers must be able to connect their emotional understanding with what they know about subject matter, pedagogy, school discourses, personal histories, and curriculum*."

Professional Digital Competence Framework for Teachers

The Norwegian Directorate for Education and Training has developed the **Professional Digital Competence Framework for Teachers** (PfDK; Kelentrić, Helland & Arstorp, 2017) based on the national guidelines and curriculum. The framework consists of seven core competencies which are then divided into: knowledge, skills, competence. Those digital skills stem from the five basic skills, namely orals skills, reading, numeracy, writing and digital skills. The core competencies based on this framework are the following:

- Subjects and basic skills
- School in society
- Ethics
- Pedagogy and subject didactics
- Leadership of learning processes
- Interaction and communication
- Change and development

From this frameworks' point of view teachers need to have basic skills that are able to update and renew (learning how to learn approach). The school as part of society needs to reflect the current digital developments and the teachers need to be well informed and include new digital

practices in the classroom where necessary. The teachers need to be aware of the ethics that apply to the use of digital tools and media, to ensure the continuation of democratic society. Pedagogical knowledge combined with digital didactics need to be included in the preparation and teaching process. Teachers need to be the active agents of learning in digital realities and lead with adaptability. Teachers are expected to use digital environments for supporting each other and ensure active listening during communication. In order to keep up with constant change in a digital society, teachers are required to practice their professional agency on life-long learning.

The framework follows a holistic approach to competences (Starkey & Yates, 2021) that expands the national scope into international, but is lacking in the aspects of wellbeing and new developments. For example, in regard to new developments, it does not take into account the impact of AI in education, and what kind of competence would be needed to address the ambiguity caused by chat gpt and other AI. Most importantly, even though it is one of the most analytical frameworks, the matters of wellbeing in digital education are not explicit. Only in the competence area of ethics, they mention that teachers need to be aware of the effect of technology in health and that is a very general statement.

International Society for Technology in Education framework for teachers

The International Society for Technology in Education (ISTE) has developed frameworks for students, educators, educational leaders, and coaches. These frameworks are covering all US and were viewed as national, however Mattar, Santos and Cuque (2022) consider them international frameworks in their review and analysis of digital competence framework for education. The list of ISTE framework for educators includes seven competencies - profiles:

- **Learner**: Lifelong learning and technology innovation updated
- **Leader**: Leadership for student empowerment and for supporting teaching and learning.
- **Citizen**: Teachers promote active and responsible participation.
- **Collaborator**: Collaboration with colleagues and students to improve practice, explore material, ideas, problem-solving.
- **Designer**: Differentiation of learning, student-center approaches, authentic design.
- **Facilitator**: Facilitating learning with technology to achieve the ISTE Standards for students.
- **Analyst**: Teacher as a researcher of new knowledge for instruction and support of students and their learning.

These seven profiles are guiding the framework for educators and teachers. In more detail, the teacher as a learner is expected to learn and implement technology in teaching, have an active professional agency in education communities and stay updated with current research trends. The teacher as a leader is a leading role model regarding the adoption of digital resources for education stakeholders, students and the whole educational community. The teacher as a citizen promotes active social responsibility in the educational community and the digital social communities. Moreover, the teacher as a collaborator endorses open communication and proactive collaboration in the educational community with a strong intercultural competence for digital content problem-solving approaches. The designer role of the teacher entails digital content creation and teaching methodology expertise in virtual environments. The teacher as facilitator acts as an agent of independent learning, promotes self-regulated learning in digital environments and nurtures creativity. Finally, the teacher as an analyst is encouraged to develop and use technology-based formative, summative and self-assessment tools for learning and to utilize the findings for progress within the educational community.

The ISTE framework does not define digital competence or digital literacy as such, but rather describes the general elements that educators need in digital education (Mattar, Santos & Cuque, 2022). The seven profiles entail competencies in the form of abilities with analytical descriptions. However, aspects in regard to wellbeing are not mentioned in the framework nor mitigating strategies for technostress. Moreover, in the description of the competencies it is unclear whether it considers the presence of AI in education or the awareness of algorithms. In conclusion, the ISTE framework for educators is a general digital competence guide that needs to be developed to include the latest digital developments in education as well as necessary competencies.

DigCompEdu

As a main approach, the European DigCompEdu (Figure 1; Redecker & Punie, 2017, Vuorikari et al, 2022) provides a comprehensive framework for educators. It extends the general DigComp framework by specific areas focusing on educators:

- Area 1: Professional Engagement: Using digital technologies for communication, collaboration and professional development.
- Area 2: Digital Resources: Sourcing, creating and sharing digital resources.
- Area 3: Teaching and Learning: Managing and orchestrating the use of digital technologies in teaching and learning.

- Area 4: Assessment: Using digital technologies and strategies to enhance assessment.
- Area 5: Empowering Learners: Using digital technologies to enhance inclusion, personalisation and learners' active engagement.
- Area 6: Facilitating Learners' Digital Competence: Enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving.

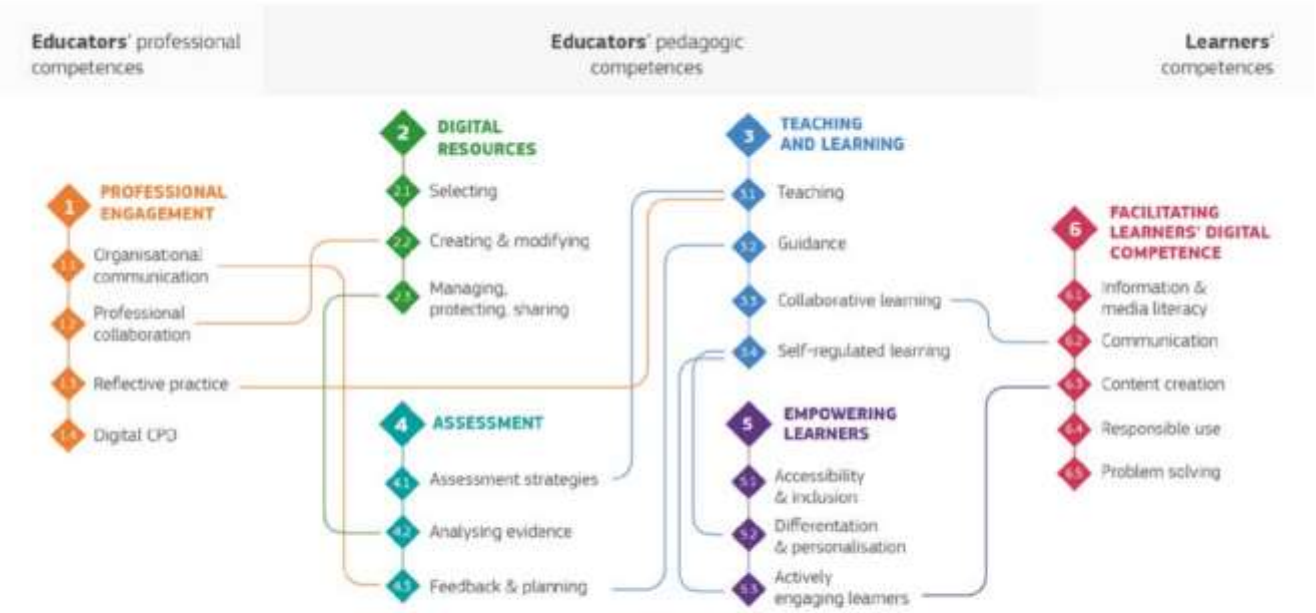


FIGURE 1: THE DIGCOMPEDU FRAMEWORK

The framework also includes competences related to our focus area: In Area 6, the framework addresses wellbeing and technology: "To take measures to ensure learners' physical, psychological and social wellbeing while using digital technologies. To empower learners to manage risks and use digital technologies safely and responsibly." (Redecker & Punie, 2017) However, this quite generic competence needs to be further refined and specialized. This has been started in the DigComp framework in version 2.2 (Vuorikari et al 2022) in which more concrete statements for knowledge, skills and attitudes have been added as examples ("Dimension 4"). Therefore, we see the DigComp (V2.2) and DigCompEdu as starting points for competencies - our model will then directly link to different areas of this framework.

Summarizing our brief review, we can state that the analyzed frameworks are useful for educators looking to integrate technology into their teaching. DigCompEdu provides the most

comprehensive set of competencies related to digital literacy and digital communication. However, phenomena like well-being, mental health or in particular technostress are not specifically addressed there. The focus has been mainly on the technical skills that are essential but only one piece of the digital competence puzzle. As Leonardi and Neeley (2022) argue, technology is the easy part, the key question is how we transform people to be able to think of the possibilities that these technologies enable us for. A total of 30% knowledge is what we should aim for as a baseline digital literacy. The rest relies on the so-called soft skills. Therefore, this framework will be extended and improved to include some core competencies for teachers' and students' wellbeing in the digital world, namely digital wellbeing.

2.3 Competences for digital wellbeing

The capacity for cognitive functions such as learning is interconnected to wellbeing and requires developed **socioemotional competencies** (Collie, 2020). Burns and Kolho (2022) highlight the importance of both digital and socioemotional competencies of teachers in digital education environments. Their research concern is whether there is a risk if we prioritize teachers' digital competences and put aside teachers' socioemotional competences as a secondary focus. Other studies refer to digital literacy competencies as a range of cognitive and socioemotional competencies (Silber-Varod, Eshet-Alkalai & Geri, 2019). Managing health-related problems at work, such as technostress requires skills such as emotional self-regulation, that are a substantial part of socioemotional competence (Jennings et al., 2014; Romero-García, Buzón-García & Marcano, 2022).

Likewise, Marr (2022) includes **emotional intelligence** - the ability to be aware of, express, and manage our emotions - and empathy as core competencies for all in the digital world. This is further supported by findings that teachers with high emotional intelligence have better coping mechanisms in stressful situations, including technostress (Molero Jurado et al., 2022). Moreover, the level of teachers' socioemotional competencies can influence their teaching methodology in the classroom and is positively associated with their teaching self-efficacy. It has become a common consensus that teachers' socioemotional competence constitute the base of teachers' competence (Cervera & Caena, 2022) and they need to be extended to the digital environment and be embedded as part of the digital competence for future teachers. In the DigComp 2.2, some aspects of socioemotional competencies have been included, but they are still scarce, not explicit and do not have a focus on teachers.

Martínez-Bravo, Sádaba Chalezquer and Serrano-Puche (2022) are arguing for inclusion of socioemotional competence and the affective dimension on the spectrum of digital

competence. When reviewing digital competence frameworks, the area of emotions has been often overlooked. According to Martínez-Bravo, Sádaba Chalezquer and Serrano-Puche (2022), the study of Area-Moreira (2015) has included the emotional dimension in the digital competence framework, as a set of affections, feelings and emotions that are related to the digital world. They analyzed the term digital literacy based on multiple studies and found six dimensions, out of which one is the emotional. The emotional dimension's definition resembles emotional intelligence as a whole. The emotional aspect is vaguely analyzed in only 3 out of the 7 frameworks for digital competencies that this study reviews. Similar findings from the Word Economic Forum report for SEL through technology (2016) mentioned how socioemotional learning (SEL) frameworks and applications have been overlooked in education and were calling for the inclusion of SEL in the digital world.

Another related competence that has not been explicitly addressed in digital competence frameworks for teachers is the social media competence. According to the digital education trends, social media have been utilized as a professional tool and as a curriculum component (Novakovich, Miah & Shaw, 2017). Considering their extended use in today's society, teachers have to be aware of social media dangers and functional details and of reckless self-education approaches that are promoted online. Teachers need to raise students' awareness about their beliefs regarding the importance of maintaining the separation of education and social spaces and discuss concerns regarding privacy issues, especially if they want to include social media in the curriculum. Competencies regarding the use of social media are mentioned in the DigComp 2.2. for citizens and need to be adapted to educational contexts. More analytically, some of the competencies are the ability to produce online content, general media literacy skills and the ability of having and maintaining an online self (Novakovich, Miah & Shaw, 2017). It is important for teachers to be aware of social media algorithmic thinking and market human value before considering their use in the classroom and aim at raising awareness of these aspects to students as well. Educating teachers in **social media competence** is a matter of digital wellbeing. The matter of digital wellbeing concerning social media practices is of central importance for the classroom and beyond. Digital wellbeing has been recently conceptualized as an underlying term for the "*impact of technologies and digital services on people's mental, physical, social and emotional health*" (Passey, 2021, p.5).

Salinas, De Escoriaza and Hernández (2022) have developed a renewed model of socioemotional competencies that are indeed an essential part for the digital world. They define them as **socioemotional e-competencies** (Cebollero-Salinas et al., 2022) and have five main components: emotional e-awareness, emotional e-regulation, e-self-control of impulsiveness,

emotional e-independence and social e-competency. This framework is focusing on adolescents, therefore an adaptation for teachers' competencies requires further consideration. A more detailed description of the competencies is discussed below:

- **emotional e-awareness** as the ability to identify and perceive one's own emotions in a digital context
- **emotional e-regulation** as the ability to response in an adaptive manner to a digital situation and have the capacity to identify the felt emotions while being in an online interaction
- **e-self-control of impulsiveness**, "inhibiting impulsive responses to social stimuli and demands and/or to information appearing on the Internet"
- **emotional e-independence** is defined as the ability to differentiate emotions that arise in digital environments, to maintain self-worth regardless of online status and interaction patterns such as gratifications (especially relevant in addiction prevention)
- **social e-competency** as the ability to maintain positive relations and prosocial behaviors in the digital contexts, understanding that "digital social life takes place at a more rapid rate, and often in a more anonymous fashion".

Examples of each of these e-competencies will be mentioned and analyzed further below. Based on the study of Salinas, De Escoriaza & Hernández, (2022) each of the five competencies consists of five concrete examples that can guide us into further understanding the substitute of each competence (see APPENDIX 1). These examples are very explicit and we will mention two for each competence.

An example of emotional e-awareness is: *"I usually know how to distinguish why I have certain feelings on social media."* That is an example of the emotional process of emotional understanding. Another example of emotional e-awareness is: *"I really understand what I feel when I play video games online, watch videos, read comments, etc."* which refers to the identification of one's own emotion. It is very important to have the capacity of identifying and understanding the emotions that arise in the digital context, considering that those emotions entail information about the situation and the individual. The two examples that the authors mention for emotion e-regulation are: *"Before making a joke [about someone] on social media (on video or audio) I am capable of imagining how that person is going to feel."* and *"Before I say anything on social media, I am capable of imagining the consequences."*. This emotional thought is the step between the stimulus and the action, where emotions are being processed.

It is a compilation of cognitive and emotional processes that constitutes a necessary competence, especially for teachers that operate in highly emotional contexts.

Moreover, in the case of e-self-control of impulsiveness, the authors provide two tentative examples, where the individual cannot control their impulse: *"On the Internet, I can't stop clicking on the attractive links I see."* and *"When something surprises me, I can't avoid commenting on it on social media.".* The skill that underlies these examples is the ability to control one's self in fast-paced virtual environments. It is one of the most important competencies that has the potential to prevent problematic digital situations such as cyberbullying. Concerning the competence of emotional e-independence, two examples are: *"When I see the number of comments other friends receive on social networks, it affects me"* and *"If people don't answer on social media, I feel as if they don't consider me part of the group.".* This competence includes the ability to understand that we have the two selves, the online and the offline and to differentiate the emotions in each context. Last but not least, two examples of social e-competency are: *"On social networks (Instagram, WhatsApp, e-mail, etc.) I pay attention to the needs of others."* and *"I tend to calm my contacts down when they get angry on social networks.".*

These competencies are very relevant for teachers in the virtual and digital teaching and learning environments, taking into consideration the elements of knowledge, skills, and attitudes. Moreover, a few of the items mentioned above that have been initially developed for adolescents might be of overlapping relevance for teachers. It is important to consider that developing these competencies plays a protective role in mental illness caused by the use of social networks. Also, the competencies act as protective factors on habitual digital behaviors such as media multitasking, cybergossip, and phubbing. In this aspect, media multitasking was used with a negative connotation, when someone is distracted by social media while studying or working and loses focus of attention. The term cybergossip is used when others are discussing someone who is not present. Some of the outcomes of such behavior include cyberbullying and unwanted sexting. The term phubbing refers to the behavior of ignoring others in face-to-face interactions because of looking at the phone or screen. This behavior is increasing and is concerning because it can lead to problematic interactions with others such as friends, teachers, and partners. Therefore, each of these examples needs to be considered thoroughly when developing the future digital competencies of teachers in order to manage the emotional challenges of social networks and beyond.

2.4 Coping with technostress

As a second way to derive competencies, we will review literature on technostress mitigation and related interventions. The study by Valiao, A. J. (2025) examined five dimensions of technostress: Techno-Overload, Techno-Complexity, Techno-Insecurity, Techno-Invasion, and Techno-Uncertainty. The study recommends targeted institutional strategies, such as regular training, enhanced technological support, and stress management programs, to mitigate the effects of technostress and sustain high levels of satisfaction and performance.

A variety of studies have intended to understand technostress and related coping / mitigation strategies. As a starting point, it is important to understand the **phases of technostress formation**. Salo et al (2022) have identified these four phases, namely: pre-technostress, technostress formation, technostress mitigation and post-technostress.

Pre-technostress is the state before technostress occurs, where IT users perceive and actualize IT affordances based on their needs and expectations. IT affordances are the possibilities for action that IT offers to users, such as communication, entertainment, or learning. Actualization is the process of realizing these possibilities through IT use. Technostress formation is the state where technostress occurs, where IT users experience negative psychological responses to IT use, such as anxiety, frustration, or overload. Technostress is caused by actualization costs, which are the undesirable outcomes or consequences of actualizing IT affordances, such as privacy breaches, information overload, or social pressure. Technostress mitigation is the state where technostress is reduced or eliminated, where IT users employ mitigation strategies to cope with technostress. Mitigation strategies are actions or behaviors that aim to change or reduce actualization costs or accept them as inevitable or tolerable. The authors identified three types of mitigation strategies: actualization change, actualization cost reduction, and actualization cost acceptance. Post-technostress is the state after technostress is mitigated, where IT users perceive and actualize IT affordances again based on their revised needs and expectations. This state can lead to a new cycle of technostress formation and mitigation if actualization costs persist or emerge.

Salo et al, (2017) argue that there are **three main mitigation strategies**: 1) stressor reduction (Modification of IT features, Modification of IT use routines), 2) stressor toleration (Modification of personal reactions to IT stressors), 3) recovery from strain (Temporary disengagement from IT, Online/offline venting). In addition, Tarafdar et al (2020) and Rohwer et al (2020) have as well identified mitigation strategies for technostress. From their findings on coping mechanisms we will refer to the positive solutions that have the potential to enhance individuals' experience with technology.

Rohwer et al (2020) refer to two categories of coping with technostress, that of problem-focused and of emotion-focused strategies. **Problem-focused coping strategies** are those that aim to change or eliminate the source of technostress. Some good examples of that are, open communication and seeking help from others, such as colleagues, supervisors, IT experts. In addition, technological solutions such as: blocking unwanted contacts, deleting social media accounts, turning off notifications, filtering emails, or taking breaks from IT, using anti-virus software, encryption tools, or online counseling services. **Emotion-focused coping strategies** are those that aim to reduce or manage the emotional distress caused by technostress. The successful and positive examples of the emotion-focused approach are: Distancing from IT, such as switching off devices, limiting screen time, or engaging in offline activities and engaging in leisure activities, such as hobbies, sports, or meditation that can provide relaxation and enjoyment, including mindfulness. Some of the coping strategies that are mentioned in technostress mitigation studies such as venting emotions and ignoring or avoiding the stressors have been reported as non-successful and have the potential to increase technostress (Rohwer et. al, 2020; Salo et. al, 2017; Tarafdar et. al, 2020).

The authors also identified several barriers that hindered the mitigation of technostress, such as lack of awareness, lack of alternatives, lack of control, lack of motivation, and lack of support. They suggested that IT users need to develop self-regulation skills and awareness to overcome these barriers and mitigate technostress effectively. Those skills that are mentioned are included in the socioemotional competence.

In order to promote the successful technostress mitigation strategies, a number of interventions have been developed. As an example, Hutson et al (2018) have identified interventions for the prevention of cyberbullying. The possibility of cyberbullying can be a stressor and the related interventions that exist to tackle that issue have a variety of approaches:

- **School-based interventions:** The interventions involved are delivering cyberbullying education and prevention programs to students, teachers, and staff in schools. The programs typically included information on cyberbullying definitions, consequences, laws, policies, and coping strategies.
- **Family-based interventions:** The interventions involved are delivering cyberbullying education and prevention programs to parents and families in various settings, such as homes, community centers, or online platforms. Some programs also involved parent-child communication, parental monitoring, or family support.
- **Individual-based interventions:** The interventions involved are delivering cyberbullying education and prevention programs to individual youth or parents in various settings,

such as clinics, counseling centers, or online platforms. Some programs also involved cognitive-behavioral therapy, motivational interviewing, or social skills training.

- **Technology-based interventions:** The interventions involved are delivering cyberbullying education and prevention programs through technology platforms, such as websites, apps, games, or social media. These interventions can be school-based, family-based, individual-based or general interventions.

Due to the complexity, we cannot review all related areas - however, when developing curricula, learning scenarios and materials, phenomena related to technostress should be taken into account. As a summary of this section, we can state that our review has provided input for developing the competence framework - as starting points, the following top level categories should be included and elaborated further: a) Understanding the process of technostress formation, b) Understanding and applying stress reduction strategies, c) Understanding and applying toleration strategies, d) Understanding and applying recovery strategies and e) Understanding and applying concrete mitigation / coping interventions. Based on this initial review, further strategies for coping and mitigation can be identified and incorporated into future versions of the competence model.

2.5 Eustress

In organizational settings, stress is defined as a process comprising four components: stressors, psychological responses, outcomes, and individual traits and organizational mechanisms. Stressors are environmental demands placed on individuals and are inherently neutral; they can be perceived as either harmful or beneficial. Cognitive appraisal plays a crucial role, as the same stressor may be interpreted differently by various individuals. Psychological responses are categorized into eustress, which is associated with positive reactions, and distress, which is linked to negative responses.

Eustress is a positive form of stress that motivates individuals, leading to personal growth, learning, and improved performance. In the context of technology, referred to as techno-eustress, this occurs when individuals view technology-related demands as opportunities for improvement rather than as threats. In digital learning, eustress represents the positive stress that learners experience when educational technologies challenge and motivate them to advance (Van Slyke, 2023; Nascimento et al., 2024; Tarafdar et al., 2024). Instead of feeling

overwhelmed by digital tools, students experience techno-eustress when they recognize technology as a means to develop skills, solve problems, and achieve success.

In light of this, positive education initiatives should aim to prevent technostress and promote eustress. This involves actively seeking out strategies to encourage positive engagement with technology in educational settings.or

- techno-stressors & technostress (i.e. distress) inhibitors and
- factors that positively influence eustress (Techno-eustress creators)

Presently, eustress has not been extensively studied, and its potential to reduce the effects of negative technostress. Early perspectives of and research on technostress assumed that individuals automatically adopt a negative psychological response to a techno-stressor, discussed as techno-distress . Typically, the technostress studied is the technological pressure that happens to teachers. This Technostress causes a variety of negative outcomes, including dissatisfaction, fatigue, anxiety, and overwork, all of which reduce individual productivity (Tarafdar et al., 2007; Willermark et al., 2023). Stressors are the conditions present in an environment with the potential to create stress (Pothuganti, 2024). Musa et al. (2023) measured technostress with 28 items which fall under five dimensions namely, technical, professional, personal, social, and learning-teaching process.

Contrarily, eustress creators give rise to eustress: Tarafdar et al. conceptualize techno-eustress creators as constituting multiple dimensions, all of which relate to how users are challenged and motivated to use IS to enhance and grow vis-à-vis their work.
Nascimento et al. (2024) note that the context of education has received some attention on techno-eustress, though most studies are on students. They concluded that techno-eustress is influenced by **technological, individual, and organizational factors.** factors were found to induce techno-eustress experiences such as ICT information overload, trust in technologies, ICT usefulness, ICT involvement facilitation, ICT ease of use, personal and organizational coping resources, and an environment of low centralization and high innovation. Notably, productivity, innovation, and job satisfaction were presented as techno-eustress outcomes.

Nascimento et al (2024) identified and analyzed techno-eustress antecedents and outcomes in the workplace concluding that technological, individual, and organizational factors influence techno-eustress:

- **Technology characteristics** and techno-eustress: usefulness, reliability, and (lack of) complexity.

- **Organizational Mechanisms** and Techno-eustress: involvement facilitation, literacy facilitation, and technical support provision (=organizational mechanisms that inhibited the negative experience of technostress). Involvement facilitation refers to the degree of participation and involvement of users during the planning, development, and implementation of technology. Literacy facilitation is the degree of training and encouragement for ICT knowledge sharing. Technical support specifies the degree of orientation, assistance, and technical aid provided to users in the ICT use context.

- **Individual Traits** and Techno-eustress. Some individual factors such as personality traits, digital literacy, and self-efficacy have been analyzed in technostress (in the sense of distress) research. Eustress variables: IT mindfulness and age. We selected IT mindfulness because of its significance in shaping how individuals perceive stress and their overall well-being. IT mindfulness can directly enhance techno-eustress.

Techno-eustress creators:

Tarafdar et al. (2024) conceptualize techno-eustress creators as constituting multiple dimensions, all of which relate to how users are challenged and motivated to use IS to enhance and grow vis-à-vis their work, Four dimensions that describe how IS positively challenges and motivates Information Systems (IS) users to use IS to become–(1) more competent at; (2) have greater control over; (3) improve their socialisation at; and (4) intellectually develop–their work.

Table 2: techno-eustress creators [source Tarafdar et al. (2024)]

Techno-mastery	IS users are challenged and motivated by use of IS to achieve competence, efficiency, and proficiency at work.
Techno-autonomy	IS users are challenged and motivated by use of IS to act with agency in prioritising and executing work.
Techno-relatedness	IS users are challenged and motivated by use of IS to leverage their connectivity with colleagues to exchange work feedback and social support.

Techno-enrichment	IS users are challenged and motivated by use of IS to make work more interesting, and orient it toward adding value and solving problems.

2.6 Assessment: Categories, purpose, focus and tools

In this section we will discuss the nature of assessment in relation to the digital competencies for teachers. Our guiding competence frameworks for identifying the reviewed assessment tools are the DigComp and the DigCompEdu. We will first analyze the types/categories of assessment, then the purpose of assessment and then the focus of assessment. Simultaneously, we will add the tools in each category that are considered the most validated in the field and in the end, we will provide a list with those tools.

Through the literature review (Kluzer & Priego, 2018; Laanpere, 2019; Mattar, Ramos, & Lucas, 2022) we have decided to discuss the 3 main types of assessments of digital competence: performance-based, knowledge-based and self-assessments. **Performance-based** assessment is a type of assessment that is usually employed to evaluate a person's level of competence. This type of assessment requires expert scoring thus making it very cost non effective for the wide audience. Performance-based assessment can be in the form of performance tests, situation-based scenarios or observations of performance. **Knowledge-based** assessment is a type of assessment that measures a person's understanding and application of knowledge. This type of assessment employs instruments with problem-based questions or scenarios to measure the factual knowledge on the situations and skills. More specifically, knowledge-based assessments can measure knowledge in two ways, answering questions that could happen in real life or in hypothetical scenarios. **Self-assessments** and self-report questionnaires are the most common type of assessment for digital competences. They are easier to use, more applicable, cost effective and usually provide direct information on the self-perceptions of someone's knowledge, skills and attitudes. They provide the individuals with the opportunity to self-reflect on their competencies and have an understanding of their strengths and weaknesses. Especially for the case of teachers. Self-assessments have been proven very helpful for their self-directed learning and for their lifelong professional development.

Another component that needs to be taken into consideration when using a specific assessment type is whether it has a **psychometric** approach or a **pragmatic** approach. The first

one, psychometric, focuses on the internal validity of the instrument rather than the usability and the applicability of the result. Whereas the second one, pragmatic, focuses on external validity, usability, having higher applicability but in the research realm has lower internal validity. These aspects need to be considered especially by the education stakeholders that are developing assessment tools. The focus of the assessment has to be explicit, and the approach or type considered carefully.

According to UNESCO (2018), the main purposes of assessment in regard to the digital competencies of teachers are four: that of research, statistics, credentialing and diagnostic self-assessment. The assessment tools that are designed for research purposes usually employ the psychometric approach. Those aiming for statistical data gathering are usually less reliable and lack both construct validity and internal validity. Credentialing assessments are made for employment purposes, they are usually highly reliable, however their construct and internal validity is mostly weaker than those developed for research. The diagnostic (self) assessments might be lacking high reliability and internal validity, but they prioritize external validity and usefulness, making them the most preferred assessment tools.

From all the frameworks that were reviewed on literature on digital competences, the DigCompEdu was the most relative for our scope. Based on this framework many assessments have now been developed and our aim in this section is to review the most used and validated available assessments. The DigComp group framework has been renewed several times into DigComp 1.0, DigComp 2.0., DigComp 2.1, and the most recent DigComp 2.2. The latest version includes more extensive descriptions of the elements of skills, knowledge and attitudes. Moreover, it has increased the proficiency level of each competence with detailed descriptions. The proficiency levels that are suggested are six, including: beginner, explorer, integrator, expert, leader and pioneer (A1-C2). According to these new additions of assessment rubrics it is relative to include assessments that are based on the DigComp group as our focus and the DigCompEdu respectively.

The most prominent assessment tools for teacher's digital competence that were based on DigCompEdu are DIGIGLO (Alarcón, D. Pilar Jiménez, & Vicente-Yague, 2020) and SELFIE. The **DIGIGLO** is a tool for assessing the digital competence of teachers as described in DigCompEdu. It consists of 29 items that include the 22 competencies from the 6 areas of DigCompEdu together with two new areas, that of "digital environment" and "extrinsic digital engagement". The area of digital environment includes competencies regarding the use of digital tools, such as software and hardware and the area of extrinsic digital engagement includes the competencies related to the implementation, update and support. The instrument

can be used as a self-assessment tool by teachers and as a performance test by education institutions, in order to identify the areas that teachers need further support and professional training. **SELFIE** for TEACHERS (Self-reflection on Effective Learning by Fostering the use of Innovative Educational Technologies) is a self-assessment tool for self-reflection that aims to help teachers identify their strengths and gaps in their digital competence. It includes 32 items on teachers' digital competence based on DigCompEdu. Results are provided on a six-level proficiency scale (A1-C2) with personalized feedback to guide teachers in reaching the next level in their digital competence. There are specific instructions for use available online. It takes approximately 30 minutes to complete. The tool is not designed to assess performance but to empower teachers to reflect on digital technologies use as it is a self-assessment tool for professional learning and development.

In addition, more tools have been developed for the assessment of digital competence that will be reviewed below. One well known tool is the DigCompEdu Check-In. Even though the DigCompEdu Check-In tool was initially made to measure digital competence in higher education, it has been used to assess the digital competence of teachers in primary and secondary level and in language teaching as well (Benali, Kaddouri & Azzimani, 2018; Dias-Trindade et al., 2021; Figueira & Dorotea, 2022). Thus, we decided to include it in the review of available tools for assessing digital competence of teachers. Another study (Lucas et al., 2021b) has developed a self-assessment tool based on the DigCompEdu framework to measure teachers' digital competence. This tool has strong validity and reliability, but it has developed mainly to be used for research purposes. The study of Tzafilkou, Perifanou and Economides (2023) has developed, likewise, a scale that is based on DigCompEdu and expands further into the school and innovation areas. This scale is composed of 20 items and six components: 1) Teaching preparation, 2) Teaching delivery and students' support, 3) Teaching evaluation and revision, 4) Professional development, 5) School's development and 6) Innovating education.

More instruments exist based on the DigCompEdu that focus on different audiences. There is one self-assessment tool for pre-service teachers, COMDID-A (Usart et al., 2020c), which measures student perceptions of their own competences divided into four factors and across four proficiency levels. The instrument consists of 22 items on a Likert scale (1. Very Low to 10. Very High). A promising self-assessment regarding students' socioemotional e-competencies (Cebollero-Salinas, Cano-Escoriaza & Orejudo, 2022) is a questionnaire that evaluates socioemotional e-competencies in an online environment in the format of self-report that can also be used as a tool for evaluating socioemotional learning programs. It consists of

25 elements, to which participants respond on an 11-point Likert scale ranging from 0 (totally disagree) to 10 (totally agree). The questionnaire has five subscales: emotional e-awareness, emotional e-regulation, e-self-control of impulsiveness, emotional e-independence and social e-competency." The socioemotional e-competencies framework and questionnaire focuses on adolescents; however, it can be adapted to teachers, and the authors suggest it be tested in other age groups and populations.

In conclusion, many tools have been developed throughout the years and are still in the development process today. Here we reviewed the current assessment tools that are used more frequently for teachers, and we have also mentioned other tools that focus on pre-service teachers and students. By examining the types and categories of assessment, as well as the purpose and focus of assessment, we can gain valuable insights into evaluating teachers' digital skills. Throughout our exploration, we have identified and highlighted the most validated assessment tools within each category. These tools offer educators and stakeholders a comprehensive set of resources to effectively measure and enhance digital competencies among teachers. As the landscape of education continues to evolve in the digital era, employing robust and reliable assessment methods becomes crucial in promoting and sustaining the growth of teachers' digital competence, ultimately benefiting students and preparing them for the challenges of the digital world.

2.7 Good practices from rural education

Across the world, half the population lives in urban areas and the other half in rural areas, according to UN data (2018). In the European Union, half of the territory is considered a rural region (Eurostat, 2015). In the educational context, there are substantial differences between urban and rural geographic areas, regarding infrastructure quality, the opportunities for professional development and the constant demographic changes (Gámez & Fernández, 2022). Small rural schools in numerous countries have traditionally been considered less attractive than larger urban schools for teachers. They often receive less favorable treatment in terms of policy support and are at risk of closure or consolidation. In Europe, these schools have been the subject of various research investigations and have been classified based on factors such as student enrollment, geographical isolation, or a small number of staff members. In contrast to the prevailing European policy trends and their impact on the cultural, socioeconomic, and educational landscape, there are individuals who advocate for small rural schools. These proponents emphasize the potential of these schools to contribute to

educational quality, foster community involvement, promote social cohesion, and facilitate lasting positive digital transformations.

There are contradictory findings to whether rural school teachers experience higher or lower levels of technostress compared to their urban counterparts. Across most European countries, rural schools have limited resources and report higher levels of teachers' technostress compared to urban schools (Wu et al., 2022). As a consequence rural teachers with higher technostress may be less likely to be innovative when using digital technologies or adopting technology in teaching at all. Some studies found that teachers in Malaysia experience similar levels of technostress in both urban and rural schools (Wahab, Mahat, Razali, Daud & Baharudin, 2022). Estrada-Muñoz et al. (2021) support that working in schools, especially in urban areas, is related to greater stress and burnout in teachers. On the other hand, Răducu and Stănculescu (2022) support that teachers in rural educational environments were at high moderate risk of burnout compared to those teaching in urban environments. It is noticeable that the experience of technostress can vary among teachers in rural and urban schools, and it's challenging to make a definitive statement that one group experiences less or more technostress than the other.

On this aspect, there are many good practices and lessons that we can learn from rural schools. A main factor for eliminating teachers' technostress is through professional development. Initiatives that promote good practices for online teaching, creative use of digital tools, so as to enhance teachers' digital competencies and confidence in using ICT impactfully and positively. In regard to the professional development of teachers, many actions have taken place in rural schools around Europe in order to address the gap between the rapid development of digital technology and education and balance the technostress that has been rising especially during and after Covid-19. Such actions include peer support groups that promote knowledge exchange between teachers on the use of digital tools, creating supportive school environments to accommodate needs-based professional development and enhancing teachers' digital competences.

To illustrate this, one good practice from a network of rural schools in Europe decided to promote peer learning actions for digital professional development. During this initiative, school teachers presented digital tools to their colleagues and also invited other peers to attend and reflect on each other's teaching style and to provide support and guidance, so that they can utilize digital technologies in their own teaching. Some of the tools that were used are Kahoot, Wordwall, Plickers, etc. Through this initiative of peer learning groups, teachers had the opportunity to develop their digital competence on utilizing online tools and the available

equipment. The dynamic of collaborative learning also enhanced their experience in maximizing the use of digital tools in their teaching and strengthened the communication of teachers through sharing experiences and knowledge. Moreover, students showed greater interest during the classes where teachers utilized those tools, reflecting the positive outcome of this initiative.

Another good example comes from a rural school in Europe that introduced Google services for school's communication purposes. By introducing Google services, such as google classroom, google forms, google docs, google sheets, google slides and google drive to the school staff, teachers were able to share material in an effective way. The school decided to share information, agendas and ready-made layouts to a school's common Drive, as a way of communicating the necessary information to all parties. Moreover, the teachers were supported in creating and using the same assessment tools, sharing educational material, creating templates, questionnaires and tests for pupils. In order to support the teachers the school utilized external projects for training the teachers in using these tools. Another action for support that was implemented in the school was the provision of technical support in the class when students were using a new technology by a well-trained co-teacher. Additionally, older students provided help to younger students regarding the use of certain digital tools. With these actions, the whole school staff was kept informed in a timely manner for the school updates and it was easier to share materials and find important information for the teachers too.

In addition, a network of rural schools in Europe together with other education stakeholders built an online platform where they provide online asynchronous lessons on a variety of topics regarding open education. One of their lessons was about open online education resources, and how to create them. With this initiative rural teachers have the opportunity to expand their knowledge of online education, empower themselves, and build networks of support. The courses are short, clear and easy to follow which makes them suitable for the busy everyday life of a teacher. In this way, we can notice the positive use of technology as a means of learning and support that fosters the idea of positive and open education and as researchers highlight, the cultivation of online pedagogy can help teachers to mitigate their technostress and improve their capacity (Chou & Chou, 2021).

In conclusion, the exploration of good practices in rural education, particularly in the realm of digital professional development initiatives, reveals the potential for transformative change and the power of innovative approaches for handling technostress and fostering wellbeing at work. Digital professional development initiatives play a vital role in equipping teachers with the necessary skills and knowledge to thrive in the digital age and successfully mitigate the

negative effects of technostress. By providing tailored training programs, fostering collaborative learning communities, and ensuring access to resources, these initiatives empower educators to effectively integrate technology into their teaching practices in a sustainable way. The benefits extend beyond the classroom, as enhanced digital competence among teachers leads to increased student engagement, improved learning outcomes, and the cultivation of crucial 21st-century skills. Through these combined efforts, rural schools are paving the way for a future where technology seamlessly enhances education, bridging the gap between rural and urban learning environments and preparing students for success in an increasingly digital world.

2.8 Emerging technologies: AIED

Emerging technologies, such as artificial intelligence (AI), machine learning (ML), mobile technologies, robotics, internet of things, cloud computing, big data analytics, etc., are transforming education ecosystems by transforming the way learning is delivered, accessed and experienced (OECD, 2020). The emerging educational paradigm is characterised by disruptive technologies, processes and practices that question the basic assumptions of traditional education. Education is increasingly enabled, supported and guided by technologies. Smart EdTech is making learning more interactive, inclusive, and data-driven. Adaptive learning technologies such as intelligent tutoring systems enable the personalisation of students' learning, detecting the knowledge (or knowledge gaps) of students and diagnosing and recommending the next appropriate steps for students' learning [5]. New EdTech solutions focus on measuring engagement and interventions to keep students engaged, both in digital and physical learning environments.

Coupled with current educational reforms such as PLEs, the digitization of educational resources, educational data mining (EDM) and learning analytics, natural language processing, speech and gesture recognition, eye-tracking, and other physiological sensors, etc., AI is increasingly being promoted as a strategic value for education (Luckin & Holmes; 2016; Zhai et al., 2021). Artificial Intelligence in Education (**AIED**) is described as the use of AI technologies or application programs in educational settings to facilitate teaching, learning, or decision making (Chassignol et al., 2018; Hwang et al., 2020). AIED brings together AI and the learning sciences (education, psychology, neuroscience, linguistics, sociology, and anthropology) to promote the development of adaptive learning environments and other AIED tools that are flexible, inclusive, personalised, engaging,and effective. Using AI technologies that simulate

human intelligence to make inferences, judgments, or predictions (e.g. natural language processing, artificial neural networks, machine learning, deep learning, genetic algorithms etc) intelligent learning environments can be built to provide personalized guidance, support, or feedback to students and assist teachers or policymakers in decision-making (Hwang et al., 2020; Akgun & Greenhow, 2022). Smart EdTech solutions include behavior detection, automated assessments, facial recognition systems, chatbots (social media sites), and predictive analytics, learning recommendations, etc., powered by machine-learning systems and algorithms. Chassignol et al. (2018) noted changes in the educational landscape in four areas: customized content, innovative teaching methods, technology enhanced assessment, and communication between student and lecturer. Nguyen et al. (2023) added that AIED is an influential tool to enable new paradigms of teaching, technological advancements, and innovations in educational research that are considered unfeasible in traditional classroom environments. (Ouyang & Jiao, 2021) identified three paradigms for AIED AI-directed, AI-supported, and AI-empowered, describing the learner's role as recipient, collaborator and leader in AI-enabled education respectively. In the first paradigm the learner is the recipient of direct cognitive learning, in the second they are collaborating with AI, while in the third paradigm AI is used to empower learning and learners take agency. Similarly, Hwang et al. [19] identified four roles of AI in education, namely serving as an intelligent tutor, tutee, learning tool/partner, or policy-making advisor.

Varsik and Vosberg (2024) categorised AIED solutions into: (a) learner-centered AI tools (e.g. intelligent tutoring systems, AI-enabled simulations, etc.) designed to enable adaptive learning and provide support in areas where students may struggle, so as to improve students' learning experiences and learning outcomes; (b) teacher-led AI tools, designed to assist teachers in their instructional and administrative roles, to enhance teaching efficiency and effectiveness; and (c) other institutional tools designed to address broader institutional objectives, such as improving operational efficiency and managing admissions. Luckin and Holmes [16] predicted that in the future, AIED will increasingly draw on our physical environment and our physical being, making them an integral part of the learning process. It will connect to the Internet of Things and be tuned to how we feel and how we move.

Generative AI (GenAI) is a subset of AI that has gained significant attention in recent years. Generative AI refers to algorithms, such as GPT-4 and DALL·E, that can produce new content, such as text, images, or even music, based on input data. Generative AI applications (e.g. ChatGPT) are quickly becoming a transformative innovation affecting pedagogy and teaching practice. Although the debate has already begun, it is still unclear how generative AI tools can

best fit into educational pedagogies. While some educators view it as a progressive step that can boost students' self-efficacy and motivation to learn, others raise concerns, pointing out that it may promote misbehaviour, restricted analytical skills, and superficial learning [24] [25] [26]. Generative AI also raises ethical concerns regarding issues such as bias and privacy, originality and plagiarism, etc., highlighting the importance of digital literacy and regulation [27]. Overall, it is important to keep the limitations of generative AI in mind when using it and not to rely on it blindly (Rahman & Watanobe, 2023). Educators need to “model responsible use of ChatGPT, prioritise critical thinking, and be clear about expectations” [29]. To achieve this, teachers need appropriate professional development opportunities to equip educators with the necessary skills and knowledge about the capabilities and uses of Generative AI in education, as well as best practices for incorporating this technology into their teaching practice (Kasneci et al., 2023; Mogavi et al., 2023).

While EdTech offers new learning opportunities, it can also overwhelm educators and students who often struggle to keep up with the rapid pace of change. Technostress refers to the stress and anxiety individuals experience due to the use of new technologies. In education, particularly with the rise of AIED, technostress can affect both teachers and students as they adapt to AI-driven tools and platforms. Technostress can arise from a variety of sources, such as: difficulty of adapting to new digital platforms and tools, information overload, technical problems and feelings of isolation. This can lead to decreased motivation, burnout, and negative impacts on mental and emotional well-being, and negatively impact learning outcomes and performance. The constant need to learn new systems, manage digital overload, and stay updated with technological advancements can lead to feelings of frustration, fatigue, and burnout.

According to UNESCO (2021), artificial intelligence in education has brought up various challenges for teachers, students and the future of education itself. There are many voices on whether we need to focus on the opportunities that AI can bring to education or on the challenges that arise. To begin with, some of the most prominent people of the tech industry have raised awareness of the dangers of AI’s rapid development which has outpaced policy debates and regulatory frameworks. From the one hand, by leveraging machine learning algorithms, natural language processing and data analytics, AI can adapt educational content to individual students, provide real-time feedback, and assist educators in making data-driven decisions. From the educational point of view there are many knowledge gaps and unclear

points on whether AI models such as ChatGPT are suitable as they are for teaching and learning purposes for a variety of reasons (Kasneci et al., 2023).

To start with, the ethical implications of AI in education are a primary concern that cause more technostress on teachers. Issues such as algorithmic transparency, accountability, and the potential for bias in many contexts need careful attention. In the latest report of UNESCO (2023) it is mentioned that AI models, and technology in general, is not ideologically neutral and might provide authoritative responses, deriving from unfiltered human-produced data. AI systems do not have clear ethical guidelines which can jeopardize fairness, gender equality, inclusivity, and may have harmful consequences for students and people of specific racial or ethnic groups. Similarly, due to the already existing gender gap in the field of technology it is important to consider the possible lack of gender diversity (Otero et al., 2023). In order to ensure ethical equity in the use of AI in education we must advocate for multidisciplinary evidence-based research that will be regularly updated to keep up with the pace of the development on the field (Humble & Mozelius, 2022).

Moreover, AI relies heavily on data collection and analysis, raising concerns about privacy and security. AI systems have the ability to gather data, including students' and teachers' sensitive information, personal data and academic records which if compromised can lead to judgment, bias or even discrimination (Akgun & Greenhow, 2021). Those systems can also be used for surveillance of students' progress or teacher accountability that might lead to controlling behaviors. Questions arise whether students and teachers will be feeling safe to share their thoughts if they know that they are constantly being monitored. Educational institutions must ensure the development of robust data protection policies, inform students and parents and all stakeholders about how data is being collected, their usage, and who has access to it and implement measures to safeguard sensitive information. Clear guidelines and regulations are required to address the potential risks of AI-generated insights and possible data breaches.

Another great challenge that is raising teachers' concerns is the teacher-student relationship. Teachers would need to inform students of AI's pitfalls and maintain a trustful relationship with their students. Integrating AI into education raises many questions about the impact on the teacher-student relationship. While AI can provide valuable support, it must not replace human interaction and the vital role of educators. Maintaining a balance between technology and human involvement is crucial to ensure a holistic and personalized learning experience. While large language models can generate multiple-choice questions, produce text from bullet points, and scaffold learning, it is clear that as for now, they can only serve as assistive tools to human learners and educators and cannot or should not replace the teacher. Even as assisting tools

it is necessary to mention that AI algorithms are not reliable enough yet to provide useful information to teachers. More questions arise if AI models can be used for student assessment procedures (Tahiru, 2021). Would those be fair, or prone to bias and misinformation?

When it comes to students' critical thinking, there are more scenarios that raise concerns. Over-reliance on AI, can have a negative effect on students' development of critical thinking and/or creativity (Kasneci et al., 2023). The easiness of ready-made answers that those models generate can hinder students cognitive development and impact learning (Otero et al., 2023). The same applies on the other way, as students have not yet developed the critical thinking to be able to assess the information provided by AI, causing misconceptions or distorted knowledge, especially if they use AI unsupervised. In the long term this could affect students' autonomy to make decisions for their life and jeopardize their agency (Akgun & Greenhow, 2021).

One of the most central skills that are being developed through human interaction, social skills could be compromised too because of AI in education. Students learn through social interactions from a young age to work in groups, collaborate, manage conflicts and communicate in effective ways at school. If AI use in education is not limited it might hinder those social skills as well. Already the younger generations are struggling with social interaction because of the invasion of technology and the extensive use of social media. This can be expanded even further with tremendous consequences on students' emotional intelligence and other essential skills such as empathy and active listening, since they do not provide the same social and emotional presence as face-to-face interactions do (Pietikäinen, 2021).

Moreover, some more challenges could arise if AI intrudes education and teaching (Celik, Dindar, Muukkonen & Järvelä, 2022). To begin with, teachers may perceive AI as uninteresting and unenjoyable to use in teaching and experience a general lack of interest (McCarthy et al., 2016). In addition to the lack of interest, the lack of knowledge to use AI (both pedagogical and content knowledge) as to learn how to implement suitable pedagogies and technological knowledge related to AI (Ng, Leung, Su, Ng & Chu, 2023), might be an inhibitory factor for teachers to use AI at all (Chiu & Chai, 2020). These factors can be reinforced with the general absence of trust towards AI and the ambiguity that is surrounding it. Since the teaching profession is already overwhelmed by the presence of technology leading to teachers' technostress, AI for education should be used in a supportive manner to enhance the teaching experience and empower teachers and to not be an additional strain.

In conclusion, addressing the challenges associated with AI inclusion in education is crucial to ensure ethical use, data privacy, and fairness. Collaboration between researchers, educators,

policymakers, and technology developers is fundamental in order to develop guidelines, regulations, and best practices that promote responsible and effective use of AI in educational settings. In this section we have reviewed some of the main challenges and concerns about the use of AI in education, however they are not limited to the aforementioned as the pace in which AI is developing is exceeding the reflection practices and needs constant reevaluation.

3 METHODOLOGY OF COMPETENCE DEVELOPMENT

In this chapter we present an overview about the applied methodology for the development of the competence framework that we utilized. We are going to analyze the methodology with which we gathered the competencies from the frameworks and identified the conceptual gap. Moreover, the analytical process will be presented for the development of the missing competence based on the DigComp frameworks (Edu & 2.2). Finally, the conceptual framework of new competence will be presented.

3.1 The process

There are a variety of possible methods for the development of competence frameworks and in this work we utilized the following. As a first step, we did a literature review of the digital competence frameworks such as the DigComp framework, the TPACK, the PfDK, the ISTE framework for educators and the DigCompEdu. Among these frameworks the common aspects were that of technical digital knowledge that a teacher needs in a digital education environment. The most complete framework from the point of view of digital progress is the DigComp 2.2 framework and from the educational perspective that of DigCompEdu. However, neither of those prominent frameworks provides an inclusive insight into the competencies for digital wellbeing. Following inductive reasoning in our methodology for theoretical framework development we first categorized the competencies of each framework in our focus topic. In the following table (Table 3), we have gathered the information for the competencies that are in the digital wellbeing realm.

Table 3. Wellbeing in DigComp frameworks

Framework	Competence area	Competence	Description
DigCompEdu	Facilitating learner's digital competence	Responsible use	To take measures to ensure learners' physical, psychological and social wellbeing while using digital technologies. To empower learners to manage risks and use digital technologies safely and responsibly.
DigComp 2.2	Communication and collaboration	Netiquette	To be aware of behavioral norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.

Framework	Competence area	Competence	Description
	Safety	Protecting health and wellbeing	To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies

The described competencies have an analytical structure and include the knowledge, skills and attitudes that are not mentioned in the table, however, they are not complete. The aforementioned review has led to the identification of competencies that have been absent in the main digital competence frameworks. As a second step of the framework development we identified a guiding theory and followed from the analysis of the literature beyond frameworks, we identified a study on the socioemotional e-competencies (Cebollero-Salinas et al., 2022) that we used as a guide for the missing competencies. In addition to this study, the theories of emotional intelligence, emotional ecology, social media competence and technostress studies were taken into account. The main digital wellbeing aspects of each theory and framework were thematically categorized and are presented in the Figure 1 below.

Figure 1. Competence mind map

3.2 The proposed theoretical framework

Furthermore, we examined the common thematic areas of each concept in order to avoid overlapping constructs in the theoretical framework. The grouping of the related competencies was structured based on the model of socioemotional e-competencies (Cebollero-Salinas et al., 2022) and was further elaborated from the other related theories that are included in the mindmap. As the final step in our development methodology, we created a design for the proposed theoretical framework, which is presented below (Figure 2). This design served as the foundation for the initial version of the competency framework. After this, we revisited and reviewed the model, incorporating feedback from the project's validation activities (early and large-scale pilots), the Learning, Teaching, and Training (LTT) Activity, and emerging results from academic research, as shown in Figures 3 & 4. These new findings support and confirm the original concepts.

Based on this framework we support the theory that is further described in the following chapter.

Figure 2. Theoretical framework design

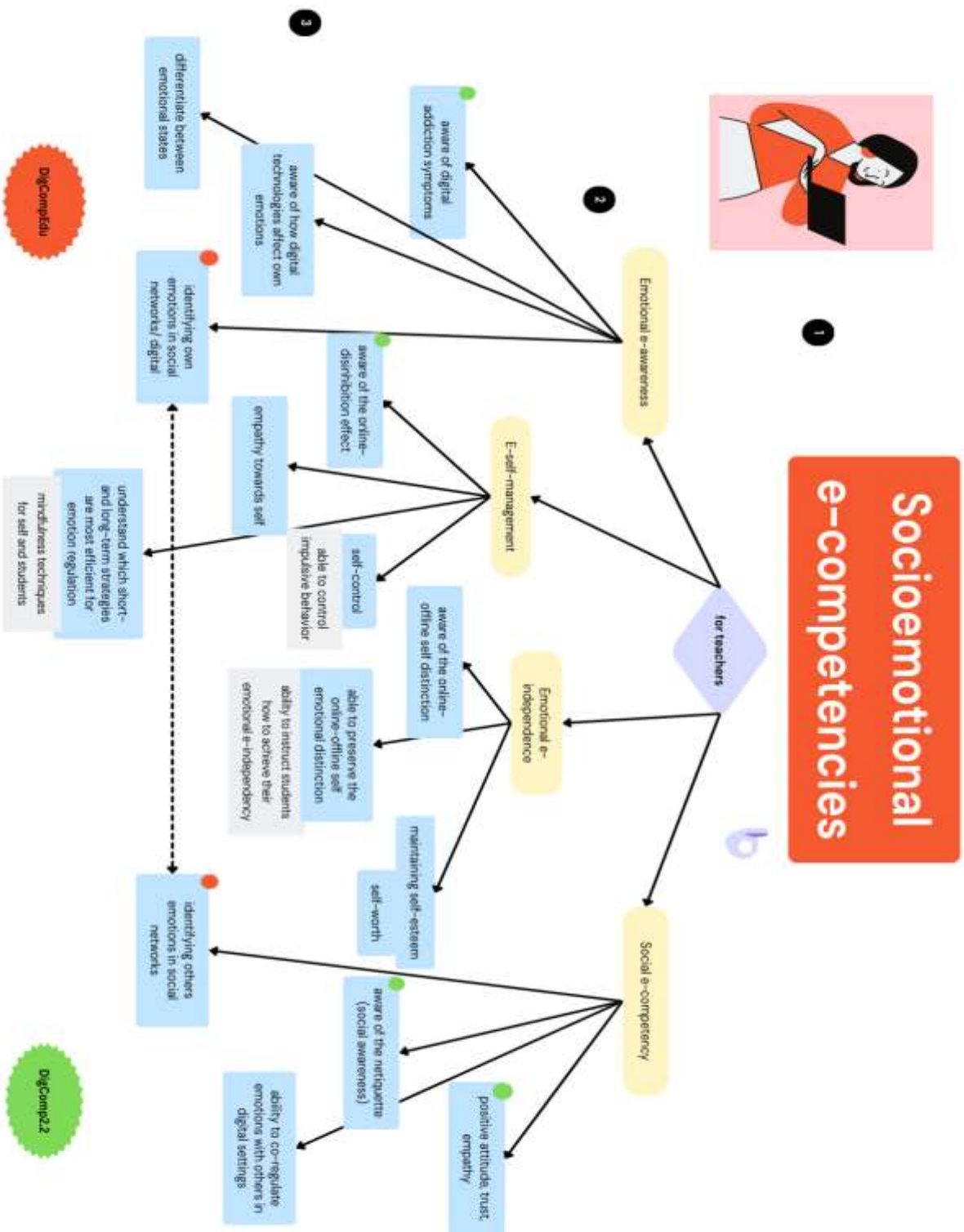
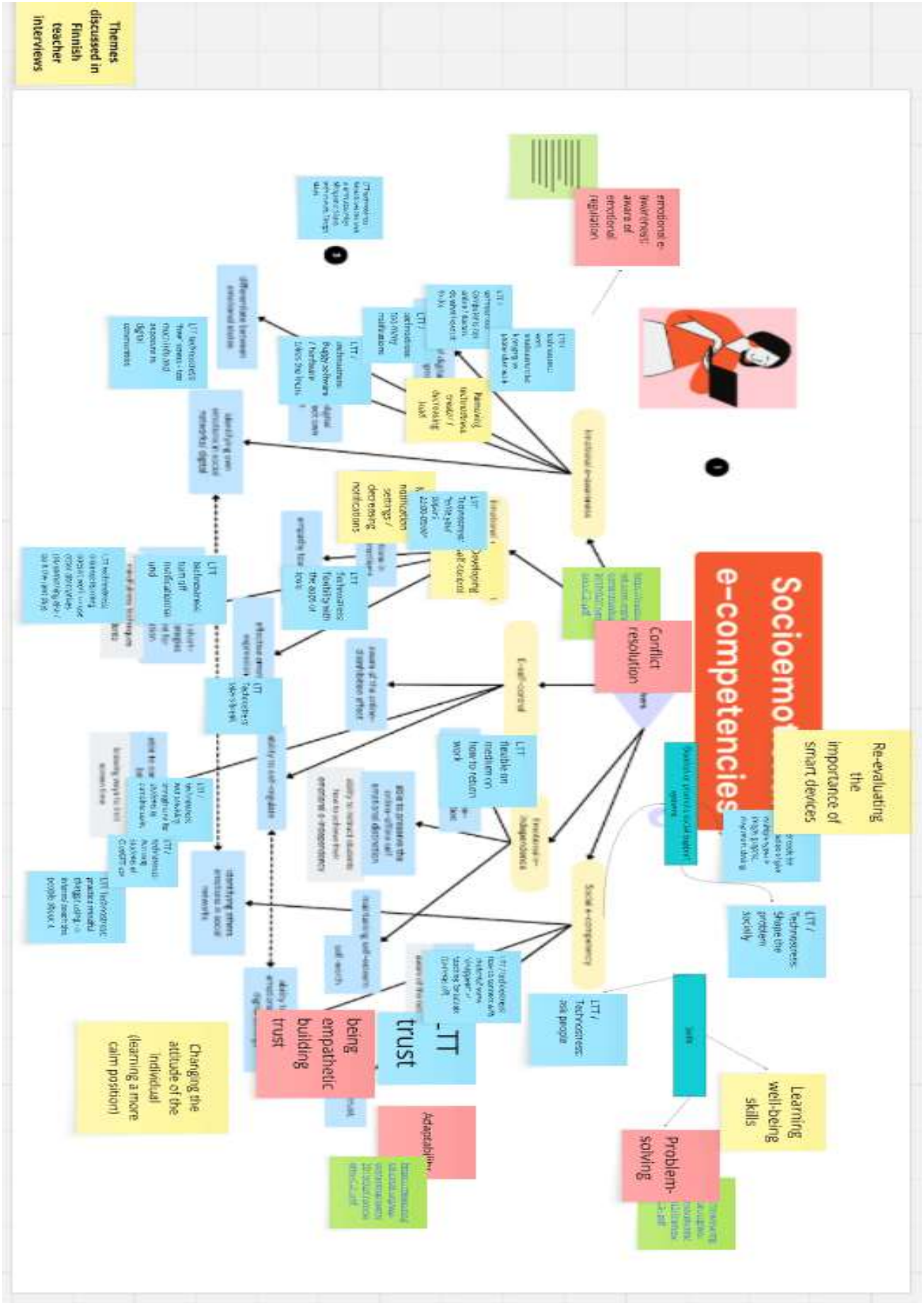


Figure 3. Theoretical framework revision



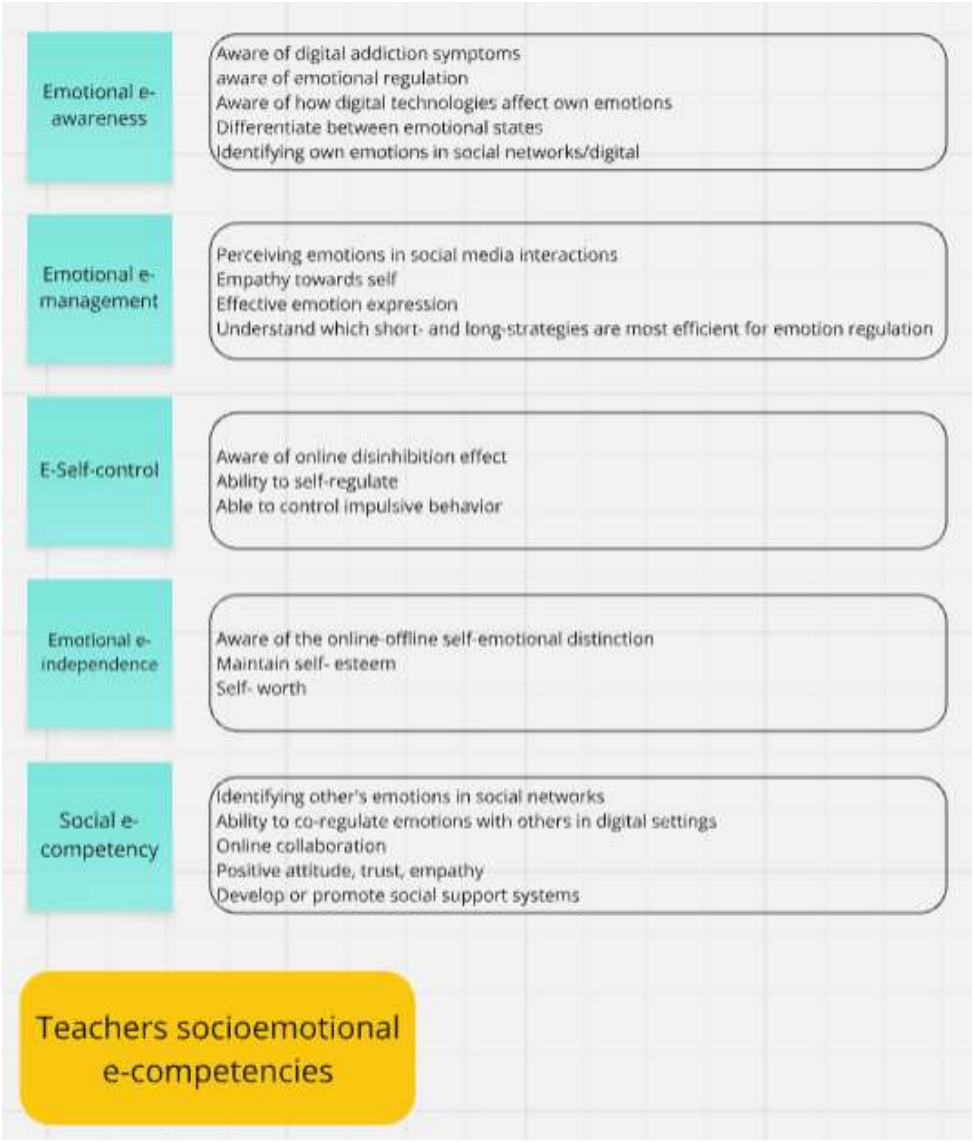


Figure 4. Teachers' socioemotional e-competencies

4. RESULTS

In the following chapter, we present the main findings and developments of the conceptual mapping of digital competences of teachers regarding socioemotional competence. We start by analyzing the proposed design that will lead this project and the possible ways to assess these competencies. In the last section, we will review the piloting of the competencies in the context of rural schools across the European Union.

4.1 The design: Teachers' socioemotional e-competencies

Based on the initial review, we compared and harmonized the pre-existing digital competence frameworks and related research leading the educational research and practice. Our proposed competence was mapped to other frameworks with a focus on digital wellbeing. The conceptual framework of the competence is presented in the figure below (Figure 5).

Figure 5. Teachers' socioemotional e-competencies framework

The conceptual framework is based on the study of Cebollero-Salinas et al. (2022), which is that of socioemotional e-competencies, defined as the competences that are needed in digital environments in the social and emotional spectrum. Adapted for the educational context and focusing on teachers, the theoretical framework consists of the following four competencies: emotional e-awareness, e-self-management, emotional e-independence, and social e-competency. We purposefully merged two of the competencies from the initial theoretical model

to comply with the emotional intelligence theory (Mayer & Salovey, 2005) and the Social and Emotional Inventory (ESCI; Boyatzis, 2007). Specifically, the competency of emotion e-regulation and the competency of e-self-control Cebollero-Salinas et al. (2022) was transformed into e-self-management to be inline with the existing theories and frameworks. To define each competency we combined the proposed definitions from the literature review. More analytically, we developed examples of knowledge, skills, and attitudes that each competence constitutes and are presented in the table below.

Table 3. Socioemotional e-competencies examples

Emotional e-awareness	
Knowledge	Aware of digital addiction symptoms
	Aware of how digital technologies affect own emotions
	Knowing how to recognize embedded user experience techniques designed to manipulate and/or to weaken one's ability to be in control of decisions
Skills	Able to differentiate between emotional states
	Can identify own emotions in social networks/ digital environments
Attitudes	Being attentive on own emotions
	A tendency to be introspective
E-self-management	
Knowledge	Aware of the online disinhibition effect
	Aware of the online possibilities to strengthen self-control
	Aware that search engines, social media and content platforms often use AI algorithms to generate responses that are adapted to the individual user
Skills	Understand which strategies are most efficient for emotional regulation

	Having self-control
	Able to use digital tools mindfully
Attitudes	Empathetic towards self
	Inclined to focus on positive impact and avoiding the negative impact of digital media
	Intentionally avoiding distractions
	Aiming to avoid information overload
Emotional e-independence	
Knowledge	Aware of the online-offline self-distinction
Skills	Able to preserve the online-offline self-distinction
	Able to maintain self-esteem, self-worth
Attitudes	Having strong self-esteem
	Inherent independent self-worth
Social e-competency	
Knowledge	Aware of the netiquette for online collaboration
	Knowing how to adopt communication practices to maintain a positive online identity
	Knowing how to apply the netiquette in digital interactions
Skills	Able to identify other's emotions in social networks
	Able to co-regulate emotions with others in digital settings
Attitudes	Positive attitude, trusting, empathetic

	Willing to help others/students to improve their digital competence
	Having a respectful stance towards others
Emotional leadership/ e-mediacy	
Knowledge	*Empathetic towards students*
Skills	*Ability to support student empowerment online* *Ability to promote student's e-awareness and e-self management* *Ability to emotionally comfort and support students confronted with stress*
Attitudes	*Positive reinforcement* *Positive handling of problematic situations in the digital classrooms*

4.1.1 Emotional e-awareness

Emotional e-awareness includes the skills of being aware of one's emotions that arise in social media or online settings, for example while seeing a video or having an online lesson. A prerequisite for developing emotional e-awareness is to have a sufficient level of self-awareness in regards to one's own emotions. This includes the knowledge, skills and attitudes that are included on the aforementioned table. This competence belongs to the intrapersonal competencies and it is one of the main competencies in the emotional intelligence theories but expands the term into the digital realm.

Teachers that have developed emotional e-awareness are more tuned to their inner self and in touch with their emotions. An important element of this competence is the knowledge for both the emotions in oneself and the knowledge of how social media algorithms use this to manipulate emotion in order to achieve a specific outcome, most commonly for consumerism. An emotional e-aware teacher understands this emotional process and will not fall easily into this trap, and the more developed this competence is the better the individual can then later manage their emotions and to promote or teach this awareness to students.

4.1.2 E-self-management

E-self-management is the capacity to generate appropriate responses and exercise self-control. This competence is connected to the technostress management but not limited. The knowledge and implementation of effective emotion regulation techniques is of central importance for this competence. When referring to emotion regulation strategies the full range of strategies is necessary such as downregulating (e.g., decreasing technostress), upregulating (e.g., increasing optimism), and maintaining an emotion (e.g., accepting sadness). At the same level of importance is the understanding of the online disinhibition effect, in which the individual does not feel the same constraint in online interactions as in face-to-face. This can lead to inappropriate behaviors and online flaming.

Teachers that have developed their e-self-management competence can understand this process, are able to exercise self-control and produce effective responses. Moreover, from the positive psychology and emotional intelligence theories, individuals that have effective self-management are empathetic towards themselves, avoiding negative self-criticism and keeping a positive attitude. Similarly, they are capable of maintaining their focus on online settings by avoiding distractions and information overload.

4.1.3 Emotional e-independence

Emotional e-independence means being emotionally strong, not depending emotionally on social media or the digital device, for example: not being affected if people do not like a post. It entails not being overly affected by the responses or validation received through online platforms, such as not being bothered if a post doesn't receive a high number of likes or positive feedback. This competency is closely linked to identity negotiation in the digital realm. In the context of identity negotiation, emotional e-independence plays a crucial role. It enables individuals to develop a strong sense of self and maintain a healthy emotional well-being despite the dynamics of online interactions. By not overly depending on external validation or the opinions of others on social media, individuals can establish a more authentic and self-assured digital presence. Emotional e-independence allows individuals to navigate the digital landscape with confidence, recognizing that their self-worth and emotional state are not solely determined by the responses or reactions they receive online. It empowers individuals to develop a balanced relationship with technology, prioritizing their emotional well-being and maintaining a sense of agency over their own identities in the digital realm.

4.1.4 Social e-competency

Social e-competency is to maintain good relationships in a virtual environment, have pro-social behavior, acknowledging others' emotions and keeping the same values as in face-to-face interactions. An integral part of social e-competency is expressing emotions in appropriate ways. Expressing emotion refers to knowing when and how to show one's emotional experience taking into account one's social context, which in this case is taking place in the digital world. Unspoken rules about how to display feelings vary across contexts and can be culturally specific in the outside world, and the same could apply to the digital.

However, there is a commonly accepted netiquette regarding online interactions. Netiquette is a term used to refer to the unofficial online norms that promote good behavior on the Internet based on respect and polite behavior on the digital media, such as social media platforms, online chatting sites, and other online websites. A tangible example of netiquette is to avoid typing in all caps in emails because it is considered to be the equivalent of shouting or yelling even if there is no such intention which can easily be misinterpreted.

Teachers that have developed social e-competency are able to successfully apply this knowledge into practice, have suitable communications skills for online interactions and choose the appropriate conflict management strategy. Their willingness to support others and offer help when needed is expanded to their students. Teachers are proactive in showing empathy to students during online lessons, or when they interact with technology and need support. They are also able to effectively co-regulate emotions in online settings with students, parents and colleagues.

4.1.5 Emotional leadership/ e-mediacy

Emotional leadership/ e-mediacy, involves leveraging a profound sense of empathy towards students in the digital learning landscape. It involves the skills to not only support students' online empowerment, helping them navigate the digital landscape with confidence, but also to promote their e-awareness and e-self management, enabling them to make informed choices and effectively manage their online presence. Additionally, emotional leadership in this context entails the ability to emotionally comfort and support students when they are confronted with stress, offering a reassuring presence in the often challenging world of digital education.

This approach is underpinned by attitudes (a) positive reinforcement, nurturing students' motivation and self-esteem, and (b) constructive handling of problematic situations that may arise in digital classrooms, ensuring a positive and supportive learning environment that promotes students' holistic well-being and development.

REFERENCES

1. Akgun, S., & Greenhow, C. (2021). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. AI And Ethics, 2(3), 431-440. https://doi.org/10.1007/s43681-021-00096-7
2. Ala-Mutka, K. (2011). Mapping digital competence: Towards a conceptual understanding. Sevilla: Institute for Prospective Technological Studies, DOI:10.13140/RG.2.2.18046.00322
3. Alarcón, R., Del Pilar Jiménez, E., & De Vicente-Yague, M. I. (2020). Development and validation of the DIGIGLO, a tool for assessing the digital competence of educators. British Journal of Educational Technology, 51(6), 2407-2421. https://doi.org/10.1111/bjet.12919
4. Area Moreira, M. (2015). La Alfabetización Digital y la Formación de la Ciudadanía del Siglo XXI. Revista Integra Educativa, 7, 3. http://www.scielo.org.bo/scielo.php?script=sci_arttext&pid=S1997-40432014000300002
5. Benali, M., Kaddouri, M., & Azzimani, T. (2018). Digital competence of Moroccan teachers of English. International Journal of Education and Development using Information and Communication Technology (IJEDICT), 14(2), 99-120. https://www.learntechlib.org/p/184691/
6. Boyatzis, R.E. (2007). The creation of the emotional and social competency inventory (ESCI). Hay Group research report. https://www.eiconsortium.org/pdf/ESCI_user_guide.pdf
7. Brockmann, M., Clarke, L., & Winch, C. (2009). Competence and competency in the EQF and in European VET systems. Journal of European Industrial Training, 33(8/9), 787-799.
8. Buckingham, D. (2015). Defining digital literacy-What do young people need to know about digital media?. Nordic journal of digital literacy, 10(Jubileumsnummer), 21-35.
9. Burns, E. & Kolho, P. (2022). Digital and social-emotional competences needed in the teaching profession. HAMK Unlimited Journal, https://unlimited.hamk.fi/ammatillinen-osaaminen-ja-opetus/digital-and-social-emotional-competences-needed-in-the-teaching-profession/#.ZGYpnnZByUk

10. Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The digital competence framework for citizens. (No. JRC106281) Publications Office of the European Union, Luxembourg. ISBN 978-92-79-68006-9. https://data.europa.eu/doi/10.2760/38842
11. Carter M. & Grover V. (2015) Me, myself, and I (T): Conceptualizing information technology identity and its implications. MIS Quarterly. 39, 931-957.
12. Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. Procedia computer science, 136, 16-24.
13. Cebollero-Salinas, A., Cano-Escoriaza, J., & Hernández, S. O. (2022). Social Networks, Emotions, and Education: Design and Validation of e-COM, a Scale of Socio-Emotional Interaction Competencies among Adolescents. Sustainability, 14(5), 2566. https://doi.org/10.3390/su14052566
14. Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The Promises and Challenges of Artificial Intelligence for Teachers: a Systematic Review of Research. TechTrends, 66(4), 616-630. https://doi.org/10.1007/s11528-022-00715-y
15. Cervera, M. G., & Caena, F. (2022). Teachers' digital competence for global teacher education. European Journal of Teacher Education, 45(4), 451–455. https://doi.org/10.1080/02619768.2022.2135855
16. Chou, H., & Chou, C. (2021). A multigroup analysis of factors underlying teachers' technostress and their continuance intention toward online teaching. Computers & Education, 175, 104335. https://doi.org/10.1016/j.compedu.2021.104335
17. Collie, R. J. (2020). The development of social and emotional competence at school: An integrated model. International Journal of Behavioral Development, 44(1), 76–87. https://doi.org/10.1177/0165025419851864
18. Council of Europe (2020). Common European framework of reference for languages: Learning, teaching, assessment – Companion volume. Strasbourg: Council of Europe Publishing.
19. Dias-Trindade, S., Moreira, J. C. F., & Ferreira, A. (2021). Evaluation of the teachers' digital competences in primary and secondary education in Portugal with DigCompEdu CheckIn in pandemic times. Acta Scientiarum-technology, 43, e56383. https://doi.org/10.4025/actascitechnol.v43i1.56383
20. E. Kasneci, K. Seßler, S. Küchemann, M. Bannert, D. Dementieva, F. Fischer ... and G. Kasneci. "ChatGPT for good? On opportunities and challenges of large language models for education". Learning and Individual Differences, 103, 102274.2023

21. European Parliament and the Council (2017): Council recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning, p. 15, CELEX: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017H0615(01)
22. European Parliament and the Council (2018): COUNCIL RECOMMENDATION of 22 May 2018 on key competences for lifelong learning, CELEX: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604(01)
23. Eurostat. (2015). Statistics on rural areas in the EU. https://ec.europa.eu/eurostat/documents/2995521/7020151/3-05102015-BP-EN.pdf/bf18a8b3-998c-476d-b3af-58292b89939b
24. F. Ouyang and P. Jiao. "Artificial intelligence in education: The three paradigms". Computers and Education: Artificial Intelligence, 2, 100020. 2021
25. Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Digital competences for teacher professional development. Systematic review. European Journal of Teacher Education, 45(4), 513-531. https://doi.org/10.1080/02619768.2020.1827389
26. Figueira, L. F. & Dorotea, N. (2022). Competência digital, DigCompEdu Check-In como ferramenta diagnóstica de literacia digital para subsidiar formação de professores. Educação & Formação, 7. https://doi.org/10.25053/redufor.v7.e8332
27. G.J. Hwang, H. Xie, B. W. Wah and D. Gašević. "Vision, challenges, roles and research issues of Artificial Intelligence in Education". Computers and Education: Artificial Intelligence, 1, 100001. 2020
28. Gámez, F., & Fernández, M. J. M. (2022). Measuring Rural Teachers' Digital Competence to Communicate with the Educational Community. Journal of New Approaches in Educational Research, 11(2), 323. https://doi.org/10.7821/naer.2022.7.1053
29. Hadar, L. L., Ergas, O., Alpert, B., & Ariav, T. (2020). Rethinking teacher education in a VUCA world: student teachers' social-emotional competencies during the Covid-19 crisis. European Journal of Teacher Education, 43(4), 573–586. https://doi.org/10.1080/02619768.2020.1807513

30. Humble, N., & Mozelius, P. (2022). The threat, hype, and promise of artificial intelligence in education. Discover Artificial Intelligence, 2(1). https://doi.org/10.1007/s44163-022-00039-z
31. Hutson, E., Kelly, S., & Militello, L. K. (2018). Systematic review of cyberbullying interventions for youth and parents with implications for evidence-based practice. Worldviews on evidence-based nursing, 15(1), 72-79. https://doi.org/10.1111/wvn.12257
32. Jennings, P., Brown, J., Frank, J., Tanler, R., Doyle, S., Rasheed, D., Greenberg, M., (2014). Promoting Teachers' Social and Emotional Competence: A Replication Study of the Cultivating Awareness and Resilience in Education (CARE) Program. (conference session) The Society for Research on Educational Effectiveness (SREE) Conference.
33. Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., . . . Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. Learning and Individual Differences, 103, 102274. https://doi.org/10.1016/j.lindif.2023.102274
34. Kelentrić, M., Helland, K. & Arstorp, A. T. (2017). "Professional Digital Competence Framework for Teachers." The Norwegian Centre for ICT in Education, 1-74 https://edudoc.ch/record/131449/files/pfdk_framework.pdf
35. Kluzer, S., & Priego, L. P. (2018). DigComp into action: get inspired, make it happen. Publications Office of the European Union. JRC Science for Policy Report, EUR 29115 EN. Editors: S. Carretero, Y. Punie, R. Vuorikari, M. Cabrera, & W. O'Keefe. https://doi.org/10.2760/112945
36. Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. In Handbook of technological pedagogical content knowledge (TPCK) for educators (pp. 13-40). Routledge.
37. Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The technological pedagogical content knowledge framework. Handbook of research on educational communications and technology, Fourth Edition (101-111). Springer New York. https://doi.org/10.1007/978-1-4614-3185-5_9
38. Laanpere, M. (2019). Recommendations on Assessment Tools for Monitoring Digital Literacy within UNESCO's Digital Literacy Global Framework. Unesco Institute for Statistics. Information Paper No. 56. UIS/2019/LO/IP/56.

http://uis.unesco.org/sites/default/fles/documents/ip56-recommendations-assessment-tools-digital-literacy-2019-en.pdf

39. Leadbeater C. & Wong A. (2010) Learning from the Extremes. San Jose, Calif.: Cisco.
40. Leonardi, P., & Neeley, T. (2022). The Digital Mindset: What It Really Takes to Thrive in the Age of Data, Algorithms, and AI. Harvard Business Press.
41. Lucas, M., Bem-Haja, P., Siddiq, F., Moreira, A. C., & Redecker, C. (2021b). The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? Computers & Education. 160, 104052. https://doi.org/10.1016/j.compedu.2020.104052
42. M.M. Rahman and Y. Watanobe. "ChatGPT for Education and Research: Opportunities, Threats, and Strategies". Applied Sciences. 2023
43. Martínez-Bravo, M.C., Sádaba Chalezquer, C., Serrano-Puche, J. (2022). Dimensions of Digital Literacy in the 21st Century Competency Frameworks. Sustainability. 14, 1867. https://doi.org/10.3390/su14031867
44. Mattar, J., Ramos, D. K., & Lucas, M. (2022). DigComp-Based Digital competence Assessment Tools: Literature Review and Instrument Analysis. Education and Information Technologies, 27(8), 10843–10867. https://doi.org/10.1007/s10639-022-11034-3
45. Mattar, J., Santos, C. C., & Cuque, L. M. (2022). Analysis and Comparison of International Digital Competence Frameworks for Education. Education Sciences. 12(12), 932. https://doi.org/10.3390/educsci12120932
46. Mayer, J. E., & Salovey, P. (1995). Emotional intelligence and the construction and regulation of feelings. Applied & Preventive Psychology, 4(3), 197–208. https://doi.org/10.1016/s0962-1849(05)80058-7
47. Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). AI and education: Guidance for policy-makers. In UNESCO eBooks. https://doi.org/10.54675/pcsp7350
48. Molero Jurado, M.d.M., Simón Márquez, M.d.M., Martos Martínez, Á., Barragán Martín, A.B., Pérez-Fuentes, M.d.C., Gázquez Linares, J.J. (2022). Qualitative Analysis of Use of ICTs and Necessary Personal Competencies (Self-Efficacy, Creativity and Emotional Intelligence) of Future Teachers: Implications for Education. Sustainability, 14, 12257. https://doi.org/10.3390/su141912257
49. Musa, M., Talip, R., & Awang, Z. (2023). Exploratory Factor Analysis for Technostress Among Primary School Teachers. Malaysian Journal of Social Sciences and Humanities (MJSSH), 8(2), e002117-e002117.

50. Nascimento, L., Correia, M. F., & Califf, C. B. (2024). Towards a bright side of technostress in higher education teachers: Identifying several antecedents and outcomes of techno-eustress. Technology in Society, 76, 102428.
51. Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W., & Chu, S. K. W. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. Educational Technology Research and Development, 71(1), 137–161. https://doi.org/10.1007/s11423-023-10203-6
52. Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2023). Ethical principles for artificial intelligence in education. Education and information technologies, 28(4), 4221-4241.
53. Nilsen, P. (2020). Making sense of implementation theories, models, and frameworks. Implementation Science 3.0, 53-79. https://doi.org/10.1186/s13012-015-0242-0
54. Novakovich, J., Miah, S., & Shaw, S. W. (2017). Designing curriculum to shape professional social media skills and identity in virtual communities of practice. Computers & Education, 104, 65-90. https://doi.org/10.1016/j.compedu.2016.11.002
55. OECD. "OECD Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots". OECD Publishing, Paris, 2021 Available from https://doi.org/10.1787/589b283f-en.
56. Otero, L. C., Catala, A., Fernández-Morante, C., Taboada, M., López, B. C., & Barro, S. (2023). AI literacy in K-12: a systematic literature review. International Journal of STEM Education, 10(1). https://doi.org/10.1186/s40594-023-00418-7
57. Passey, D. (2021) Digital Technologies-And Teacher Wellbeing? Education Sciences, 11(117). https://doi.org/10.3390/educsci11030117
58. Pawlowski, J., Eimler, S. C., Jansen, M., Stoffregen, J., Geisler, S., Koch, O., Müller, G., & Handmann, U. (2015). Positive Computing. Business & Information Systems Engineering, 57(6), 405–408. https://doi.org/10.1007/s12599-015-0406-0
59. Pietikäinen, M. (2021). Challenges of artificial intelligence : from machine learning and computer vision to emotional intelligence. http://jultika.oulu.fi/Record/isbn978-952-62-3199-0
60. POTHUGANTI, S. (2024). TECHNOSTRESS: A COMPREHENSIVE LITERATURE REVIEW ON DIMENSIONS, IMPACTS, AND MANAGEMENT STRATEGIES. Computers in Human Behavior Reports, 100475.

61. R. H. Mogavi, C. Deng, J.J. Kim, P. Zhou, Y.D. Kwon, A.H.S. Metwally ... and P. Hui. “Exploring user perspectives on chatgpt: Applications, perceptions, and implications for ai-integrated education”. arXiv preprint arXiv:2305.13114. 2023
62. R. Luckin and W. Holmes. “Intelligence unleashed: An argument for AI in education”. UCL Knowledge Lab: London, UK. 2016
63. Reddy, P., Sharma, B., & Chaudhary, K. (2020). Digital literacy: A review of literature. International Journal of Technoethics (IJT), 11(2), 65-94. DOI:10.4018/IJT.20200701.oa1
64. Redecker, C., & Punie, Y. (2017). European framework for the digital competence of educators: DigCompEdu (No. JRC107466). Joint Research Centre (Seville site).
65. Rideout VJ., Foehr UG., & Roberts DF. (2010) GENERATION M2 Media in the Lives of 8 - to 18-Year-Olds. A Kaiser Family Foundation Report. http://www.kff.org/entmedia/upload/8010.pdf.
66. Rohwer, E., Flöther, J. C., Harth, V., & Mache, S. (2022). Overcoming the “Dark Side” of Technology - A scoping review on preventing and coping with work-related technostress. International journal of environmental research and public health, 19(6), 3625. https://doi.org/10.3390/ijerph19063625
67. Romero-García, C., Buzón-García, O., & Marcano, B. (2022). Socio-Emotional Competence and Self-Efficacy of Future Secondary School Teachers. Education Sciences, 12(3), 161. https://doi.org/10.3390/educsci12030161
68. Salinas, A. B. C., De Escoriaza, J. C., & Hernández, S. O. (2022). Are emotional e-competencies a protective factor against habitual digital behaviors (media multitasking, cybergossip, phubbing) in Spanish students of secondary education? Computers & Education, 181, 104464. https://doi.org/10.1016/j.compedu.2022.104464
69. Salo, M., Pirkkalainen, H., Chua, C. E. H., & Koskelainen, T. (2022). Formation and mitigation of technostress in the personal use of IT. MISQuarterly, 46(2), 1073-1108. https://doi.org/10.25300/MISQ/2022/14950
70. Salo, M., Pirkkalainen, H., Chua, C., & Koskelainen, T. (2017). Explaining information technology users' ways of mitigating technostress. In ECIS 2017: Proceedings of the 25th European Conference on Information Systems, Guimarães, Portugal, June 5-10, 2017.
71. Seligman, M. E. (2012). Flourish: A visionary new understanding of happiness and well-being. Atria Paperback.

72. Silber-Varod, V., Eshet-Alkalai, Y., & Geri, N. (2019). Tracing research trends of 21st-century learning skills. British Journal of Educational Technology, 50(6), 3099–3118. https://doi.org/10.1111/bjet.12753
73. Starkey, L., & Yates, A. (2021). Do digital competence frameworks align with preparing beginning teachers for digitally infused contexts? An evaluation from a New Zealand perspective. European Journal of Teacher Education, 45(4), 476–492. https://doi.org/10.1080/02619768.2021.1975109
74. Tahiru, F. (2021). AI in Education: A Systematic Literature Review. Journal of Cases on Information Technology (JCIT), 23(1), 1-20. http://doi.org/10.4018/JCIT.2021010101
75. Tarafdar, M., Gupta, A., & Turel, O. (2013). The dark side of information technology use. Information Systems Journal, 23(3), 269-275.
76. Tarafdar, M., Pirkkalainen, H., Salo, M., & Makkonen, M. (2020). Taking on the “dark side” - Coping with technostress. IT professional, 22(6), 82-89.
77. Tarafdar, M., Stich, J.-F., Maier, C., & Laumer, S. (2024). Techno-eustress creators: Conceptualization and empirical validation. Information Systems Journal, 34(6), 2097–2131. https://doi.org/ 10.1111/isj.12515
78. Tzafilkou K., Perifanou M. & Economides A. A. (2023) Assessing teachers’ digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education. Education and Information Technologies. https://doi.org/10.1007/s10639-023-11848-9
79. UN. (2018). 68% of the world population projected to live in urban areas by 2050, says UN. United Nations Department of Economic and Social Affairs. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html
80. UNESCO (2018). UNESCO ICT Competency Framework for Teachers. Version 3.0. https://unesdoc.unesco.org/ark:/48223/pf0000265721
81. UNESCO. Giannini, S. (2023) Generative AI and the future of education. https://unesdoc.unesco.org/ark:/48223/pf0000385877
82. Usart, M., Minguell, M. E., & Cervera, M. G. (2020c). Validation of a tool for self-evaluating teacher digital competence. Educacion Xx1, 24(1). https://doi.org/10.5944/educxx1.27080
83. Valiao, A. J. (2025). Technostress and its impact on job performance of teachers. Journal of Interdisciplinary Perspectives.

84. Van Slyke, C., Clary, G., & Tazkarji, M. (2023). Distress, eustress, and continuance intentions for distance learners. Journal of Computer Information Systems, 63(1), 149-161.
85. S. Varsik and L. Vosberg. "The potential impact of Artificial Intelligence on equity and inclusion in education", OECD Artificial Intelligence Papers, No. 23, OECD Publishing, Paris, https://doi.org/10.1787/15df715b-en. 2024
86. Varvel, V. E. (2007). Master online teacher competencies. Online journal of distance learning administration, 10(1), 1-41.
87. Vuorikari, R., Kluzer, S. & Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens, (No. JRC128415), Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48882-8, doi:10.2760/115376,
88. Willermark, S., Högberg, K., & Nilsson, P. (2023). Exploring technostress in disruptive teaching practices. International Journal of Workplace Health Management, 16(4), 328-343.
89. Wong, S. C. (2020). Competency definitions, development and assessment: A brief review. International Journal of Academic Research in Progressive Education and Development, 9(3), 95-114.
90. World Economic Forum - WEF (2016). New vision for education: fostering social and emotional learning through technology. VOCEDplus, the International Tertiary Education and Research Database. http://hdl.voced.edu.au/10707/443447
91. Wu, D., Zhou, C., Liang, X., Li, L., & Chen, M. (2022). Integrating technology into teaching: Factors influencing rural teachers' innovative behavior. Education and Information Technologies, 27(4), 5325–5348. https://doi.org/10.1007/s10639-021-10815-6
92. X. Zhai, X. Chu, C. S. Chai, M. S. Y. Jong, A. Istenic, M. Spector ... and Y. Li. A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. Complexity, 2021(1), 8812542.
93. Zembylas, M. (2007). Emotional ecology: The intersection of emotional knowledge and pedagogical content knowledge in teaching. Teaching and Teacher Education, 23(4), 355–367. https://doi.org/10.1016/j.tate.2006.12.002
94. Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. Computers & Education, 168, 104212.

APPENDIX 1

Socioemotional e-competencies (Cebollero-Salinas et al., 2022).

Emotional e-awareness items:

"When I am on social media, I notice if I am angry or happy (I play, I communicate . . .)"

"When I am on social media (I read comments, I look at profiles, I watch videos) I can put a name on what I feel."

"When I entertain myself on the Internet (playing video games, watching videos, etc.), I identify my emotions."

"I usually know how to distinguish why I have certain feelings on social media."

"I really understand what I feel when I play video games online, watch videos, read comments, etc."

Emotion e-regulation items:

Before making a joke [about someone] on social media (on video or audio) I am capable of imagining how that person is going to feel."

"I have good control of my own emotions on social media."

"I control the emotions I express through the Internet."

"Even if something bothers me on social media, I am capable of responding with good manners."

"Before I say anything on social media, I am capable of imagining the consequences."

E-self-control of impulsiveness items:

"If a rumor is being commented in a WhatsApp group or on another social network, I find it difficult not to make a comment too."

"On the Internet, I can't stop clicking on the attractive links I see."

"On social media, I can't avoid commenting on the jokes they write on WhatsApp, etc."

"When something surprises me, I can't avoid commenting it on social media."

"On social media, I can't avoid posting comments about what has happened."

Emotional e-independence items:

"When I see the number of comments other friends receive on social networks, it affects me"

"I feel socially awkward if others get lots of comments on social networks."

"I feel unsuccessful if my contacts discover something negative about me on social media."

"If people don't answer on social media, I feel as if they don't consider me part of the group."

"I feel unsuccessful when my photos/videos don't get comments."

Social e-competency items:

"On social networks (Instagram, WhatsApp, e-mail, etc.) I pay attention to the needs of others."

"I tend to know how to help people who need help on social networks (Instagram, WhatsApp, e-mail, etc.)."

"I offer help on social networks when people need it."

“I tend to help on problems that arise on social networks.”

“I tend to calm my contacts down when they get angry on social networks.”