

Competence Framework-Based Assessment to Foster Sustainability Management

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Abstract

Urgent actions are needed both individually and collectively to reach the targets set by the United Nations Sustainable Development Goals by 2030. The complex issues of sustainability and climate change set the need for new skills and competences. Education systems worldwide need to integrate competence development into their agenda to achieve a sustainable transition. Higher education institutions have a crucial role in decreasing the gap between the graduated students' competences and the requirements of the labour market. In the pursuit of a workforce prepared for the complexities of the 21st-century workplace, this paper explores the interplay between European competence frameworks and transversal skills. Using a comparative analysis of four frameworks—DigComp, EntreComp, LifeComp, and GreenComp—we identify distinct features and cross-reference competences with transversal skills. As a result, media and information literacy emerges as a crucial transversal skill across all frameworks. This study offers valuable insights for strategic decision-making in talent development and organizational planning, aligning education with the dynamic demands of today's society. The findings underscore the key role of transversal skills in preparing individuals for the 21st century labour market.

Keywords

competence frameworks, transversal skills, sustainability education, education management, sustainability management

1 Introduction

In the pursuit of a more sustainable world, individuals should be empowered with the competences necessary to encourage change towards sustainability. The shaping of capable individuals, equipped to contribute meaningfully to sustainable development, underscores the critical role of education systems. Learning goals, content, and pedagogical approaches need to be revised to adeptly prepare students for the complex challenges of the 21st century (UNESCO, 2017). Two main policy approaches have emerged for education development: extending the duration of students' education and enhancing program quality, with a particular emphasis on skill development (Raju and Sosale, 2022). Traditionally, economic policymaking has acknowledged the key role of human capital in driving economic growth. Even though improving education is a key priority, slow returns on investment often discourage governments from committing to long-term educational improvements (Hanushek, 2012). Education's role has evolved recently from the simpler task of providing basic training to a more complex one. Today, employees require

a diverse skill set, including effective communication and collaboration, and must navigate challenges like lifelong learning and career changes. This requires an education approach that focuses more on skills development to meet the needs of the modern labour market (Hanushek, 2012). The modern workplace characterized by globalization, technological advancements, and societal competitiveness, creates the need for transversal competences. The shift towards a competence-based approach in education focusing on skills, values, and attitudes has become crucial. This shift is especially relevant in addressing complex challenges such as sustainability (Singer, 2006).

Bloom's revised cognitive taxonomy offers a perspective on defining educational goals by highlighting advanced thinking abilities (Anderson and Krathwohl, 2000). The taxonomy stresses the importance of learning, critical analysis, and imagination urging educators to go beyond teaching fundamental thinking levels such as remembering and understanding. Achieving higher-order thinking skills requires moving from conventional teaching

methods that mainly concentrate on lower cognitive levels. This dynamic approach to education not only fosters creativity but also cultivates the competences necessary to meet the challenges of the 21st century.

Recognizing the importance of making improvements in education at all levels, universities – especially those offering engineering programmes have a significant role in tackling sustainability issues. International organizations, such as the UN and the European Commission are dedicated to promoting sustainability, creative learning, and skill enhancement. This dedication has led to the creation of many different initiatives and resources that promote education centered on skills and competences with a focus, on sustainability.

The primary goal of this paper is to highlight the importance of skills in addition to cognitive abilities for tackling the complex challenges of the modern era. This is accomplished through a descriptive and analytical examination that compares four European competence frameworks. These frameworks, developed by the European Joint Research Center cover entrepreneurial, personal, and social as well as sustainability competences. Our comparative content analysis aims to serve as a guide to identify the key transversal competences within these frameworks that are crucial to successfully addressing sustainability and other intricate challenges of the 21st century.

This paper is structured in a manner beginning with a detailed explanation of the methodology used in the study. It is followed by a literature review covering sustainability education, competence-based education, and transversal skills. The main section is split into two parts: an introduction of the European Competence Frameworks with a focus on their general characteristics; secondly a comprehensive comparison of these frameworks with Transversal Skills. Following this, the subsequent sections discuss applications and the limitations of the study. In conclusion, the paper summarizes the key findings and their implications for talent development, organizational planning, and aligning education with the evolving needs of society today.

2 Methodology

The foundation of this review paper is based on the key role of competences in addressing the challenges of the 21st century with a special focus on sustainability. Our main interest lies in the four European competence frameworks aiming to translate them into transversal skills. Created by the Joint Research Center of the European Commission, these frameworks offer a comprehensive

set of competences crucial for success in four distinct domains (digital, entrepreneurial, life, and sustainable).

Our main goal is to conduct a comparative content analysis to establish a common understanding of these frameworks across different areas. We also aim to identify transversal skills that can serve as a foundation outlined in these frameworks. Our methodology involves a literature review on competence development and a content analysis of the four competence frameworks. In our literature review, we carefully selected themes and used relevant keywords related to education, for sustainability competence focused education and transversal skills.

To analyze and categorize framework competences into transversal skills we followed the guidance by Cohen et al. (2007) using a systematic approach that includes coding, categorizing, comparing, and drawing conclusions.

The study focused on using the four Competence Frameworks as samples, and the smallest coding units were identified based on the competences within each framework under each competence area. In the phase of the data analysis, a detailed examination of the identified transversal skills across the frameworks was conducted. The authors categorized the data independently followed by discussions on the results and reaching a consensus when needed. This thorough approach ensured a structured exploration of European competence frameworks providing valuable insights into essential transversal skills for competence development.

3 Literature review

The authors selected three topics to explore in their literature review: sustainability education, Competence-based Education (CBE), and transversal skills. These topics were selected because they collectively address the aspects of modern education and how they influence students' overall growth, employability, and readiness for the demands of the 21st-century labour market. The common thread linking these topics is the development of competences. As per our results, Sustainability Education focuses on incorporating transversal competences that align with sustainability principles. Competence-based Education offers an approach to the development of broad competences including those relevant to sustainability. Transversal skills include a range of competences crucial for success in different environments. The discussion follows a structure starting competences in a specific area (sustainability) to a general Competence-based Education approach and then exploring the broader application of transversal skills.

3.1 Sustainability education

A competence-based approach could certainly enhance the incorporation of sustainability in education. The key competences for sustainability as described in Wiek et al. (2011) and Redman and Wiek (2021) consist of systems thinking, anticipatory competence, normative competence, strategic competence, collaboration, critical thinking, self-awareness, integrated problem-solving, implementation, integration, and intrapersonal competences. These competences are considered transversal, multifunctional, and applicable across different contexts aligning with UNESCO's identification of eight fundamental competences for sustainability (Wiek et al., 2011; Chomova, 2021) emphasizes the importance of an interdisciplinary learning environment and project-based learning, both of which support holistic competence development. Additionally, the inclusion of sustainability competences in teacher training underscores the potential for incorporating sustainability throughout educational sectors (Moreno-Pino et al., 2021). Therefore, the holistic development of competences aligned with sustainability principles is crucial for the integration of sustainability in the educational systems (Wiek et al., 2011; Moreno-Pino et al., 2021; Chomova, 2021).

3.2 Competence-based education

Competence-based Education (CBE) is an approach in education aimed at supporting students to tackle the complex challenges of today's world. It involves a shift from traditional knowledge transfer to developing competences that include skills, values, and attitudes applicable to both the job market and everyday life (UNESCO, 2015b). The terminology related to competences is unclear with varying definitions and categorizations of skills and competences (Anderson-Levitt and Gardinier, 2021). However, the key difference lies in the scope of competences, which includes not just skills but also values and attitudes (UNESCO, 2015b). Various methodologies such as case studies, interdisciplinary team teaching, and project-based learning are utilized for competence development within CBE (Wesselink, 2010).

CBE focuses on learning pace, building strong competences, and ensuring student achievement rather than considering strictly the seat time and credit hours like traditional education does (Duong et al., 2022; Prokes et al., 2021). It offers personalized support that enables students to demonstrate their knowledge and skills at their own speed through assessments. This educational approach is closely linked with preparing students for the challenges of the workplace by providing advantages like

learning pace and quicker completion of courses (Duong et al., 2022; Prokes et al., 2021). However, there are some challenges related to the different roles of faculty members and concerns regarding the compatibility of infrastructure in settings (Duong et al., 2022; Prokes et al., 2021).

Competences are broadly described as a blend of skills, attitudes, and knowledge that individuals need to be productive workers and responsible members of society (Anderson-Levitt and Gardinier, 2021). These competences including areas such as language proficiency, digital skills, critical thinking abilities, and interpersonal communication skills are intended to be applied in scenarios with an emphasis on real-world relevance (Anderson-Levitt and Gardinier, 2021).

The terminology ambiguity in CBE has been discussed in various papers, highlighting the differing interpretations (Anderson-Levitt and Gardinier, 2021). Additional challenges include varied definitions, difficulties in assessment, and potential discrepancies with established academic standards. The growth of CBE is driven by addressing the nontraditional needs of students by offering advantages like quicker completion of courses (Prokes et al., 2021). The advocacy by different international organizations contributes significantly to the importance attributed to CBE (Duong et al., 2022; Prokes et al., 2021).

The strengths associated with CBE involve increased opportunities for learners and approaches that prioritize student needs, while criticisms express concerns that economic motives may overshadow educational objectives behind CBE implementations (Prokes et al., 2021; Duong et al., 2022). The focus on competence development aligns with the broader goal of fostering transversal skills that impact hiring and evaluating practices in the job market (Balcar, 2014).

In summary, the conceptual flexibility of CBE emphasizes its adaptability nature. Its significance lies in supporting the development of higher-level thinking skills, flexible learning, and the integration of real-life competences. Proponents say it creates opportunities for broader education and workforce preparation, while critics worry about learning equity and inequities. The integration of technology plays a key role in advancing educational enhancements related to competences (Brauer, 2021).

3.3 Transversal skills

The study of non-academic skills often known as key, core, generic, or soft skills has been in the focus of education and employment for many years (Devika et al., 2020). Other terms such as employability, transversal, or 21st-century skills have been used by scholars. Over time the concept of

transversal competences has gained prominence signifying a shift towards skills that can be applied across various fields, settings, and social interactions. Despite the lack of a universally accepted definition, the common theme among non-academic skills is their transferability which equips individuals to apply them in diverse situations and circumstances and could involve both technical and non-technical competences (Whittemore, 2018; Devika et al., 2020; Nagele and Stadler, 2017). While some researchers have raised doubts about the extent of their applicability (Nagele and Stadler, 2017) most literature emphasizes their adaptability which has led to the widespread use of the term "transversal" to characterize these abilities.

Transversal competences are categorized in many ways. Nagele and Stadler (2017) use the categories of interpersonal, conceptualization, and business-related skills along with those related to community engagement. Whittemore (2018) applied collaborative problem-solving, continual learning, digital proficiency, initiative, resilience, adaptability, cultural sensitivity, and expression as categories. Villan-Vallejo et al. (2022) emphasize interpersonal skills, teamwork abilities, leadership qualities, a strong work ethic cross-cultural fluency, and digital literacy. The European Parliament highlights competences in their classification of transversal competences such as the ability to require learning skills, the possession of social and civic competences, being initiative, and entrepreneurial, and having cultural awareness (European Parliament and the Council of the European Union, 2006). The Education Research Institutes Networks in the Asia Pacific (ERI Net) established by UNESCO Bangkok has classified transversal skills based on their research findings from Asian countries. Their framework includes innovative thinking abilities, interpersonal and intrapersonal skills, global citizenship, media, and information literacy, along with "other" competences for those that might not fit into the original categories. This framework builds on competences listed in job descriptions and corporate expectations (UNESCO, 2015a).

Belchior-Rocha et al. (2022) emphasize the significance of transversal skills for employability in today's job market. Their results indicate that transversal skills such as communication, adaptability, conflict resolution, teamwork, and critical thinking play a crucial role in helping recent graduates successfully transition into the labour market. Employers highly value these skills as they support the graduates' professional and social integration at work. The study also emphasizes the need for higher education institutions to focus on the acquisition and development

of these skills to better prepare students for contemporary work environments (Belchior-Rocha et al., 2022). Balcar (2014) conducts an examination of various studies on the impact of soft skills on wages. He discusses how psychological traits, attitudes, and soft skills significantly influence individuals' earnings and points out the increasing importance of these skills in today's job market. Based on his analysis of existing research he suggests that soft skills like communication, collaboration, and leadership are closely linked to higher wage returns (Balcar, 2014).

Abrantes et al. (2022) delve into exploring the connection between transversal skills and employability among graduates from distance learning programmes at universities. According to their findings, there seems to be a positive connection between developing transversal competences such as critical thinking, problem-solving, and communication and the improvement of graduates' job prospects. This highlights the significance of these abilities in shaping the students' career advancement (Abrantes et al., 2022).

Maunsell (2023) pointed out the importance of incorporating transversal skills into higher education curricula in response to the changing needs of the job market. The study emphasized the systematic integration of these skills into different disciplines and subject areas aligning educational goals with the necessary transversal skills for each specific program or course (Maunsell, 2023). Isaac et al. (2023) mentioned that despite concerns regarding displacing core subject content educators might discover that including methods to teach transversal skills can improve the original learning outcomes of the course which can be an incentive to adopt these innovative educational approaches.

In summary, the primary benefit of transversal skills as outlined in various studies is that they equip graduates with the right competences for the changing labour market of the 21st century. UNESCO suggests critical thinking, interpersonal communication, global citizenship, and media literacy as key transversal skills (Asylbekova et al., 2023) with many authors stressing the importance of their integration into the educational curricula (Maunsell, 2023; Belchior-Rocha et al., 2022). The employability of graduates is closely tied to the development of these skills (Belchior-Rocha et al., 2022; Abrantes et al., 2022).

To conclude the literature review examined three interconnected themes: Sustainability Education, Competence-based Education (CBE), and Transversal Skills. These themes collectively contribute to an understanding of how contemporary education shapes and prepare them for the changing labour market needs. Sustainability Education

advocates for integrating transversal competences aligned with sustainable principles. CBE represents a shift in education that underscores competence development beyond traditional knowledge sharing. Transversal Skills are crucial for adaptability and transferability across different areas preparing individuals for their career challenges.

The synthesis of these themes highlights the importance of developing competences that match the changing needs of modern workplaces. This literature review set the stage for an examination of digital, entrepreneurial, life, and green competences as well as the categorization of frameworks into transversal skills.

4 European competence frameworks

4.1 Background

There is a growing recognition of the importance of certain skills such as problem-solving, creativity, and innovation in the education sector (Noweski et al., 2012; Rahman, 2019). These skills are considered crucial for success in the world and extend beyond traditional cognitive abilities (Rahman, 2019). Despite this acknowledgment, the current educational framework often lacks in fostering these skills as it tends to prioritize cognitive capabilities over them (Noweski et al., 2012). The World Economic Forum's Future of Jobs Report from 2018 also emphasizes the significance of these skills (Reed, 2020). While cognitive skills remain valuable, they alone may not suffice to address the complexities of today's challenges. The European Council has identified eight essential competences for the 21st century: Literacy competence, Multilingual competence, Mathematical competence and competence in science, technology, and engineering, Digital competence, Personal, social, and learning-to-learn competence, Citizenship competence, Entrepreneurship competence, Cultural awareness, and expression competence (European Parliament and the Council of the European Union, 2006; European Commission, 2018). The list was first published in 2006 and revised in 2018. Many attempts were initiated to identify the exact subcompetences needed for the 21st century after the publication of the key competences, but there was no scientific common understanding. Therefore, related to the key competence recommendations for lifelong learning, the Joint Research Center of the European Commission developed and mapped the competences needed for a successful life in different areas. There have been 4 competence frameworks developed and published so far, in the order of publishing:

1. DigComp: The Digital Competence Framework for Citizens- published first in 2013 then revised in 2016 (Vuorikari et al., 2022)
2. EntreComp: The entrepreneurship competence framework in 2016; (Bacigalupo et al., 2016)
3. LifeComp: The European framework for the personal, social, and learning to learn key competence in 2020 (Sala et al., 2020)
4. GreenComp: the European sustainability competence framework in 2022 (Bianchi et al., 2022)

All these frameworks identified competence areas and broke the specific areas down into different competences. They bring examples of skills, knowledge, and attitude that the competences involve through case studies and other examples to support the understanding of the frameworks. The frameworks were developed through a cocreation process involving many key stakeholders including academics, policymakers, and practitioners. The development process was built on a strong scientific basis, with the following steps: Identifying – Analysing – Mapping – Piloting/Testing, Updating, and Revising. The frameworks serve as conceptual tools designed to facilitate the common understanding of competences as a set of knowledge, skills and attitudes that everyone - at all levels and fields of education should be able to develop (Bacigalupo, 2022).

4.2 The four competence frameworks

The main aim of DigComp is to improve the digital competences of citizens in today's digitalized world. DigComp can be a useful tool for both educators and policymakers to increase the digital proficiency of their target group. DigComp identifies five digital competence areas and breaks them down to 21 competences. Furthermore, they identify 8 proficiency levels from level 1 – foundation to level 8 – highly specialized. In 2022 a new report was published with more than 250 examples and resources and guidelines for local implementation. Based on DigComp, JRC created a version of DigComp specifically targeting three different stakeholder groups: consumers, citizens, educators and educational organizations (Vuorikari et al., 2022). The latter ones do not form part of the present analysis.

The main aim of EntreComp is to improve the entrepreneurial competences of European citizens. Entrepreneurship has been in the focus of the European Commission for the last decades and resulted among others in the

Entrepreneurship 2020 Action Plan published in 2013 which aims to improve the entrepreneurial potential in Europe (European Commission, 2013). EntreComp defines entrepreneurship as a lifetime skill and lists the main characteristics of an entrepreneur. Three competence areas were selected: Ideas and Opportunities; Resources; Into action - each area containing five specific competences.

The goal of LifeComp is to promote lifelong learning to enhance personal and social competences of the citizens so that they can live a meaningful life and become successful individuals. It gives a common understanding of the main personal, social and learning to learn competences. LifeComp identified 3 main competence areas with 3 – 3 specific competences in each area as it can be seen on (Sala et al., 2020).

GreenComp is the reference framework for sustainability competences by JRC. Its main aim is to provide a common understanding of sustainability skills in an adoptable form for different audiences: for learners as well as educators, or different organizations. As per its definition of sustainable competences, the key point is to develop the knowledge, skills, and attitudes about sustainability so people can take action with sustainability in mind. The report identified 12 sustainable competences in 4 main competence areas. GreenComp is the only one out of the four frameworks that use a storyline for its visualization using the bee pollination metaphor. In the visualization, the beehive represents the first competence area 'embodying sustainability values' – as the beehive protects the bees as their home. Pollen collected from the flowers is associated with the area 'embracing complexity in sustainability' as the main element that attracts bees to the flowers. Flowers represent the competence area of "envisioning sustainable futures" as they will be turned into fruits and then seeds to create new plants. The bees themselves stand for the last competence area called 'performing for sustainability' as bees act both at individual and group levels to maintain their colony (Bianchi et al., 2022).

A comparative content analysis of the JRC's competence frameworks – DigComp, LifeComp, EntreComp, and GreenComp – reveals distinctive yet interconnected features. Fig. 1 shows the main characteristics of each of the four frameworks. The competence areas are topic-specific, and each framework identifies between 3–5 main areas. The number of identified competences that are categorized in the main areas is between 9 (LifeComp) and 21 (DigComp).

Adaptability is an indicator that is common in all frameworks emphasizing the importance of skills to support

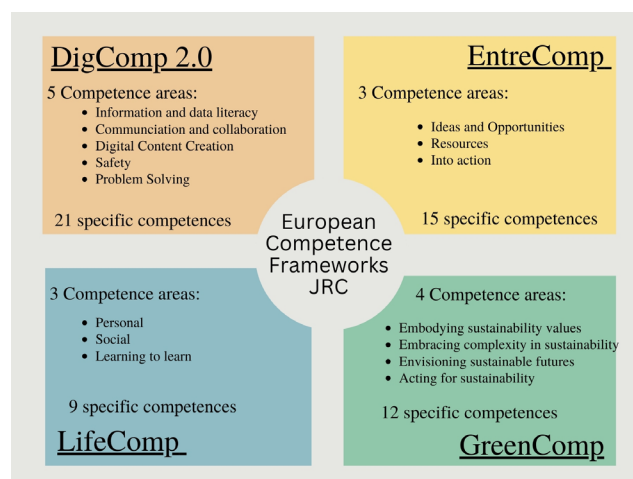


Fig. 1 The four competence frameworks – authors' own illustration

individuals to adapt to changing situations. DigComp, with its emphasis on digital literacy, highlights skills such as information processing and problem-solving in the digital domain. LifeComp takes a view focusing on critical thinking and collaboration as vital skills for lifelong learning. EntreComp, focusing on entrepreneurship, places importance on innovation and recognizing opportunities as key indicators and also emphasizes creativity and risk-taking in entrepreneurial settings. GreenComp brings attention to environmental consciousness and the ability to future literacy as essential competences. All these frameworks emphasize the development of competences that go beyond traditional academic knowledge. They also advocate for integrating competences across different domains acknowledging how interconnected skills are in the modern world. While DigComp, LifeComp, EntreComp, and GreenComp target domains individually they collectively promote a versatile skill set covering digital literacy, lifelong learning, entrepreneurship, and sustainability.

Some general competences that appear in several frameworks are the following: critical thinking – evaluating the given information; communication – engaging with others; taking action – leading, and mobilizing others, and taking initiative; and problem-solving. Sustainability appears (apart from GreenComp) in EntreComp as a specific competence as "ethical and sustainable thinking" but it is not named in the other two frameworks.

The four European Competence Frameworks could be broadly used in many areas, for example in the education sector for curricula review, teachers' training, training designs for special target groups, in policies to create relevant strategies, policies, initiatives, etc. They are designed to be used by a wide range of stakeholders, such as teachers, job seekers,

students, employees, and employers. It is emphasized in the frameworks that people do not need to be proficient in every one of the competences, just some of them depending on their personal strengths, jobs, and other contexts (Punie, 2017).

5 Cross-referencing competence frameworks with transversal skills

To create the cross-reference between the competence frameworks and transversal skills, we choose the ERI-net transversal skill categorization (UNESCO, 2015a). Our aim was to better understand how the competences in each framework relate to the bigger picture of transversal skills enhancing sustainability transition and management. An assessment matrix was developed (Table 1) to match the competences outlined in each framework to the relevant transversal skill categories. The authors carefully created the matching first individually, then discussed the results based on their evaluation.

As can be seen in Table 1, there was not a one-to-one correspondence, therefore in certain cases, we intertwined competences with multiple transversal skills. All together there are 57 competences listed in the four frameworks. On average, we categorized 2.1 times the competences into one of the transversal skills, therefore in the end, the overall frequency equals 123. Fig. 2 presents the frequency count of transversal skills across the six ERI-net categories. Each category represents a distinct transversal skill, and the corresponding numerical values indicate how frequently each skill appears. Notably, "Media and Information Literacy" has the highest frequency with 26 occurrences, followed closely by "Critical and Innovative Thinking" with 23. "Inter-personal Skills" and "Global Citizenship" share the same frequency count at 22 each, while "Intra-personal Skills" has a count of 19. Additionally, there are 11 competences categorized as "Other," representing skills that do not fall into the specified categories but are still recognized as transversal in nature.

The ranking shown in Table 2 represents the significance of the transversal skills based on the results of the cross-referencing. According to our findings "Media and Information Literacy" is considered the most important transversal skill, followed by "Critical and Innovative Thinking," and then "Inter-personal Skills" and "Global Citizenship" sharing the third position. "Intra-personal Skills" hold the fifth position, and "Other" is considered the least important within the four competence frameworks.

This breakdown offers an overview of these skills providing insights into how much emphasis each receives within the competence frameworks.

6 Applications and limitations

Through a comparative content analysis of the 4 frameworks, our results provide a basis for identifying which transversal skills are the foundation for specific and thematic competences. Thus, they can be developed in a targeted way in either corporate or academic settings. University programme management can identify the necessary competence set required for the students and align their curricula and learning outcomes accordingly, promoting compliance with international accreditation requirements/expectations and supporting management decision-making on sustainability-oriented educational development. Furthermore, management teams can identify the specific competences within an organization to drive sustainability initiatives and other challenges successfully. The result of our comparison can support recruitment processes and the design of employee training and personal development plans.

By using our results, the learning outcomes of educational programmes can be aligned with the changing demands of the labour market. As a result, students or employees can be better equipped to face complex challenges, drive innovation, and contribute to long-term success while maintaining a focus on sustainability and social responsibility.

The study faced certain limitations that require acknowledgment and consideration. One notable challenge was the prevalence of the high media and information literacy skills in our results - as this field was the only transversal skill that had its own thematic competence framework (DigComp). The existence of this framework introduces a potential source of distortion in our results, as all the subcompetences have been categorized into the media and information literacy skill category. After long consideration, we decided not to remove these subcompetences from the overall results since the fact that this field has its own competence framework highlights the significance of the area.

Furthermore, the subjective aspect of classification presented a challenge. Both authors initially classified the subcompetences of the frameworks independently and later discussed to refine and finalize the results. While subjectivity appears in this approach, collaborative discussions were used to ensure the credibility and validity of our findings.

7 Conclusion

In summary, this paper aimed to highlight the importance of skills in addition to cognitive abilities in tackling the diverse issues of today's world. By examining and comparing four competence frameworks. DigComp, EntreComp, LifeComp, and GreenComp Issued by the European Joint

Table 1 Cross-referencing competence frameworks with transversal skills

Competence area	Competences	Critical and Innovative Thinking	Interpersonal Skills	Intrapersonal Skills	Global Citizenship	Media and Information Literacy	Other	
DigComp	Information and data literacy	Browsing, searching and filtering data, information, and digital content		x		x		
		Evaluating data, information, and digital content	x			x		
		Managing data, information, and digital content	x	x			x	
		Interacting through digital technologies		x			x	
		Sharing through digital technologies		x			x	
	Communication and collaboration	Engaging in citizenship through digital technologies			x	x	x	
		Collaborating through digital technologies		x			x	
		Netiquette		x		x	x	x
	Digital content creation	Managing digital identity	x	x			x	
		Developing digital content	x				x	
		Integrating and re-elaborating digital content	x				x	
		Copyright and licences				x	x	
		Programming					x	
	Safety	Protecting devices					x	x
		Protecting personal data and privacy			x		x	x
		Protecting health and well-being	x		x		x	x
		Protecting the environment				x	x	
	Problem-solving	Solving technical problems	x	x			x	
Identifying needs and technological responses		x	x			x		
Creatively using digital technologies		x				x		
Identifying digital competence gaps		x	x			x		
Spotting opportunities		x			x	x		
Creativity		x						
Ideas and Opportunities	Vision			x	x			
	Valuing ideas				x		x	
	Ethical and sustainable thinking	x			x		x	
	Self-awareness and self-efficacy			x				
	Motivation and perseverance			x				
Resources	Mobilizing resources		x			x		
	Financial and economic literacy					x	x	
	Mobilizing others		x		x			

Table 1 Cross-referencing competence frameworks with transversal skills (continued)

Competence area	Competences	Critical and Innovative Thinking	Interpersonal Skills	Intrapersonal Skills	Global Citizenship	Media and Information Literacy	Other
EntreComp	Taking the initiative		x				
	Planning and management		x	x			
	Into Action						
	Coping with uncertainty, ambiguity, and risk	x			x	x	
	Working with others			x		x	
LifeComp	Learning through experience				x	x	
	Personal						
	Self-regulation	x			x		
	Flexibility				x		
	Wellbeing				x		x
	Social						
	Empathy				x	x	x
	Communication			x			
	Collaboration			x		x	
	Growth mindset				x		
GreenComp	Learning to learn						
	Critical Thinking	x					
	Managing Learning				x		
	Embodiment sustainability values						
	Valuing sustainability	x				x	
	Supporting fairness					x	x
	Promoting nature			x		x	
	Embracing complexity in sustainability						
	Systems thinking	x				x	
	Critical thinking	x					x
GreenComp	Problem framing	x	x				
	Futures literacy	x				x	x
	Envisioning sustainable futures						
	Adaptability	x			x		x
	Exploratory thinking	x			x		
Acting for sustainability	Political agency			x		x	
	Collective action			x		x	
	Individual initiative			x		x	
Total	Frequency	23	22	19	22	26	11
	Position	2	3	5	3	1	6

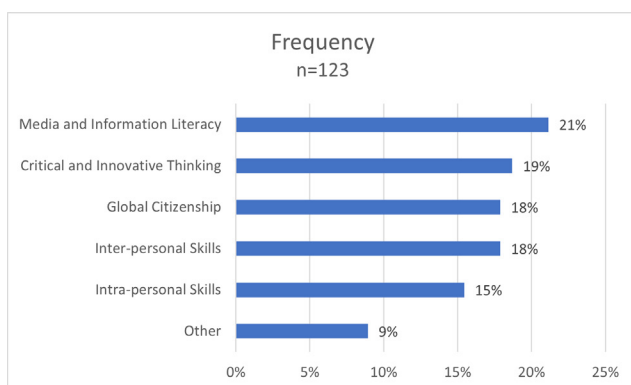


Fig. 2 Frequency count of transversal skills in the four frameworks

Research Center we aimed to identify key transversal competences within these frameworks necessary for personal

Table 2 Ranking of Transversal Skills in the Competence Frameworks

Transversal Skills	Position
Media and Information Literacy	1 st
Critical and Innovative Thinking	2 nd
Interpersonal Skills	3 rd
Global Citizenship	3 rd
Intrapersonal Skills	5 th
Other	6 th

and organizational achievement especially dealing with sustainability and other complex challenges.

After examining the competence frameworks, we found that DigComp, EntreComp, LifeComp, and GreenComp all highlight the importance of developing

holistic skills that go beyond traditional academic knowledge. These frameworks not only provide a theoretical understanding but also offer practical guidance for educators, policymakers, and organizations.

Comparing the competences of the frameworks with the transversal skills using the ERI-net categorization we noticed certain patterns. Media and Information Literacy stood out as the most frequently mentioned transversal skill highlighting its significance in today's world. Critical and innovative thinking, interpersonal skills, global citizenship, and intrapersonal skills also play key roles in shaping a comprehensive set of transversal competences.

These findings have implications for education, workforce development, and strategic decision-making. By aligning curricula and talent development with these identified transversal skills institutions can better prepare individuals to tackle the challenges of modern workplaces. Moreover, recruitment strategies can be adjusted to identify candidates with these competences. Additionally, organizational leaders can use this information to enhance employee training programs and support growth to create a workforce capable of addressing current issues effectively.

It is also important to recognize the limitations of our study. Firstly, the importance of the media and information

literacy skills might be distorted, since one competence framework is dedicated to the digital area. However, acknowledging the importance of digitalization in the 21st century, we did not modify the results. The subjective aspect of categorization is another factor that requires attention. Nevertheless, these challenges open ways for future research to explore specific areas in more depth and enhance methodologies for greater accuracy.

In conclusion, the goal of this paper is to encourage exploration, dialogue, and initiatives in the field of Competence-based Education and transversal skills. As we deal with the complex challenges of the era, focusing on comprehensive competences will be essential in shaping individuals capable of making valuable contributions to a sustainable society.

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References

- Abrantes, P., Silva, A. P., Backstrom, B., Neves, C., Falé, I., Jacquinet, M., Ramos, M. d. R., Magano, O., Henriques, S. (2022) "Transversal Competences and Employability: The Impacts of Distance Learning University According to Graduates' Follow-Up", *Education Sciences*, 12(2), 65.
<https://doi.org/10.3390/educsci12020065>
- Anderson-Levitt, K., Gardinier, M. P. (2021) "Introduction contextualising global flows of competency-based education: polysemy, hybridity and silences", *Comparative Education*, 57(1), pp. 1–18.
<https://doi.org/10.1080/03050068.2020.1852719>
- Anderson, L. W., Krathwohl, D. R. (eds.) (2000) "Taxonomy for Learning, Teaching, and Assessing, A: A Revision of Bloom's Taxonomy of Educational Objectives", Longman. ISBN 0-8013-1903
- Asylbekova, M. P., Otarova, T. N., Yelkin, D. C. (2023) "The importance of transversal skills in higher education curricula and in the labor market", *BULLETIN of L.N. Gumilyov Eurasian National University. Pedagogy. Psychology. Sociology Series*, 142(1), pp. 178–193.
<https://doi.org/10.32523/2616-6895-2023-142-1-178-193>
- Bacigalupo, M. (2022) "Competence frameworks as orienteering tools", *RiiTE Interuniversity Journal of Research in Educational Technology*, (12), pp. 20–33.
<https://doi.org/10.6018/riite.523261>
- Bacigalupo, M., Kamyliis, P., Punie, Y., Van den Brande, G. (2016) "EntreComp: The Entrepreneurship Competence Framework", EUR 27939 EN, Luxembourg, Publications Office of the European Union. ISBN 978-92-79-58538-8
<https://doi.org/10.2791/593884>
- Balcar, J. (2014) "Soft Skills and Their Wage Returns: Overview of Empirical Literature", *Review of Economic Perspectives*, 14(1), pp. 3–15.
<https://doi.org/10.2478/revecp-2014-0001>
- Belchior-Rocha, H., Casquilho-Martins, I., Simões, E. (2022) "Transversal Competencies for Employability: From Higher Education to the Labour Market", *Education Sciences*, 12(4), 255.
<https://doi.org/10.3390/educsci12040255>
- Bianchi, G., Pisiotis, U., Cabrera, G. (2022) "GreenComp The European sustainability competence framework", JRC Publications Repository.
<https://doi.org/10.2760/71066>
- Brauer, S. (2021) "Towards competence-oriented higher education: a systematic literature review of the different perspectives on successful exit profiles", *Education + Training*, 63, pp. 1376–1390.
<https://doi.org/10.1108/ET-07-2020-0216>
- Chomova, K. (2021) "Education for Sustainability in Higher Education", In: 21st International Joint Conference Central and Eastern Europe in the Changing Business Environment, Prague, Czech Republic, pp. 59–71. ISBN 978-80-225-4816-8
<https://doi.org/10.18267/pr.2021.krn.4816.5>

- Cohen, L., Manion, L., Morrison, K. (2007) "Research Methods in Education", Routledge. ISBN 0-203-02905-4
<https://doi.org/10.4324/9780203029053>
- Devika, R. P., Raj, P., Venugopal, A., Thiede, B., Herrmann, C., Sangwan, K. S. (2020) "Development of the Transversal Competencies in Learning Factories", *Procedia Manufacturing*, 45, pp. 349–354.
<https://doi.org/10.1016/j.promfg.2020.04.031>
- Duong, B.-H., Dao, V., DeJaeghere, J. (2022) "Complexities in Teaching Competencies: A Longitudinal Analysis of Vietnamese Teachers' Sensemaking and Practices", [preprint] University of Oxford.
<https://doi.org/10.25446/oxford.23686653.v1>
- European Commission (2013) "Communication from the commission to the European Parliament, the council, the European Economic and social committee and the committee of the regions", European Commission-DG Enterprise & Industry, [online] Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0795&from=EN> [Accessed: 24 March 2023]
- European Commission (2018) "Commission Staff Working Document Accompanying the Document Proposal for a Council Recommendation on Key Competences for LifeLong Learning", Brussels, Belgium, SWD(2018) 14 final [online] Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018SC0014> [Accessed: 24 March 2023]
- European Parliament and the Council of the European Union (2006), "Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning", *Official Journal of the European Union* [online] Available at: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=O-J.L:2006:394:0010:0018:en:PDF> [Accessed: 24 March 2023]
- Hanushek, E. A. (2012) "The economic value of education and cognitive skills", In: Sykes, G., Schneider, B., Plank, D. N. (eds.) *Handbook of Education Policy Research*, Routledge, pp. 39–56. ISBN 9780203880968
<https://doi.org/10.4324/9780203880968>
- Isaac, S., Jalali, Y., Petringa, N., Tormey, R., Dehler Zufferey, J. (2023) "Are Engineering Teachers Ready To Leverage The Power Of Play To Teach Transversal Skills?", In: *Book of Proceedings for the 51st Annual Conference of the European Society for Engineering Education*, Dublin, Ireland, pp. 586–594. ISBN 978-84-123222-6-2
<https://doi.org/10.21427/QP3D-B914>
- Maunsell, P. (2023) "Principles of Best Practice for the Integration of Transversal Skills in the Curricula of Further and Higher Education Programmes", Limerick and Clare Education and Training Board (LCETB), Limerick, Ireland. [online] Available at: <https://eolas.etbi.ie/server/api/core/bitstreams/63ac17dc-dd30-46c6-bb8a-4ede41e563cf/content> [Accessed: 05 January 2024]
- Moreno-Pino, F. M., Jiménez-Fontana, R., Cardeñoso Domingo, J. M., Azcárate Goded, P. (2021) "Study of the Presence of Sustainability Competencies in Teacher Training in Mathematics Education", *Sustainability*, 13(10), 5629.
<https://doi.org/10.3390/su13105629>
- Nagele, C., Stalder, B. E. (2017) "Competence and the Need for Transferable Skills", In: Mulder, M. (ed.) *Competence-based Vocational and Professional Education. Technical and Vocational Education and Training: Issues, Concerns and Prospects*, 23, Springer, pp. 739–753.
https://doi.org/10.1007/978-3-319-41713-4_34
- Noweski, C., Scheer, A., Büttner, N., von Thienen, J., Erdmann, J., Meinel, C. (2012) "Towards a Paradigm Shift in Education Practice: Developing Twenty-First Century Skills with Design Thinking", In: Plattner, H., Meinel, C., Leifer, L. (eds.) *Design Thinking Research*, Springer, pp. 71–94.
https://doi.org/10.1007/978-3-642-31991-4_5
- Prokes, C., Lowenthal, P. R., Snelson, C., Rice, K. (2021) "Faculty views of CBE, self-efficacy, and institutional support: An exploratory study", *The Journal of Competency-Based Education*, 6(4), pp. 233–244.
<https://doi.org/10.1002/cbe2.1263>
- Punie, Y. (2017) "Introduction to DigComp and EntreComp", The European Commission's science and knowledge service, Joint Research Centre, DigComp and EntreComp Stakeholders event, Brussels, Belgium. [online] Available at: <https://ec.europa.eu/social/BlobServlet?docId=17733&langId=it> [Accessed: 05 January 2024]
- Rahman, M. M. (2019) "21st Century Skill "Problem Solving": Defining the Concept", *Asian Journal of Interdisciplinary Research*, 2(1), pp. 64–74.
<https://doi.org/10.34256/ajir1917>
- Raju, S., Sosale, S. (2022) "Skills, Human Capital, and Economic Development", Policy Research Working Paper, World Bank Group, Washington DC, USA.
<https://doi.org/10.1596/1813-9450-10032>
- Redman, A., Wiek, A. (2021) "Competencies for Advancing Transformations Towards Sustainability", *Frontiers in Education*, 6.
<https://doi.org/10.3389/educ.2021.785163>
- Reed, S. K. (2020) "Cognitive Skills You Need for the 21st Century", Oxford Academic. ISBN 9780197529034
<https://doi.org/10.1093/oso/9780197529003.001.0001>
- Sala, A., Punie, Y., Garkov, V., Cabrera, M. (2020) "LifeComp: The European Framework for personal, social and learning to learn key competence", European Commission, Joint Research Centre, Publications Office of the European Union. [online] Available at: <https://data.europa.eu/doi/10.2760/302967> [Accessed: 05 January 2024]
- Singer, M. F. (2006) "A cognitive model for developing a competence based curriculum in secondary education", In: Al. Crisan (ed.), *Current and Future Challenges in Curriculum Development: Policies, Practices and Networking for Change. Education 2000+ Humanitas Educational*, pp. 121–141. [online] Available at: https://www.researchgate.net/publication/258216691_A_cognitive_model_for_developing_a_competence_based_curriculum_in_secondary_education [Accessed: 05 January 2024]
- UNESCO (2015a) "Preparing and supporting teachers in the Asia Pacific to meet the challenges of twenty-first century Learning; regional synthesis report", UNESCO Office Bangkok. ISBN 978-92-9223-570-3 [online] Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000246852> [Accessed: 05 January 2024]
- UNESCO (2015b) "Rethinking Education. Towards a Global Common Good?", UNESCO Publishing. ISBN 978-92-3-100088-1 [online] Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000232555> [Accessed: 05 January 2024]
- UNESCO (2017) "Education for Sustainable Development Goals: learning objectives", UNESCO Publishing. ISBN 978-92-3-100209-0 [online] Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000247444> [Accessed: 05 January 2024]

- Villan-Vallejo, A., Zitouni, A., García-Llamas, P., Fernández-Raga, M., Suárez-Corona, A., Baelo, R. (2022) "Soft Skills and STEM Education: Vision of the European University EURECA-PRO", BHM Berg- und Hüttenmännische Monatshefte, 167, pp. 485–488. <https://doi.org/10.1007/s00501-022-01275-7>
- Vuorikari, R., Kluzer, S. and Punie, Y. (2022) "DigComp 2.2: The Digital Competence Framework for Citizens", EUR 31006 EN, Publications Office of the European Union. ISBN 978-92-76-48882-8 <https://doi.org/10.2760/115376>
- Wesselink, R. (2010) "Comprehensive competence-based education. The development and use of a curriculum analysis and improvement model", (PhD), Wageningen University and Research. ISBN 978-90-8585-784-6 [online] Available at: <https://edepot.wur.nl/151085> [Accessed: 05 January 2024]
- Whittemore, S. (2018) "Transversal competencies essential for future proofing the workforce", Skillalibrary, Milano, Italy. [online] Available at: <https://www.researchgate.net/publication/328318972> [Accessed: 05 January 2024]
- Wiek, A., Withycombe, L., Redman, C. L. (2011) "Key competencies in sustainability: a reference framework for academic program development", Sustainability Science, 6, pp. 203–218. <https://doi.org/10.1007/s11625-011-0132-6>