European sustainability competence framework background document

*Literature Review,
Analysis of Frameworks and
Proposals*

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Contents

Preamble

This report was commissioned to help the JRC preparing the initial steps towards the European Sustainability Competence Framework (*GreenComp*)[1], published in January 2022. In particular, it contributed to the preparation of an initial set of competences based on an in-depth literature review by Chiara Scalabrino as well as the identification of experts to be consulted. In every case, the reader should note that *GreenComp* is the sole document to be referred to as the European Sustainability Competence Framework.

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[1] https://joint-research-centre.ec.europa.eu/greencomp-european-sustainability-competence-framework_en

Acknowledgements

Abstract

This report presents a preliminary literature review and frameworks analysis used for the preparation of the initial phases of the design process of the European Sustainability Competence Framework (*GreenComp*). Specifically, it includes a literature review conducted between October 2020 and February 2021, and an initial set of competences, to be used as a synthesis of the work done in the fields that contributed to the definition of the sustainability competences or for subsequent expert consultations. This preliminary set of competences especially aimed to be functional for all levels and areas of Lifelong Learning, from early childhood to old age, in formal, non-formal and informal contexts.

The report also includes a section on Education for Sustainability as a unique tool to facilitate the learning of the competences. Furthermore, it provides examples of Education for Sustainability behavioural learning objectives and examples of the contribution that the acquisition of sustainability competences can potentially give to the implementation of the EU policy instruments conceived to accelerate the shift to a circular and low carbon economy (e.g., EU Ecolabel, Green Public Procurement or the EU taxonomy for sustainable activities). Finally, benefits and recommendations for scaling up Education for Sustainability are presented.

Executive summary

The European Commission (EC) in recent years launched several policy initiatives to transform Europe into a fair and prosperous sustainable society. In 2019, through the European Green Deal, the Commission explicitly called for activating education and training through skills development, change in behaviour and investment in sustainable education. The Green Deal Communication referred to the preparation of "a European competence framework to help develop and assess knowledge, skills and attitudes on climate change and sustainable development". Similarly, the EU biodiversity strategy for 2030 recommended "encouraging cooperation in education for environmental sustainability". Furthermore, the European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience (2020) and the European Education Area by 2025 (2020), also pointed out the need to develop a European competence framework on sustainability.

In this context, this report presents a preparatory literature review and frameworks analysis that served as a basis for the development of the European Sustainability competence framework, finally published in 2022 (Bianchi et al. 2022), and for the spreading of the sustainability competences in Europe.

This study, conducted between October 2020 and February 2021, builds onto the suggestions of a previous study carried out for the JRC in 2020. Precisely, a refinement and enlargement of this previous study and a specific review of the scientific and grey literature were conducted to provide:

- An historical perspective of the evolution of sustainability competences and their use in Education for Sustainability practices.

- A comprehensive inventory of sustainability competences for lifelong learning, reflecting the widest geographical, historical, educational (lifelong learning), and professional perspectives of the most renowned international experts.

- Clear and wide-ranging definitions of the sustainability competences, embracing a vast array of contributions.

- A selection of competences, with their descriptions, resulting from the comparison and merging of the competences in the literature.

- A presentation of the main existing approaches for the learning of sustainability competences.

- A list of the potential benefits of scaling up Education for Sustainability for the acquisition of the competences.

- A list of recommendations from relevant organisations, for scaling up Education for Sustainability and spreading the strengthening of the competences in Europe.

From the methodological point of view, for the refining of the peer reviewed literature analysis, the search was widened in Scopus, Web of Science and ERIC, expanding the timeframe, the lifelong learning and professional perspectives, and adding new keywords and documents in Spanish. In addition, specific web searches and the main research social networks contributed to provide additional reports from the grey literature. As a result, about 150 articles and reports were collected and new frameworks of competences were added to the ones presented in the previous JRC report by G. Bianchi (2020), to complement the recent frameworks of competences which mainly target higher education. To be as complete and inclusive as possible, in terms of authors' and lifelong learning perspectives, also the eight sets of competences analysed for their use in higher Education by Wiek, Withycombe, and Redman (2011), were included. Finally, all the competences collected were organized in an "Inventory table" for the comparison of the definitions and terms used to describe them.

Overall, this inventory of competences, the subsequent classification of all the competences and the analysis of the information in the literature, led to the following results:

- A description of the main meanings and uses of the variety of terms used in the Sustainability and the Education for Sustainability fields, of the rich history of Education for Sustainability and of the pedagogical approaches that make it a fundamental tool to facilitate the learning of the competences (Section 3.1).

- The proposal of a preliminary set of seven competences (Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17), accompanied by comprehensive definitions, their components (Knowledge, Skills and Attitudes) and examples of their associated contribution to the low carbon and circular economy (Tables Table 6, Table 8, Table 10, Table 12, Table 14, Table 16,

Table 18)). The proposed competences are: "Systems thinking", "Futures thinking" (Anticipatory), "Values thinking" (Normative), "Critical thinking", "Strategic action-oriented competence (Agency/ implementation/ integrated problem solving)", "Intra-personal (Self-awareness)" and "Inter-personal (Collaboration)" (Section 3.2).

- An introductory overview of the similarities and differences between the proposed set of Sustainability competences resultant from the literature review and analysis, and the already existing EU frameworks of key competences for Lifelong Learning (Section 3.3).

- The main benefits of scaling up ES and promoting the learning of the competences in Europe, such as for example: responding to the citizens' desire to contribute to a better future, enabling students to appreciate the complexity of our world, empowering people of any age to be 'global citizens', or driving Europe's competitiveness and innovation (Section 3.4).

- A synthesis of stakeholder groups' recommendations for scaling up Education for Sustainability, for example, through the building of synergies between the sustainability and the education sectors, the training and development of the awareness of key stakeholders and decision-makers to transform them into change-agents or the strengthening of Education for Sustainability (in quality and quantitative) through adequate funding (Section 3.5).

1 Introduction

The European Commission (EC) has recently launched several policy and work documents to transform Europe into a fair and prosperous sustainable society. Specifically, in 2019 and 2020, The European Green Deal, the Regulation (Taxonomy) on the establishment of a framework to facilitate sustainable investment, the Chemical Strategy for Sustainability, the Biodiversity Strategy for 2030 and A new Circular Economy Action Plan For a cleaner and more competitive Europe. The EC has also promoted the European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience (2020) and the European Education Area by 2025 (2020), which underscored the need to develop a European competence framework on sustainability, that was then finally published in 2022 (Bianchi et al. 2022). Additionally, the recovery from the Covid-19 crisis has also been planned in way to support the transition to a more sustainable economy and society.

For an effective implementation of these policies, the responsible effort of all EU Member States (MS) is needed. This requires the support, participation and individual and collective action of European public organizations, the business sector and civil society. Thus, president von der Leyen acknowledged the need for more education to bring about change in citizens' behaviours. Schools, training institutions and universities are key empowering agents in the green transition.

Through the European Green Deal, in 2019 the Commission explicitly called for activating education and training through skills development, including upskilling and reskilling, change in behaviour and investment in sustainable education. The Communication referred to the preparation of "a European competence framework to help develop and assess knowledge, skills and attitudes on climate change and sustainable development". Similarly, the EU biodiversity strategy for 2030 recommends "encouraging cooperation in education for environmental sustainability".

Due to the lack of coherent educational policy in Education for Sustainability (ES), the European Commission proposed the development of a European competence framework, which could include specific suggestions to help Member States implement successful teaching practices and innovative methodologies to address today's environmental problems through education, from a lifelong learning perspective. Whilst respecting the subsidiarity principle in Education policies, the main goal of this initiative is to recommend Member States that European citizens reach a basic level of proficiency in sustainable development knowledge, skills and attitudes, and to prompt action towards mitigating climate change and building a circular economy.

The use of competence frameworks is supported and promoted through the Council Recommendation on Key Competence for Lifelong Learning (2018/C 189/01). Until now, the JRC has produced the following competence frameworks:

- The European Digital Competence Framework (*DigComp*).

- The European Entrepreneurship Competence Framework (*EntreComp*).

- The Digital Competence Framework for Educators (*DigCompEdu*).

- The European framework for the personal, social and learning to learn key competence (*LifeComp*).

This report is the result of the preliminary phase of a joint initiative by the JRC and DG EAC with the aim to prepare the initial steps of the process that has brought to the publishing of the European Sustainability Competence Framework (*GreenComp*).

1.1 Objectives of the study

In detail, the study aimed at the following objectives:

— An analysis of the approaches for the acquisition of the Sustainability competences in the EU Member States and at the global level: description of the terms used in the Sustainability and the Education for Sustainability (ES) fields, the educational dimensions (approaches, contents and learning objectives) of ES, the evolution of the Education for Sustainability movement and its approaches to the competences, and the main benefits of scaling up Education for Sustainability for the learning of the competences in Europe and relevant European stakeholder groups' recommendations.

— The review of the existing literature on Sustainability and Education for Sustainability competence frameworks, and a proposal of a preliminary set of Education for Sustainability competences with their clusters of knowledge, skills and attitudes, and examples of associated behaviours.

— An analysis of the preliminary set of Education for Sustainability competences resultant from the literature analysis, in the context of the other existing EU frameworks for Lifelong Learning (*DigComp*, *EntreComp* and *LifeComp*).

— The proposal of a list of experts to be considered for their involvement in future phases of the development of the EU sustainability competence framework.

These wide-ranging objectives required focusing on diverse and complementary aspects of Education for Sustainability. In chapter 2, a description of the main approaches used to research the various dimensions of Education for Sustainability and the Sustainability Competences will be presented. However, for a thorough comprehension of the description of the methodology and of the findings of the study, in the following subsection we will introduce a few essential terms and concepts.

1.2 Premises on key terms and concepts related to Education for Sustainability Competences

As a premise, it is important to point out that in the literature, terms like **competency, competence, capability,** and **ability** are often used interchangeably. Thus, for the purpose of this report, henceforth the literal wordings of the quoted authors will be used only in the citations.

In the rest of the cases, as in all the existing EU competence frameworks, the term **competence** will be used.

Additionally, given the delayed publishing of this background report, that comes after the conclusion of the expert consultations and the design process of *GreenComp* (the sole document to be referred to as the European Sustainability Competence Framework), to avoid confusion with the just mentioned framework, the words **key competence/s** will be used only in the citations of the authors in the literature and when needed for the description of the methodology of the study.

1.2.1 Competences and the EU competence frameworks

In a 2004 report, a wide range of experts argued that educational goals are relatively general statements about knowledge, attitudes, values, interests, motivations, abilities and skills. Furthermore, that "competency models" serve to describe the learning outcomes and thus they provide frameworks for operationalising educational goals (Klieme et al., 2004). The EU competence frameworks *DigComp*, *EntreComp* and *LifeComp*, specify that the term "competence framework" designates an organised conceptualisation of competences that must be distinguished from a qualification framework.

In general, many documents reporting the definitions of competence, include elements such as attitudes, knowledge, values and skills (Corres, Rieckmann, Espasa and Ruiz-Mallén, 2020). In particular, the Recommendations on Key Competences for Lifelong Learning of the European Parliament and the Council (2006) and of the Council (2018), define a "competence" 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". (Council of the European Union, 2018, 7).

Specifically, in the Key Competences Recommendation for Lifelong Learning of the European Parliament and the Council (2006) and in the report "DigComp 2.0: The Digital Competence Framework for Citizens" (Vuorikari, Punie, Carretero Gómez, Van den Brande, 2016), attitudes are conceived as the motivators of performance, the basis for continued competent performance, and they include values, aspirations and priorities.

The above-mentioned knowledge, skills and attitudes taxonomy, referred to as KSA, is influential in the training world. It was developed by Bloom and colleagues from the 1960s (Bloom, 1976; Bloom, Hastings and Madaus, 1971; Bloom, Mesia and Krathwohl, 1964) for use in educational establishments and it is based on three domains of educational activities: cognitive, psychomotor and affective (European Centre for the Development of Vocational Training – Cedefop, 2006).

In brief, competences are dynamic combination of knowledge, skills and attitudes individuals need for self-regulated action in complex contexts and situations. They are not what should be taught, but what should be learned (Sleurs, 2008), as they are abilities, concepts and problem-solving strategies people should acquire through life experiences and learning processes, so that they are developed at different age-appropriate levels (UNESCO, 2017). Accordingly, competence-based education is outcome-focused, as it is aimed at enabling individuals to engage effectively in different situations and contexts (Rieckmann, 2012).

1.2.2 Education for Sustainability and Sustainability competences

Education for Sustainability promotes the understanding of the complex world in which we live, to be able to collaborate, speak up and act for positive change (UNESCO, 2015). Accordingly, sustainability competences represent cross-cutting competences that are necessary for all learners of all ages worldwide, to become "sustainability citizens" able to engage constructively and responsibly with today's complex world (UNESCO 2015, 2017).

Nevertheless, Sterling, Glasser, Rieckmann and Warwick, in 2017, called attention on an unsatisfactory state of the sustainability competencies field, characterised by a sea of labels, terminological confusion, lack of consensus regarding what constitutes a comprehensive and relatively non-overlapping set of sustainability competencies, and a relative lack of attention to pedagogic and institutional change implications.

Brundiers et al. (2020), putting together the most relevant definitions in the literature (Table 1), highlight three important features of the key competencies in sustainability:

- They serve as a cluster of related competencies.

- They are called key competencies in sustainability to distinguish them from other key competencies, including academic competency.

- They are referenced as a framework as they are interdependent; each contributes its part to sustainability problem-solving processes.

Table 1. Main definitions used in Sustainability competences

Competency	Cluster of specific and interrelated individual dispositions comprising knowledge, skills, motives, and attitudes… (Wiek et al. 2011, Rieckmann 2012, 129, UNESCO 2017).
Sustainability competencies	Comprise the entirety of individual dispositions comprising knowledge, skills, motives, and attitudes necessary to solve sustainability-related problems and advancing sustainable development in a range of different contexts, including private, social and institutional (Engle et al. 2017, Waltner et al. 2019).
Key competency in sustainability	A distinctive and multifunctional competency, which is composed of several sustainability competencies that functionally relate to each other. It facilitates achieving successful performance and a positive outcome that progresses sustainability (given what is known, valued, and aspired at a given moment in time), while working on specific sustainability challenges and opportunities in a range of contexts (Wals 2015, Wiek et al. 2011).

Source: Brundiers et al., 2020.

In summary, sustainability competences enable us to nurture 'change agents', 'problem solvers' and 'transition managers' (Wiek, Withycombe and Redman, 2011). They enable individuals to see "the big picture" drawn by the relations among the different Sustainable Development Goals (SDGs) of the "2030 Agenda for Sustainable Development" (Box 2) set by the United Nations in 2015 (UNESCO, 2017).

Given the above premises and considered:

- that the aim of Education for Sustainable Development is to equip learners with the knowledge, skills, values and attitudes needed to contribute to a more sustainable world and shape a prosperous future (UNESCO, 2017; 2021a), and

- the definitions used in the Recommendations on Key Competences for Lifelong Learning of the European Parliament and the Council (2006) and of the Council (2018),

for this study "knowledge, skills and attitudes (KSA)" (with values as a part of attitudes) have been considered as the main components of the Sustainability competences.

2   Methodology of the study

The objective of this section is to present the methodology used to research the Education for Sustainability literature and to select an initial set of Sustainability competence to be used as a synthesis for the planning of the *GreenComp* design process and expert consultations.

This study was conducted between October 2020 and February 2021 and required an in-depth literature review on Education for Sustainability and related existing frameworks. It considered both the global and EU Member States levels, and the selection and analysis of the literature focused on the pursuit of the following specific aims:

- To provide the most clear-cut and comprehensive descriptions of the competences that will be selected with a lifelong learning perspective in mind.

- To present and describe in this report, the Sustainability and Education for Sustainability field that originated the competences and the approaches for their learning, according to internationally renowned authors.

- To formulate recommendations for the promotion of the acquisition of the Sustainability competences.

- To identify relevant experts in the field to be considered for their involvement in future phases of the development of the EU sustainability competence framework.

2.1   Methodology used for the literature review on Education for Sustainability and for the design of the proposed initial set of Sustainability Competences

The study presented in this report was conceived based on the report "Competences for Sustainability – A systematic literature review", carried out in 2020 by Bianchi.

Bianchi (2020) systematically gathered and analysed the information and knowledge documented in the academic and grey literature on Sustainability Education (SE) and employment, mainly published between 2010 and 2020, and as a result presented 19 frameworks grouped as follows:

- Four frameworks of "Key competencies in Sustainability" for academic program development (Wiek et al., 2011, 2016; Brundiers et al., 2020; Redman and Wiek –under review).

- Nine "Competence frameworks in SE and ESD", in their respective articles originally named, competences for Sustainability, for Sustainable Development, for Education for Sustainable Development and for the Circular Economy.

- Six frameworks of "Green skills/Sustainability competences among professionals working in sustainability-related professions".

Next, having found a rich landscape, the author (Bianchi, 2020) highlights a general convergence of these frameworks on what competences in sustainability are, and a focus of the most encompassing ones to date, on higher education. Lastly, the report concludes underlining the need of a focus on continuous learning and pedagogical approaches and recognising the necessity of the development of a more encompassing system to identify and update the sustainability competences that are critical to perform jobs in a sustainable manner.

Precisely, starting from the JRC report (Bianchi, 2020), a refinement and enlargement of the review of frameworks was planned to seek broader views of the Lifelong Learning, historical, geographical, educational and professional perspectives.

This meant an analysis and comparison of the competences in the frameworks previously collected by Bianchi (2020) and the search and analysis of additional relevant peer reviewed articles, international reports or books published mainly between 1990 and 2020. Although the great majority of documents available online are of the last 20-30 years, also some documents from the 1970s and 1980s were analysed. All this permitted the inclusion of new frameworks and of documents of distinguished authors that contributed with a vast array of definitions and descriptions of the competences (useful in all the sector of lifelong learning) before they were even called so. Documents written in Spanish were also included if considered relevant for at least one of the two main aims of our research: the descriptions of Education for Sustainability and of the Sustainability competences.

Specifically, all this allowed the review and analysis:

— To consider academic articles that, albeit not including the words competence or framework, do describe competences such as for example: systemic, critical or value thinking.

— To incorporate frameworks designed for important groups of professionals, such as educators, eco designers and managers.

— To include other historically relevant documents, to open the spectrum of lifelong learning beyond academic programs development.

— To collect information on the evolution of the competences and on the educational approaches to develop them, reflecting the diversity of perspectives of the most distinguished authors and practitioners.

— To pull together the widest range of wording options, for their inclusion in an inventory to be used for the classification and merging of the competences presented in the literature.

— To identify the most authoritative authors of the Education for Sustainability and Sustainability competences fields, to be considered for their involvement in future phases of the development of the EU sustainability competence framework.

In other words, the principles that guided the search, selection and analysis of the literature, helped pursuing the aim of presenting a preliminary set of competences synthetising the research in the field, and including:

— All the Sustainability competences that citizens need, even if some of these could already appear, with nuances, in the *LifeComp*, *DigComp* or *EntreComp* frameworks. This choice, to be complete to the eyes of the cited authors and experts, and to anyone interested in learning the competences or in promoting their development.

— Encompassing definitions of the competences (with their clusters of knowledge, skills and attitudes), so to favour descriptions of the selected competence for Sustainability as complete as possible and ensure their thorough understanding.

— A Lifelong Learning for sustainability perspective. That means applicable to all the different levels and areas of education and training, from early childhood to old age.

— A wide historical, geographical and professional perspective. That means that they integrate the variety of perspectives of the authors that contributed to define them and that they may be used as a bases for the learning of people with the most diverse backgrounds (e.g., geographical, professional…).

For the refining of the peer reviewed literature analysis, the search was widened in Scopus, Web of Science and ERIC (In Box 1 the keywords used to extend the search of Sustainability competences frameworks). For instance, keywords like Environmental Education were added, because this was the first wording used worldwide in the history of ES, and because in some countries and by some authors and institutions (e.g., Spain and other Spanish speaking countries) it is still preferred to ESD.

Box 1. Keywords used for the search in the literature of the documents collected for the extended literature review presented in this report

Sustainability learning, Sustainability education, Education for sustainability, Education for sustainable development, Environmental education, Sustainability leader*

Competenc*, Skill*, Capabilit*, Abilit*, Characteristic*

Framework, Model, Theory

At the same time, some web searches and the main online research social networks contributed to provide additional reports from the grey literature.

As a result, about a 150 peer reviewed articles and reports from the grey literature were collected. Of these documents:

1. Some provided the basis to compile relevant information on Sustainability and Education for Sustainability, and especially on the following aspects that are important for the development and spreading of Sustainability competences:

- Existing approaches for the acquisition of Sustainability competences: terms and concepts used in the Sustainability and the Education for Sustainability fields, the evolution of Education for Sustainability and its educational dimensions, approaches and learning objectives.

- The main benefits and recommendations for scaling up Education for Sustainability for the learning of the competences in Europe.

2. The 19 articles or reports already selected in the JRC report (Bianchi, 2020) were used to get in depth information on the sets [2] of competences, their definitions, the contexts and methods used to design them. Additionally, other 17 articles and reports were selected, based on the criteria previously mentioned in the (a) to (k) lists. The full list of the 36 (19+17) articles and reports may be found in the table in Annex 1.

2.1.1.1 Criteria used for the selection, classification and distillation of sustainability competences

To analyse the existing attempts to identify the most important competences in lifelong learning for Sustainability, the 19 frameworks primarily presented in the JRC report by Bianchi (2020), together with the 8 that had been analysed by Wiek et al. (2011) for their use in Higher Education, and 9 more sets of competences identified through the research process described in the previous paragraphs, were organized in an "Inventory table" for the comparison of all the terms used to present the competences and their components. This spreadsheet includes all the data that has been analysed, and for its magnitude it has been included in Annex 2.

In brief, the inventory table included all the competences that appeared in the 36 sets of competences described in the articles, reports and books that had been selected, mainly written in the last three decades. It presented an extended variety of possible competences and components (knowledge, skills and attitudes), to provide the widest range of classification options.

Additional reasons for the inclusion of such a great number and older sets of competences were that, overall, analysing 36 sets of competences, while not protracting the research too much, gave information on the "age" of the sustainability competences, on the evolution of their meaning, learning methodologies and uses. Furthermore, on an aspect that is of interest to anyone who wants to contribute to spread these competences: the degree of experience and know-how in the development and learning of these competences.

As an example, the initial decision of including also the eight sets of competences analysed for their use in higher Education by Wiek et al. (2011), would have helped to find out:

- If by any chance, Wiek et al. (2011) included frameworks designed for lifelong learning in their analysis or which criteria and methods they used for the selection of the competences in their final proposal.

- If Wiek et al. started from existing frameworks of competences or if, for their research, as keywords to find the competences, they had to search for aims, objectives, methods or outcomes of ES, or directly for the names of the competences.

- If the works of the authors analysed by Wiek et al. (2011) would have enriched the table of useful wordings describing the competences and their components (knowledge, skills and attitudes).

- If the authors analysed by Wiek et al. (2011) were to be included in the list of the most renowned experts in the field to be considered for involvement in future phases of the development of the EU sustainability competence framework.

2.1.1.1.1 The inventory for the analysis of the sets of competences and the selection of competences and components

In the inventory table for mapping, each competence was represented in the first column of each row. Then, the names and the concepts behind the names of the various competences or components included in each

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one of the 36 sets of competences, were classified in the corresponding row. Precisely, at the end of this first process, the 36 sets of competences appeared classified each one in a column.

After this first qualitative analysis, and subsequent quantitative analysis, the most convergent (more repetitions) competences that composed the draft initial set of competences were nine.

In a second moment, of these nine, seven competences were selected, based on the following distillation criteria:

- The set of competences had to be applicable to education in a lifelong learning perspective (not only to the most represented Higher Education level).

- The set of competences had to be clear-cut and understandable by the most extended variety of stakeholders and experts of all levels of education (e.g., teachers, managers, policy makers and researchers).

In accordance with the first criteria, the "critical thinking" competence was maintained in the final version of the proposed framework, although the most relevant and recent frameworks for the development of academic programs, considered it a 'basic competence' and not a key sustainability competence for Higher Education. On the other hand, according to the second criteria and to simplify, the "Strategic thinking/ Strategic or action-oriented competence", the "Integration/ Integrated problem-solving competence" and the "Implementation/ Implementing Sustainability competence" were combined in one competence that for the proposal presented in this report was called "Strategic action-oriented competence (Agency/ implementation/ integrated problem solving)". This specific decision was based on the consideration that strategic planning, problem-solving, implementation and all the other nuances of these terms (agency, action…), used in the 36 sets of competences, ultimately represent different phases of action/agency for sustainability. In other words, that individual or collective "action for sustainability" always to some extent include strategic thinking, problem solving, planning and implementation.

At the end, after an accurate qualitative and quantitative analysis of the meanings of all the names given to the competences collected in the inventory table, and after the analysis of their descriptors or elements, a final set of seven competences was selected: **"Systems thinking", "Futures thinking" (Anticipatory), "Values thinking" (Normative), "Critical thinking", "Strategic action-oriented competence (Agency/ implementation/ integrated problem solving)", "Intra-personal (Self-awareness)" and "Inter-personal (Collaboration)"** (Table 2).

Table 2. The selection process of the proposed names for the set of sustainability competences that emerged from the literature review

Name of the competences in the frameworks and sets of competences in the literature	Number of repetitions in the sets of competences (as key competence or as competence)		Names of the proposed competences
Systems thinking (Holism, complexity…)	32		Systems thinking
Futures thinking (Anticipatory)	25		Futures thinking
Values thinking (Normative)	21		Values thinking
Critical thinking	13 (+ 3 articles focusing on higher education consider them Basic competences acquired in HE)		Critical thinking
Strategic thinking/Strategic or action-oriented	23		Strategic action-oriented
Integration/ Integrated problem-solving	9	37	
Implementation/ Action/ Agency	5		
Intra-personal (Self-awareness)	21		Intra-personal
Inter-personal (Collaboration)	28		Inter-personal

It must be pointed out that the decision to use, for the first level classification, the just mentioned wordings, that in the Education for Sustainability literature indicate "sustainability key competences", was because they are comprehensive, and the combination of key competences is preferred in the most recent sustainability competence frameworks. Even more importantly, this allowed to consider all the key competences and competences presented in the 36 sets of competences found in the literature and collect them in the "Inventory table" in Annex 2, for their two-levels classification in key competences and clusters of competences which compose each key competence. Nevertheless, it must be highlighted that, although in the inventory table the classification keeps the Education for Sustainability distinction in key competences and competences, in the following step of the analysis for the design of the "classification tables" that will be presented in the following paragraphs, to avoid confusion with the EU lifelong learning key competences, it was decided to substitute the words "key competence" and "competence" with, respectively, "competences" and "components".

On the selection of the names of the main competences of the proposed set, it is important to clear that also other more straightforward, but less comprehensive, wordings could have been chosen. In fact, for example, if compared with "Systems thinking", "Futures thinking", "Values thinking", "Critical thinking" and "Strategic action-oriented", the terms "Intra-personal" and "Inter-personal" could, at a first glance, not be sufficiently clear to all possible education stakeholders. As a matter of fact, in many sets of frameworks analysed in the literature, terms indicating the competence (e.g., collaboration, empathy...) are preferred to the just mentioned terms indicating key competences. For these reasons, other terms such as "Self-awareness" and "Collaboration", probably not as comprehensive, could substitute "Intra-personal" and "Inter-personal", as preferred in some of the older frameworks analysed.

Said all that, the seven competences selected for the proposed set of competences, were then represented in seven "Classification tables" (Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17), one for each competence. Each competence accompanied by all its components, grouped in clusters that better represent what the main competence more broadly implies in terms of knowledge, skills and attitudes.

With the aim of providing the reader with the main concepts behind each competence, their definition is the result of the combination of the definitions of various authors. In practice, we tried to compile the wordings, keeping in mind the main aim of a sustainability competence framework, which in Europe could be to prepare citizens to build a better future, through the transition to a circular and low carbon economy. As an example, we considered essential to specify in the definition of "Systems thinking" the concept of "addressing the root causes of sustainability problems and not just their symptoms", because to achieve a circular and carbon neutral economy by 2050, it is essential to draw out waste, emissions and toxic effluents in the design phase of products, instead of implementing only "end of pipe" solutions. Another example from the social sphere, could be that to address migrations it is important also to work on its root causes in the countries of origin. For example, through the mitigation of climate change and the adaptation to its consequent extreme droughts or floods, fighting natural resources unfair exploitation (e.g., minerals, biomass...) and worker rights violations.

2.1.1.1.2   The selection of competences and components

While the selection of the competences was done based on a convergence criterion (number of repetitions of the concept), conversely the collection of components that assemble and describe the seven competences, was pulled together based on the criteria of relevance across all levels of lifelong learning (with their adaptations to learners), complementarity and intelligibility. In applying these criteria, complementary elements that added meaning for a comprehensive definition of the key competence were kept. Conversely, complementary elements that were not relevant for the full understanding of the key competence, were excluded. When a concept or similar concepts were repeated in more than one of the initial sets of competences with different wordings, the clearest wording or a combination of wordings was used.

In synthesis, the objective was to provide a unifying proposal that could give possible users (policy makers, courses managers, educators of any level...) a straightforward and comprehensive idea of Sustainability competences. In other words, this "unifying proposal" had to represent the best as possible integration of the 36 different views selected from the Sustainability and Education for Sustainability literature.

Once the competences went through the process of distillation and classification described, they were assigned to one of the categories (knowledge, skills and attitudes) that represent four complementary descriptors of what each sustainability competence entails.

That is to say that, although sets of competences are usually represented in lists, the competences are dynamic and interconnected. Consequently, some of the components (Knowledge, skills and attitudes) could be assigned to more than one main competence. For instance, the competence "Topical knowledge in sustainability and in other disciplines (e.g., climate change, water, energy, food…)" may be considered a competence (or component) of Systemic thinking, as well as of Future thinking or of the Strategic action-oriented sustainability competence.

For these reasons, in the final classification tables (Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17), the competences that could be assigned to more than a competence, were assigned to the one it was mostly related to. Additionally, once all the clusters of competences and components were represented in their "classification table", some extra competences/components or words were suggested to complete the description of the competence.

In conclusion, the final Table 4, Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17) resulting from the analysis, selection and classification of the 36 sets of competences, will be presented in chapter 3, that presents the Findings of this report. They present the proposed set of seven sustainability competences that may be used as a synthesis of the competences found in the Sustainability and Education for Sustainability literature or as a basis for expert consultations. In practice, these competences are composed by clusters of components that have been put together merging the existing sets of competences in the literature and adding a few concepts that were missing. All this to provide the users with a set of concepts the most comprehensive as possible, and as a result, each classification table is composed of five columns. The first column for the competence and the other four for its components, subdivided in the four categories: knowledge, skills and attitudes.

3 Findings from the literature review on Education for Sustainability approaches and Sustainability Competences

Based on the literature review, in this section we will present the main findings of this study:

1. In section 3.1, a description of the terms used in the Sustainability and the Education for Sustainability fields, the history of Education for Sustainability and the approaches for the acquisition of the competences.

2. In section 3.2, the main findings from the analysis of the sets of competences selected from the literature and the proposal of a set of Sustainability competences.

3. In section 3.3, an analysis of the proposed Sustainability competences in the context of the already existing EU frameworks for Lifelong Learning.

4. In section 3.4, the main benefits of promoting the learning of the competences in Europe.

5. In section 3.5, recommendations from relevant European organisations, for scaling up Education for Sustainability and the learning of the competences.

3.1 Sustainability and Education for Sustainability

3.1.1 The main terms used in the two fields

In this report we will deal with a multitude of terms and concepts whose meanings for some authors and practitioners overlap, for others coincide and for others differ in accordance with how they are interpreted or where they are applied. Specifically, we will talk about:

- Sustainability and Sustainable Development.

- Environmental Education, Environmental Education for Sustainability, Education for Sustainable Development, Education for Sustainability, Sustainability Education.

Given this variety of terms, the reader may find it difficult to give them meaning. Therefore, in relation with expressions such as Environmental Education, Education for Sustainable Development and Education for Sustainability, we ask the reader to consider that:

"While we acknowledge that words are important, people could wait forever for a consensus to develop on the best term to use. It is therefore important to keep in mind that it is not the words per se that are significant. It is how these words are used and what they actually mean to people that is most important. It is more imperative to develop some common understanding around education for sustainability, or close siblings of this term, than to argue over the best words to use" (Parliamentary Commissioner for the Environment of New Zealand, 2004, 39).

For these reasons, to introduce the concepts of Sustainability and Education for Sustainability, we will briefly describe the two movements ([3]). To do so, we will use the literal wordings of the authors that have contributed to sketch their stories and characteristics when these authors will be cited (e.g., Education for Sustainable Development or ESD, when the words of UNESCO will be mentioned).

Therefore, in the following pages, we invite the reader to consider as equivalent the terms:

- "Sustainable Development" and "Sustainability" on the one hand, and

- "Environmental Education", "Education for Sustainable Development", "Education for Sustainability", "Sustainability Education" and "Environmental and Sustainability Education", on the other.

([3]) We refer to the movement of Sustainable Development and Sustainability on one hand, and of Environmental Education, Education for Sustainable Development and Education for Sustainability, on the other.

3.1.2   The terms Sustainable Development and Sustainability

Respect for sustainability has ancient roots in human cultures. For example, the popular saying "We do not inherit the Earth from our ancestors, we borrow it from our children" is attributed to the indigenous culture of North America (Engelman, 2013).

Caradonna (2014) states that the history of the concept can be traced back to the late 17th century, to the critique of the impact of industrialisation and to the efforts to solve issues impacting on forestry.

However, it is since the 60s and 70s of the last century that concerns about the state of the environment and poverty, and criticisms to the prevailing development model began to spread globally, with publications such as:

- The book "Silent Spring" by Rachel Carson (1962) which reveals to the public the consequences of pesticide abuse.

- The report "Limits to Growth" (1972), commissioned to the Massachusetts Institute of Technology (MIT) by the Club of Rome. It denounced the unsustainability of the growth rates of population, industrialization, pollution, food production and resource exploitation.

- The book "Small is beautiful: Economics as if people matter", where Schumacher (1973) shares criticism on an economy that bases its decisions on profitability and not on human needs.

Finally, the United Nations World Commission on Environment and Development (UN WCED), in the Brundtland Report "Our common future" (1987), defined officially for the first time, the concept of Sustainable Development (SD) as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). Nevertheless, as defined by the Brundtland Commission, the concept was never fully shared and since then many authors sought new definitions until, as Lozano (2008) acknowledges, in 1992 at least 70 had been collected.

Some authors think that this proliferation of interpretations has been favoured by the ambiguity of the terms. For example, the translation into Spanish or Italian, lead to confusion when "development" is used as a synonym of "growth", while, as the ecological economist Herman Daly (1977) points out, "development" must be seen as "qualitative improvement" for man, and not as quantitative-material growth. It seems like the criticisms of the term "development" have arisen especially in countries that are moderately or highly developed. Specifically, in countries that are part of the 20% of the world population that uses 80% of natural resources, where most people have already reached a basic level of well-being and many have surpassed it, reaching overwhelming opulence and indecent waste. In contrast, if the expression "sustainable development" is read from a global perspective that brings together very different countries, the term "development" must be interpreted in terms of the need for progress towards a better quality of life in poor countries, where in many cases people's poverty contrasts with a great wealth in natural resources. As a confirmation of this hypothesis, there is a whole community of educators that carries out Development Education (DE) (⁴) without ever having criticized the word "development".

In relation to these different perceptions of the word "development", Sterling (2010) affirms that in some developing countries, the "western" distinction between Environmental Education (EE) and Development Education (DE) was received with misunderstanding, since there, environmental and development were seen as different sides of the same coin. Particularly, this "western" distinction between EE and DE, and the different perceptions of the word "development", in the two movements, makes us think that, although more importance is given to the need for sustainability in industrialised countries or, in contrast, to the acceleration of development in the less industrialised countries, the concept of sustainable development is very

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(⁴)   In the Dictionary of Humanitarian Action and Development Cooperation (http://www.dicc.hegoa.ehu.es/listar/mostrar/81), it is said that "DE was born in the countries of the North during the period of decolonization in the 50s and 60s, linked to cooperation for development and NGOs. However, it was at the beginning of the 80's when it experienced its evolution… mainly from the hand of British, Dutch and Nordic NGOs" (Eizagirre). Sterling (2010) states that even though EE and DE emerged from different roots and traditions, inevitably in the 90s the two parallel educational movements began to be seen as "brother" movements (https://developmenteducation.ie).

anthropocentric and very focuses on the survival of the human species. All other living species and natural resources, our natural capital ([5]), are considered only as functional to it.

The debate has been so lively, that Engelman (2013) warns about the excessive use of the concept without real action when at the turn of the millennium, the term gains a life of its own, with no assurance that this was based on the Brundtland Commission's definition. The author talks about the age of "sustainababble", a cacophonous profusion of uses of the word sustainable to mean anything from environmentally better to cool, or to lend itself to behaviours often called greenwashing.

Conversely to the latter, among the trends in Education for Sustainable Development, UNESCO (2018a) draws attention to those driving the sustainability agenda that push for a strong definition of sustainable development that considers the wise use of resources and environmental conservation as limits not to be transgressed by social activities and economic growth. Therefore, solutions can be considered to be truly sustainable only when, in a holistic manner, they remain true to the environment (the natural life support systems of the planet and of all its life forms), to society (social justice and peace for the common good of all people, not merely benefiting a few) and the economy (prosperity and partnerships for sufficiency rather than for profit maximization for its own sake at all costs) (OECD, 2016).

In conclusion, probably because of being a multidimensional concept, "Sustainable development" lends itself to very different interpretations. UNESCO (2002) concludes that we have learnt that achieving sustainable development is essentially a process of learning. That it is linked as much with notions of peace, human rights and fairness as with theories of ecology or global warning. While it involves the natural sciences, policy and economics, it is primarily a matter of culture: it is concerned with the values people cherish and with the ways in which we perceive our relationship with others and with the natural world. These worldwide and multifaceted features of Sustainable Development are at the heart of the previously mentioned "2030 Agenda for Sustainable Development", approved by the United Nations (UN) Member States in 2015. This Agenda calls for action by all countries, developed and developing, in a global partnership to achieve 17 Sustainable Development Goals (SDGs). The SDGs (Box 2) provide a blueprint towards ending all forms of poverty, fighting inequalities and tackling climate change, while ensuring that no one is left behind.

Box 2. The UN 17 Sustainable Development Goals (SDGs)

1. No Poverty – End poverty in all its forms everywhere

2. Zero Hunger – End hunger, achieve food security and improved nutrition and promote sustainable agriculture

3. Good Health and Well-Being – Ensure healthy lives and promote well-being for all at all ages

4. Quality Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

5. Gender Equality – Achieve gender equality and empower all women and girls

6. Clean Water and Sanitation – Ensure availability and sustainable management of water and sanitation for all

7. Affordable and Clean Energy – Ensure access to affordable, reliable, sustainable and clean energy for all

8. Decent Work and Economic Growth – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

9. Industry, Innovation and Infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

10. Reduced Inequalities – Reduce inequality within and among countries

11. Sustainable Cities and Communities – Make cities and human settlements inclusive, safe, resilient and sustainable

12. Responsible Consumption and Production – Ensure sustainable consumption and production patterns

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[5] "Natural capital is equivalent to the existence of environmental assets, such as soil, biodiversity and fresh water, which bring benefits to humans" (WWF, 2016).

13. Climate Action – Take urgent action to combat climate change and its impacts

14. Life below Water – Conserve and sustainably use the oceans, seas and marine resources for sustainable development

15. Life on Land – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

16. Peace, Justice and Strong Institutions – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

17. Partnerships for the Goals – Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Source: United Nations, 2015.

In synthesis, in line with clarifications on Sustainable Consumption and Production of the United Nations Environmental Program – UNEP (2010), it could be concluded that the pursuit of Sustainable Development and Sustainability embraces at the same time:

- Satisfying human needs.

- Promoting a good quality of life through decent standards of living.

- Sharing resources between rich and poor.

- Acting with an attention to future generations.

- Respecting ecosystems, minimizing the use of resources, the production of waste and pollution.

- Promoting lifestyles that give greater value to social cohesion, local traditions and non-material values.

- Fostering peace, equity and justice.

- Involving individuals, families, communities, governments and the economic sector (UNEP, 2010).

3.1.2.1 Complexity and the inseparability of the sustainability dimensions

In this report, we refer to "sustainability" as a catalytic vision and aspirational long-term goal. In the following paragraphs, we will present the reasons why today the term "Sustainability" is often preferred to point out the three intertwined dimensions of the challenges humanity faces: natural, social and economic.

According to Morin (1999) "Complexus" means "that which is woven together". In fact, there is complexity whenever the various elements (economic, political, sociological, psychological, emotional, mythological…) that compose a whole are inseparable, and there are inter-retroactive, interactive, interdependent relations between the subject and its context, the whole and the parts, the parts and the whole, the parts amongst themselves (Morin 1999). Meadows in 1982 acknowledged that we treated our world, a complex, interconnected and finite ecological-social-psychological-economic system, as if it were divisible, separable, simple, and infinite. The author argued that our intractable and persistent global problems arise directly from this mismatch (Meadows, 1982). That is probably why, as Ceruti (2020) explains, today man is in a cognitive crisis which concerns his relationship with himself and with reality. It is a paradoxical condition. We live in an increasingly complex world but dominated by a paradigm of "simplification", which illusorily separates us from nature, locks us up within national borders, fragments knowledge and stiffens identities. This model increases regressive trends and the risk of future catastrophes (Ceruti, 2020). In practice, this results in that our current economic system is fundamentally linear. It focuses on producing products and delivering them to the customer in the fastest and cheapest way possible. We extract resources, turn them into goods, and then discharge back into nature massive amounts of often highly toxic waste (which we call air, water, and soil pollution) or as solid, industrial, and hazardous waste (which we dispose of in landfills or burn in incinerators). After 200 years, this so-called "take-make-waste" production system has become firmly embedded in our psyches as the dominant paradigm (Doppelt, 2003, 34).

Yet our use of the planet's atmosphere, crust, forests, fisheries, waters, and resources is now a force like that of nature (Engelman, 2013, 8). In fact, in 2019 the Anthropocene Working Group (AWG) ([6]) voted in favour of designating a new geologic epoch, the Anthropocene, in which many conditions and processes on Earth are profoundly altered by human impact, significantly intensified since the onset of industrialization.

The field of sustainable development has emerged in response to these mounting ecological and social challenges stemming from the traditional economic paradigm. At its core, in practice this new approach fundamentally is trying to transform the linear model into a circular one, that design experts McDonough and Braungart call a "cradle to cradle" production scheme (Doppelt, 2003). Based on similar ideas, the European Union adopted a comprehensive circular economy policy package of legislative and non-legislative initiatives, since 2015, setting the world's largest single market area on a transition (Ellen MacArthur Foundation, 2020) towards a "sustainable, low-carbon, resource-efficient and competitive economy" (European Commission, 2015, 6). Circular Economy has now become a key component of the European Green Deal and the Coronavirus Recovery Plan (European Commission, 2020). However, in a recent research, Calisto Friant, Vermeulen and Salomone (2020), considering the emerging state of the academic literature on the social, ecological and political implications of the Circular Economy, depict it as a still contested concept, with many different societal actors seeking to influence its meaning and understanding, with a diversity of conflicting approaches to circularity (Calisto Friant et al., 2020; Korhonen et al., 2018; Lazarevic and Valve, 2017; Repo et al., 2018).

3.1.3   The terms Environmental and Sustainability Education ([7]) (EE and SE)

3.1.3.1   *History of a movement and fundamental traits of EE and SE*

The field of Environmental Education (EE) arose in the 1960s out of the growing awareness of the threat of environmental degradation and the need for greater public awareness of the growing scientific and ecological problems of the environment (Gough, 2013). The movement, in practice, stemmed from nature study and conservation education and in 1969, for the first time, Stapp together with a group of experts, defined "Environmental Education" in The Journal of Environmental Education, as "aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems and motivated to work toward their solution" (Stapp et al., 1969, 30).

In their view, EE had to achieve four objectives:

- A clear understanding that man [sic] is an inseparable part of a system, and that man [sic] has the ability to alter the interrelationships of this system.

- A broad understanding of the biophysical environment, both natural and man-made [sic], and its role in contemporary society.

- A fundamental understanding of the biophysical environmental problems, how can they be solved, and the responsibility of citizens and government to work toward their solution.

- Attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in its problem-solving (Stapp et al., 1969, 31).

Later on, in 1972, the first United Nations Conference on the Human Environment held in Stockholm (Sweden), was a major turning point for EE internationally, as the participants specifically called for "education in environmental matters, for the younger generation as well as adults", in Principle 19 of the Stockholm Declaration (United Nations -UN, 1972). Then, two subsequent conferences still stand today as seminal events for EE on the world stage. The International Workshop on Environmental Education, held in Belgrade in 1975, resulted in what is known as The Belgrade Charter, which proposed what became the most widely accepted definition of EE:

([6])   The Anthropocene Working Group is a panel of scientists in charge of the task of examining the Anthropocene as a geological time (chronostratigraphic) unit and its potential addition to the Geological Time Scale. The AWG acts as a component body of the Sub commission on Quaternary Stratigraphy (SQS), a constituent body of the International Commission on Stratigraphy (ICS).

([7])   From here, we will present the history and characteristics of a very dynamic educational movement characterized by an evolution of different terms and perspectives. For this reason, as anticipated at the beginning of the chapter, we will use the terms EE, ESD, ES and SE in the ways in which they are used by the cited authors. The reader is kindly asked to keep in mind that the different terms, she/he will come across while reading, refer to this single great educational movement in which a variety of world cultures converge.

"Environmental education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively toward solutions of current problems and the prevention of new ones" (United nations environmental Program – UNEP, 1975, 2).

Nonetheless, the definitive codification of EE as an international enterprise ultimately came out of the world's first Intergovernmental Conference on Environmental Education held in Tbilisi (Georgia) in October of 1977. In the Tbilisi Declaration, the "Goals", "Categories of objectives" (Awareness, Knowledge, Attitudes, Skills and Participation) and "Guiding principles" of Environmental Education provide the foundation for much of what has been done in the field since 1978. The goals set by the Tiblisi Declaration were:

- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas.

- To provide every person with opportunities to acquire the **knowledge, values, attitudes, commitment and skills** needed to protect and improve the environment.

- To create **new patterns of behaviour of individuals, groups and society** as a whole towards the environment (UNESCO, 1978, 26).

In the 1990s, although the concept emerged in the 1980s, the term "Sustainability" began to form part of the vocabulary of environmental education. Tilbury for example, in 1995 clarifies that Environmental Education for Sustainability (EEFS) builds upon much of the principles of the EE of the 1980s, by adding relevance to the curriculum, adopting an issue-based approach, by stressing the participation and action-orientated dimensions in learning and by placing emphasis on values education. Further, EEFS attempts to capture the complexity of environmental problems and encourage a higher level of thinking which cannot come about by separating the elements that constitute it. For this reason, it focuses more sharply on developing closer links between environmental quality, ecology, socioeconomics and the political threads which underlie it (Tilbury, 1995). As a matter of fact, Sustainable Development is more about new ways of thinking than about ecology and science. While it involves the natural sciences, policy and economics, it is primarily a matter of culture (UNESCO, 2002). It cannot be achieved by political agreements, financial incentives or technological solutions alone; Sustainable Development requires changes in the way we think and act, and Education plays a crucial role in bringing about this change (UNESCO, 2014a). If education is to be transforming, then education itself must be transformed, and Education for sustainability constitutes a catalyst for this change (Sterling, 1996).

Nowadays, in fact, there is a growing international recognition of ESD — or ES – as an integral and transformative element of quality education and lifelong learning, and as a key enabler for sustainable development (UNESCO, 2018a). It was acknowledged as such at the three seminal global sustainable development summits: the UN Conference on Environment and Development held in 1992 in Rio de Janeiro (Brazil), the World Summit on Sustainable Development that took place in 2002 in Johannesburg (South Africa), and the UN Conference on Sustainable Development, that also was organised in Rio de Janeiro, but in 2012.

Education for Sustainable Development is also recognized in Article 12 of the Paris Agreement (UNESCO, 2017), as an integral element of the UN Sustainable Development Goal on quality education and as a key enabler of all the other SDGs (UNESCO, 2017, 2021a; UN, 2015). Sure enough, Target 4.7 of SDG 4, states that "The knowledge, skills, values and attitudes required by citizens to lead productive lives, make informed decisions and assume active roles locally and globally in facing and resolving global challenges can be acquired through ESD" (UNESCO, 2016b, 49).

More in detail, the most encompassing definition asserts that Education for Sustainable Development:

- Allows human beings to acquire the knowledge, skills and attitudes necessary to shape a sustainable future.

- Empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations.

- Is a holistic and transformational education that addresses pedagogy and the learning environment, the learning contents and outcomes.

- Achieves its purpose by transforming social institutions so that they can respond creatively to global sustainability challenges (UNESCO, 2018b).

To conclude, ESD may be understood as an umbrella term for education approaches centred on the wellbeing of people and planet, including environmental education, climate change education, consumer education and global citizenship education (UNESCO, 2012).

3.1.3.2 Brief conclusions on the naming of Environmental and Sustainability Education

As specified at the beginning of this chapter, and as confirmed by the above description of its history, a variety of terms are associated to the same worldwide multicultural movement.

Sterling, in 2010, recapitulates that since 1992, after the Brundtland Commission and the Rio de Janeiro Earth World Summit, different points of view have been disseminated on education for change and the terms Environmental Education and Education for Sustainable Development:

- Those who say EE is a synonymous with ESD.

- Those who see ESD as a component of EE.

- Those who see EE as a component of ESD.

- Those who wish to do away with ESD altogether.

- Those who believe that ESD is a better term than EE and that the latter should be abandoned (Sterling, 2010).

McKeown and Hopkins (2003), reminding that the specific terms and rhetoric related to sustainability concepts were originally translated from many different languages, suggest that collaborative, locally appropriate action in both EE and ESD is more useful than an "either-or" debate over whose terminology should be adopted. Said that, before addressing the dimensions of Education for Sustainability and simplifying a lot because of the differences among countries, perspectives and interpretations, we will briefly resume the terms used today.

In the EU policy documents, we identified the following wordings:

- "Education for sustainable development (ESD)" in the "Council conclusions on education for sustainable development" (Council of the EU, 2010).

- "European competence framework to help develop and assess knowledge, skills and attitudes on climate change and sustainable development" in the Communication from the Commission "The European Green Deal" (European Commission, 2019).

- "Council Recommendation on encouraging cooperation in education for environmental sustainability" in the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "EU biodiversity strategy for 2030. Bringing nature back into our lives" (European Commission, 2020).

In the Environmental and Sustainability Education literature, "depending on the history, cultural context or specific priority areas" (UNESCO, 2014a) of who uses them, today we identify the following labels:

— Environmental Education (EE) is tightly associated to the first phases of the movement and evolved in a multitude of perspectives until García (2002), aware that he was simplifying a lot, groups the different existing paradigms into three major trends:

- the initial model, with a naturalistic character, very focused on understanding the environment, ecological concepts and research on the environment;

- the environmentalist and conservationist model;

- a model close to sustainable development and social change, with a diversity of positions, from those that do not question the established system to those that demand a profound change in socioeconomic structures.

Currently, EE is still used by authors and practitioners in different countries. Among the users of this term, some still associate it only to "naturalistic" or "conservationist" practices, while others include the natural, social and economic dimensions as parts of the "environment".

— Education for Sustainable Development (ESD) is widely used globally as it is the terminology used by UNESCO in all its documents. Probably because it encompasses the view of a multitude of countries, of which many developing countries.

— Sustainability Education (SE) is easy to couple with Environmental Education in the short sentence "Environmental and Sustainability Education", as we did in the title of a former section. Hence, it represents a nuance of Education for Sustainability that is not translatable in many of the EU languages (e.g., in Italian and Spanish).

— Sustainable Education is a concept used by Professor Sterling that denotes a shift in educational culture based on critical awareness and deep change in educational values, assumptions and practice, that goes beyond integrating sustainability-related topics and principles into curricula (Sterling, 2008).

— **Education for Sustainability** (ES or EfS), in opposition to the education originally seen as Education "in" and "about" Sustainability (Tilbury, Crawley y Berry, 2004), encompasses a catalytic vision and aspirational long-term goal, and **is suitable for translations to the many EU Member States' languages**. These are the reasons why **we have chosen this term together with ESD, which is preferred by UNESCO, in the sections that follow**.

3.1.4 Education for Sustainability (ES) or Education for Sustainable Development (ESD) approaches

Given the historical richness of perspectives portrayed, we agree with Sterling (2010) when he emphasizes the importance of keeping in mind that labels constitute a double-edged sword: although they serve to simplify and communicate, they can also confuse and fragment. For this reason, one must look beyond the labels and not forget their deepest meanings. To portray these deepest meanings, in this section, we will present the main traits of Education for Sustainability, a powerful tool to help the citizens that live in Europe to build the competences needed to progress towards sustainability.

3.1.4.1 *Education for Sustainability principles and dimensions*

To create a more sustainable world, individuals must engage with sustainability related issues and become change-makers. Therefore, for the achievement of the Sustainable Development Goals, education is crucial. However, not all kinds of education support sustainable development. In fact, an Education that promotes economic growth alone may well also lead to an increase in unsustainable consumption patterns (UNESCO, 2017).

Furthermore, we must point out that ESD is much more than the transmission of principles and knowledge related to sustainability (UNESCO, 2012). It means and implies far more than what the people working outside the field often perceive it to mean (Sterling, 2014). Specifically, in the Global Action Programme that encompasses policies and practices on ESD, UNESCO (2014a) clarifies that, irrespective of whether the activities use the term education for sustainable development, environmental education, sustainability education, global education, development education or other terms, ESD – or ES - is intended to encompass all activities that are in line with the following principles:

- ESD, goes far beyond the acquisition of mere information. It entails including key sustainable development issues into teaching and learning, but also requires innovative, participatory teaching and learning methods that empower and motivate learners to take action for sustainable development.

- ESD promotes competences like critical thinking, understanding complex systems, imagining future scenarios, and making decisions in a participatory and collaborative way.

- ESD is grounded in a rights-based approach to education. It is concerned with the provision of quality education and learning that is relevant today.

- ESD is transformative education in that it aims at reorienting societies towards sustainable development. This, ultimately, requires a reorientation of education systems and structures as well as a reframing of teaching and learning. It concerns the core of teaching and learning and cannot be considered an add-on to existing educational practices.

- ESD encompasses formal, non-formal and informal education and lifelong learning from early childhood to old age. It therefore also encompasses training and public awareness activities within wider efforts towards sustainable development.

- ESD relates to the environmental, social and economic pillars of sustainable development in an integrated, balanced and holistic manner. It equally relates to a comprehensive sustainable development agenda which, among others, includes the interrelated issues of poverty reduction, climate change, disaster risk reduction, biodiversity, and sustainable consumption and production. It responds to local specificities and respects cultural diversity (UNESCO, 2014a).

ESD – or ES - should be understood as an integral part of quality education, inherent in lifelong learning, from preschool to tertiary education and in non-formal and informal education. It provides an education that matters and is truly relevant to the learners, in the light of today's challenges (UNESCO, 2017). Furthermore, ESD constitutes a powerful tool for reforming education systems, because of its emphasis on student-centred learning and its progressive reframing of pedagogies (UNESCO, 2018a).

3.1.4.2 *Pedagogy, learning approaches and environments*

Discussions especially focused on the educational contents of ES, often limit their attention to sustainability. Nevertheless, as anticipated in the previous section, while the 'content' dimensions are crucial, sometimes they are accentuated to the detriment of the 'education' component, built on a long history of pre-existing progressive educational theories drawn on earlier work in environmental education, global citizenship education and experiential education. The unique aspect captured by ESD is its holistic packaging and application of these various learning approaches and pedagogies with a perspective towards transformative learning (UNESCO, 2018a).

Methods are chosen for a specific setting. They must match the needs of the learner group (e.g., based on age, prior knowledge, interests, abilities), the context in which the learning takes place and the resources and support available (e.g., teacher competences, teaching materials, technology, funding) (UNESCO, 2017).

To inspire learners to act for sustainability, ESD approaches entail rethinking learning environments, both the physical and the virtual and online ones (UNESCO, 2014a). To empower and motivate them, ESD approaches engage learners in cooperative learning that include questioning, critical thinking and decision-making (UNESCO, 2014b; Ofei-Manu and Didham, 2012). In short, key ESD -or ES- pedagogical approaches may be summarised in learner-centred, action-oriented and transformative, as follows:

⎯ **Learner-centred** approaches, rather than the mere transfer of knowledge and a passive learning experience, promote the learners' active construction of knowledge. The learners' prior knowledge are the starting points for stimulating learning processes that require learners to reflect on their own knowledge and learning. Educators become facilitators that guide the learning process, stimulate and support those reflections. (UNESCO, 2017; García, 2002; Bart, 2015; Sterling, 2001; 2011)

⎯ In **action-oriented** learning, learners engage in action and reflect on their experiences in terms of the intended learning process and personal development. Action-learning increases knowledge acquisition, values clarification and competence development by linking abstract concepts to personal experience and the learner's life (UNESCO, 2017). Researchers such as Rodríguez and García (2009), express concern for what they call "activist practices" (García, 2002). In these practices, in opposition to "action-oriented practices", as the authors explain, there is no reflection on the meaning of the proposed activities, on how the contents are formulated and organized, on the meaning of what is done for the people who participate, or the effectiveness activities in terms of learning.

⎯ **Transformative** learning is a term that arose from the work of the adult pedagogue Mezirow (1978) and that initially was not related to the great challenges of social change and sustainability (Sterling, 2011). Moore (2005) explains that its goal is to empower individuals to change their frames of reference, perspectives and worldviews. It essentially refers to a change in perception and creation of meaning that occurs in the learner through a particular learning experience that makes him question his assumptions or way of thinking (Sterling, 2011). To give an idea of transformative approaches, in Table 3, we summarise some of the main differences between transmissive and transformative approaches that Sterling reported in 2001.

Table 3. The main differences between transmissive and transformative education

Transmissive education	Transformative education
Promotes the transfer of "one-fits-all" information	Starts by analysing existing knowledge and belief
Is rigid	Is flexible
Communicates a 'message'	Facilitates the construction of meaning
Counts on passive introductions	Promotes active learning styles
Is product oriented	Is process oriented
It focuses on teaching	Thinks that teachers are also learners and that learners are also teachers
Is interested in behavioural change	Is interested in mutual transformation
Has specialisation as a core value	Has integrative understanding as a core value
Seeks simple learning	Seeks also critical and epistemic learning
Promotes a competitive environment	Promotes a collaborative environment
Encourages fear of mistakes	Encourages learning from mistakes
Discourages copying from others	Encourages learning from others
Uses quantitative evaluation measures	Uses qualitative as well as quantitative measures

Source: Author's elaboration based on Sterling (2001)

In conclusion, transformative learning is complex and often uncomfortable, and entails a great deal of time and energy (Moore, 2005).

3.1.4.3 Conclusions on Education for Sustainability pedagogical approaches, competences and educators

UNESCO (2017) recapitulates that only a holistic and transformative ESD can make possible the development of the competences needed for promoting sustainable development. ESD does not only integrate contents such as climate change, poverty and sustainable consumption into the curriculum. It also requires interactive, learner-centred and transformative pedagogical approaches which support self-directed learning, participation and collaboration, problem-orientation, inter and trans-disciplinarity.

In short, Education for Sustainability pedagogical approaches do not consist of a series of handbooks with a list of "one-fits-all" activities that anyone can effectively facilitate. That is to say that, in an educational itinerary, usually various and flexible activities are designed, combined and tailored to the learners by the Education for Sustainability professional with all the Sustainability competences considered key for Education for Sustainability Educators. This is because transformative and learner-centred methodologies require that the different pedagogical methods, resources and contents have to be combined in an appropriate way, so to design and guide the educational process according to the planned objectives and following a coherent unifying thread that gives it meaning. The contents and the methods must be tailored to the previous knowledge and (expressed or hidden) interests of the learners. The process and its implementation must be continuously readapted according to the feedback collected through the constant observation of the learners' reactions and the evaluation of the outcomes (Scalabrino, 2017). Coherently, as Mayer (1998) reminds, for deep change, we have to offer time and occasions to discuss and reflect. We must renounce to change behaviours in short periods of time and try to set the conditions for longer term change (Mayer, 1998). To explain this through an example, if the final objective is "to promote the change from a Linear to a Circular Economy, we must acknowledge that the irresponsible and hyper consumeristic behaviours of our society are comparable to those of a sedentary person addicted to exceedingly abundant food, high in fat, sugar and salt. If information delivered within a few hours was sufficient to learn and find the strength to eat healthier, overweight people would not exist today" (Scalabrino, 2019).

The Sustainability competences (e.g., systems thinking, future thinking…) that will be presented in the following section, can be learned through life experiences, lifelong learning and, especially through Education for Sustainability provided by ES professionals who have developed the competences themselves. As Scherak and Rieckmann (2020) explain, for teachers to be able to implement Education for Sustainable Development

in a professional manner and to take an appropriate approach both to content and to method, they need to develop sustainability competences and ESD competences, which can be described as the ability to support learners in developing sustainability competences through a range of innovative teaching and learning practices. As maintained by the partners of the Rounder Sense of Purpose European project (2019), teachers must have a critical understanding of sustainable development on the one hand and the pedagogical approaches of ES (also the skills to apply them) on the other. We think that the professionalism of the ES educator must be built through experience, multidisciplinary knowledge, motivation, creativity, capacity of observation, active listening, empathy and much more. For all these reasons, specific competence frameworks have been designed for the professional development of ES educators. For instance, by UNECE (2011) and Vare et al. (2019).

3.1.4.4   Learning content

As political and socio-cultural realities and specific environmental and ecological challenges make a contextual grounding of ESD essential, there is no "one size fits all" ESD (UNESCO, 2014b). Education for Sustainability must encourage learners to explore the links between their lives and wider environmental and development concerns, by dealing with issues like consumerism and how the practices of business and industry influence their lives. In doing so, it prepares learners for contemporary reality (Tilbury, 1995) and helps them to cope with its complexity. Having to do with life on Earth, with its natural, social, economic and cultural components, and the connection among these components, anything can become the content of Education for Sustainability. Sure enough, ES cannot be claimed as a subject in itself, rather it must be treated as a 'whole' concept that calls for inputs from all parts of the curriculum (Worldwide Fund for Nature [WWF], 1990, 1) and from different disciplinary fields. Anyhow, in a recent UNESCO (2018a) report, a few key points on Education for Sustainability contents are summarised:

- While the acquisition of sustainability competencies is at the core of Education for Sustainable Development, the choice of topics and content used for developing them must seek the potential for action by learners.

- Key fields of action for facilitating sustainable development are the 17 Sustainable Development Goals. Among the SDGs, topics that have been identified as crucial for sustainable development are climate change, biodiversity, sustainable production and consumption, and poverty.

- All these themes are persistent long-term challenges. They are complex and manifold in their interrelations. Thus, they offer a high potential for action and transformation on the part of learners.

- Other crucial themes for Sustainable development are identified in The Bonn Declaration that stresses the need to learn how to address priorities such as: water, energy, climate change, disaster and risk reduction, loss of biodiversity, food crises, health risks, social vulnerability and insecurity (UNESCO, 2009).

3.1.4.5   Learning outcomes

Stimulating learning and promoting core competencies, such as critical and systemic thinking, collaborative decision-making, and taking responsibility for present and future generations are the main learning outcomes of ESD (UNESCO, 2014a). UNESCO (2019) summarises that, for effective teaching and learning, ESD has to offer a holistic learning experience that puts learners on a pathway of empowerment and transformation. Therefore, it describes three interlinked learning dimensions that need to be developed in conjunction:

- **Cognitive**: To acquire knowledge, understanding and critical thinking about global, regional, national and local issues, the social, economic and environmental aspects of sustainable development, as well as the interconnectedness and interdependency of different countries and populations.

- **Social and emotional**: To have a sense of belonging to a global human community, sharing values and responsibilities, empathy, solidarity and respect for differences and diversity, as well as feel and assume responsibility for the future.

- **Behavioural**: To act effectively and responsibly individually and collectively, at local, national and global levels for a more peaceful and sustainable world.

3.1.4.6 Behavioural learning outcomes and premises to the examples associated with the proposed set of competences

Behavioural change is not a simple process and reflects non-linear rather than linear theories of knowledge (Gough, 2013). That is probably why emancipatory or critical pedagogy seeking to empower learners to democratically transform society, have been considered appropriate for the development of environmental education (Huckle, 1991; Greenall Gough, 1991). Thus, the issue of what shapes pro-environmental behaviour is such a complex one, that it cannot be represented through one single framework or diagram (Kollmuss and Agyeman, 2002).

Said that, an intrinsic difficulty exists in the assessment of ESD behavioural learning outcomes. While in the 1970s and 1980s, research in environmental education was dominated by applied science methods (quantitative), particularly popularized by American researchers, then there was a slow and steady evolution away from these methods towards postpositivist methodologies (Palmer, 1998). For instance, the international implementation scheme for the UN Decade of Education for Sustainable Development 2005-2014 stated that aspects such as the adoption of values and changes in behaviour cannot be adequately captured by numbers alone. In terms of qualitative analysis, community-wide ethnographic studies and analyses will provide data and will show the multiple connections in people's lives between the changes in values, practices, behaviours and relationships, which sustainable development implies (UNESCO, 2006).

With these premises, as proposed by the European Commission to better understand the potential of developing the Sustainability competences in the EU, special attention was given in this report to the behavioural outcomes of Education for Sustainability.

In the set of Sustainability competences, designed putting together many diverse frameworks and sets of competences from the literature, and that may be used as a bases for expert consultation, one of the resulting seven competences is dedicated to the concepts of "Strategic action-oriented competence", similar to concepts that in some of the frameworks in the literature are called agency, implementation or integrated problem solving. Although each one of these different terms does not appear as many times as the Systems or Value competences, one or two of them do appear in almost all the frameworks analysed. For this reason, to simplify, and considering the different terms as equal to different steps of the "Strategic action-oriented competence", we grouped also agency, implementation and integrated problem solving, in this single competence, whose name could be changed during the following phases of the development process of the competences or in expert consultations accordingly to experts' preferences.

As seen in previous sections of this report, "action oriented" is also one of the pedagogical approaches of education for sustainability. Tilbury (1995) explains that an action-orientated approach is a crucial component of education for Sustainability because being informed about the environment and having a positive attitude towards the environment are, although essential, not sufficient in resolving environmental problems. For people to be able to act upon their knowledge and awareness, they need to become acquainted with a variety of action skills (Wals, 1990).

To make the Sustainability competences more understandable by stakeholders that are not expert in the field, it was asked to give a concise idea of the behavioural changes that each competence in the classification contributes to promote. Although aware of the complexity, we found that this task gave us the opportunity to show how the competences are intertwined in their acquisition and their practical outcomes. However, for a better understanding of the set of competences proposed and of the practical examples provided, some premises are required.

To summarise, at first it could appear strange to associate behaviours to the proposed preliminary set of Sustainability competences, because of:

— The presence, as anticipated, in most of the frameworks analysed in the literature, of a competence related to action towards sustainability, that we combined in our proposed "Strategic action-oriented" competence.

— The current well-established approach of ESD that aims at developing competences that empower individuals for the following actions:

- To reflect on their own actions, considering their current and future social, cultural, economic and environmental impacts, from a local and a global perspective.

- To take informed decisions and to act in complex situations in a sustainable manner, which may require them to strike out in new directions.

- To participate in socio-political processes, moving their societies towards sustainable development (UNESCO, 2017).

— The existence, in the classification proposed, of many competences expressing "abilities" to implement a certain pro-sustainability action, and that we have categorised under "skills".

Hence, because of the complex nature of competences and behaviours, as a premise to the examples on "behavioural outcomes" (Table 6, Table 8, Table 10, Table 12, Table 14, Table 16, Table 18) that will follow the definition and classification of each proposed competence (Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17), the following must be pointed out:

- As sustainability competences are all interwoven, often a single competence contributes to strengthen the others.

- More than one competence at a time usually contribute to a variety of sustainable behaviours, in different areas such as energy, waste, purchases, etc. Not all of these areas could be represented in the examples.

- As a single behaviour (that for example could be related to energy, water or social justice) is usually the result of a set of interacting sustainability competences, with some forcing, we associated the single learning objective to the competence that we think is more influential.

- The level of implementation of a behaviour depends on the background, age and competence development of the person that implements it.

- A competence is context-dependent because individuals do not act in a social vacuum. Action always takes place in specific and various social and socio-cultural fields (Sleurs, 2008). They sometimes need infrastructures (e.g., a public transport network) or instruments (e.g., trash cans to separate waste). They can be favoured, for example, by incentives (e.g., the ones given for energy efficiency or for separating waste – bottles and can machines) or regulations (e.g., the EU Ecolabel or the organic farming regulations).

With these essential premises, in the page following the classification of each one of the competences proposed as a synthesis or for expert consultation, as required, we provide a table with:

- an extremely simplified list of behaviours in the cells entitled 'Examples of "learning objectives" and behaviours associated with the competence' and,

- a more articulated description of the interconnectedness of competences and behaviours (due to the above-mentioned complexity), in the 'Examples of the contribution of the competence to a low carbon and circular economy, to sustainable lifestyles and behaviours'.

For the simplified examples, we associated with the competence several of the Education for Sustainability "learning objectives" summarised by Brundiers et al. (2020) and the ESD "Behavioural learning objectives" to achieve the 17 Sustainable Development Goals (SDG), classified by Rieckman (UNESCO, 2017). It is to be stressed that the purpose of the two just mentioned lists of learning objectives was not their association with the Sustainability competences. For example, in the UNESCO (2017) classification each behaviour was chosen as an example of behaviour contributing to a single SDG.

3.2 Main findings on the Education for Sustainability competences and proposed set of competences

The preliminary study of the Education for Sustainability and Sustainability literature, prepared by Bianchi (2020) for the JRC, brought to the identification of 19 frameworks of Sustainability competences, mainly designed in the last 10 years. The subsequent analysis of the Education for Sustainability literature, described in this report, brought to the selection of 17 more sets of competences which widened the lifelong learning and the historical perspectives, and added definitions and competences for professionals such as educators, eco designers and managers. Altogether, the 36 sets of competences, provided a nuanced and comprehensive collection of concepts called by their authors sometimes competences and sometimes key competences. Then, to avoid confusion with the EU lifelong learning key competence framework, these concepts were grouped in competences, each one of them described by a cluster of components subdivided in knowledge, skills and attitudes.

From the wider historical perspective of this second study, as we just anticipated, at a first glance we noticed that there are a variety of sets of competences where the terms key competences and competences interchange in a not linear evolution. Some concepts that in the literature are nowadays called key competences (Systems, futures, values thinking...) appear as goals or approaches of Education for sustainability in the nineties and others like, for example, critical thinking or problem-solving appear as skills, objectives or guiding principles of Environmental Education in the main EE international founding documents of the seventies. The same concepts become clear key competences in the last decade. In general, the studied authors show different views of the issue, so that some frameworks consist of a combination of competences, some of key competences and some of both elements.

The in-depth comparison of the competences in the 36 sets examined, confirmed the inseparable dimensions of Sustainability. Among the multiple dimensions found in the union of frameworks, there are: Society-economy-environment; Local-global; Thinking, actions, impacts and values; Past-present-future; Individual-collective.

The historical perspective also displayed the evolution of the competences for sustainability before the emphasis on Higher Education of recent years. It also confirmed the great extent of convergence on the competences in sustainability that was found among the most relevant and recent sources presented in the review by Bianchi (2020) for the JRC. To summarise, it showed that concepts such as systemic thinking, future thinking, critical thinking, values thinking and participation/collaboration, can be traced back in the online ES literature to the decades between the 1970s and 1990s as concepts of different kind, but not grouped in frameworks of competences as in the recent literature. That is to say that the literature clearly shows that these competences guide Environmental and Sustainability Education since between three and five decades, in different ways.

To give an idea of the variety of applications of the ES competences, in their history, they have been defined "**objectives/goals**", or "**guiding principles**", "**elements/components**", "**approaches**" and "**learning outcomes**" of learning or of Education for Sustainability.

For example, in one of the first most renowned review of competences (Wiek et al., 2011), for the authors' searches were used the terms "goals" and "outcomes". Going further back in time, Tilbury (1993; 1995) identified holism (systems), values, futures, the action oriented and the critical dimensions, among the **components** defining Environmental Education for Sustainability in the 1990s (Tilbury, 1995), and later, defining Education for Sustainability (Tilbury and Wortman, 2004). Spanish writing authors such as Bonil, Junyent and Pujol (2010) and García (2002), see concepts such as complexity, the critical perspective, values and actions as elements of the **theoretical foundations** of Education for Sustainability. In fact, we confirm that they already appear in the founding documents that resulted from the first Environmental Education conferences of the 1970s. Most of the competences selected for the proposed set of competences are also found as **learning outcomes** (Tilbury, 2011) or as Education for Sustainability **quality criteria**, for example in publication by the School Development through Environmental Education (SEED) and the Environment and School Initiatives (ENSI) networks (Breiting, Mayer and Mogensen, 2005).

Furthermore, from a practical point of view, sustainability competences could also be considered as a starting point for the analysis of learners' preconceptions and as milestones to guide a teaching-learning process for Sustainability.

The variety of terms that we found, in the history of Environmental and Sustainability Education, to name the concepts behind the competences, uncover useful information on the "age" of the sustainability competences, on the evolution of their meanings, learning methodologies and uses. Furthermore, on an aspect that is of importance to anyone who wants to contribute to the spreading and strengthening of the competences in people: the degree of experience and know-how in the development and learning of the competences that exists in the field, which strongly position quality Education for Sustainability as a unique tool to facilitate their learning.

In the following pages the proposal of a set of Sustainability competences will be presented and later summarised and described in a series of Tables (Table 4, Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17, Table 6, Table 8, Table 10, Table 12, Table 14, Table 16, Table 18).

To facilitate its understanding, we summarise the following premises on the nature and representation of the competences:

1. In the proposed preliminary set, the competences are organised in 'competences' and in their clusters of 'components'. The latter serve to enrich the short definition of the competence and to favour a

more comprehensive and nuanced understanding that could help inspire self-learning or teaching activities.

2. Albeit presented as lists in tables, the competences are intertwined. In practice, they cannot always be learned totally independently one from the other and most of the times the development of one of them enhances the others. This interwovenness may be sensed in the examples in the tables called 'Examples of "behavioural learning objectives" and contributions of the competence to a low carbon and circular economy, to sustainable lifestyles and behaviours', that will be presented in wing point 3 (b).

3. For each Sustainability competence:
   a) The first page is dedicated to its description, organised in a table that includes a general definition and a cluster of components that describes it (Table 5, Table 7, Table 9, Table 11, Table 13, Table 15, Table 17). The general definition in the first row of the table, is the result of a distillation of the descriptions that appear in the 36 sets of competences analysed. Instead, to present the clusters of 'components', with some forcing, they have been subdivided in Knowledge, skills and attitudes, in the four columns of the second row of the table. In relation to this classification, it is to be remarked that the limits between Knowledge, skills and attitudes are sometimes blurred. For this reason, some competences may be transversal to more than a Sustainability competence or, also appear in the other already existing EU frameworks of competences.
   b) The second page presents, in a separate table (Table 6, Table 8, Table 10, Table 12, Table 14, Table 16, Table 18), some examples of associated 'behavioural learning outcomes'. These examples have been requested by the JRC to better understand the potential of the competences and to favour a thorough understanding by all kind of stakeholders, including the ones that are not from the field of Education for Sustainability. Nevertheless, before reading the examples of behavioural learning outcomes, we invite the reader to go through the sections "Learning outcomes" and "Behavioural learning outcomes and premises to the examples associated to the competence" (Sections 3.1.4.5 and 3.1.4.6).

4. The competences proposed in the following pages originate from the analysis of 36 frameworks and sets of competences that are listed in the table in Annex 1. The inventory for the analysis and comparison of all the competences that have been found in the 36 sets of competences is included on multiple pages in Annex 2.

3.2.1 The proposed set of sustainability competences and definitions based on the literature review

Table 4. Proposed set of Sustainability competences and definitions based on the literature review

Names of the proposed Sustainability competences	Proposed definitions
Systems thinking	The Systems thinking competence allows us to see the "big picture". Specifically, to see and understand the relationships between the local and global perspectives; among our thinking, actions, impacts and values; among the social, economic, environmental and cultural dimensions of sustainability/unsustainability issues. It allows to address the causes of socio-economic-environmental problems, and not only their symptoms.
Futures thinking (or Anticipatory)	The Futures thinking (or anticipatory) competence allows to analyse predicted scenarios, to discover possible futures and to imagine alternative, better or favourite futures. It helps building scenarios, imagining possibilities and to find direction, to plan how to make positive futures happen. It offers energy, aspiration and motivation to take responsibility for a better future and to be actively involved
Values thinking (or Normative)	The Values thinking (or normative) competence helps to clarify our own values, to differentiate between espoused and practiced values, to understand other people's values, the diversity of values and their implications. Allows personal reflection and conscious decision making regarding personal and professional actions for sustainability.
Critical thinking	The Critical thinking competence helps us examine and question the assumptions that influence our way of seeing the world (to question norms, practices and opinions, and to reflect on our own values, perceptions and actions). It helps us to identify the root

	causes of problems, instead of just their symptoms. It allows to react to the multiple messages, information and advertising that flood our lives. It feeds our motivation to take a position in the sustainability discourse and to participate in change, both individually and collectively, and to develop a sense of our own power to shape our own lives. Some confuse it with 'making criticisms', but critical and reflective thinking in Education for Sustainability is a much deeper process that involves acute research, understanding, and analysis of information and its sources.
Strategic action-oriented (or Agency/ implementation/ integrated problem solving)	The Strategic action-oriented (or agency/ implementation/ integrated problem solving) competence allows acting fairly and ecologically, at individual and collective levels. It implies wise decision-making, creative problem solving, strategic skills and spirit of initiative and empowerment to apply or bring change for sustainability. It permits, individually and collectively, to design and implement interventions and transitions toward sustainability, at the individual and collective levels.
Intra-personal (or Self-awareness)	The Intra-personal (or Self-awareness) competence enables us to reflect on our role in the local community, and national and global society. Hence it allows self-awareness, self-regulation and self-empowerment to grow and persist as a change agent for sustainability. It permits to hold contradictory feelings and thoughts; to cope with complexity and manage personal and group stress; to cultivate awareness; to find inner peace, compassion, meaning making; to experience love, respect and connection.
Inter-personal (or Collaboration)	The Inter-personal (or collaboration) competence allows to motivate and facilitates collaborative and participatory sustainability research, problem solving and implementation. It enables to understand and respect the needs, perspectives and actions of others (empathy), and to deal with conflicts in a group. It permits impactful stakeholder engagement and wise transformation for sustainability.

Source: Author's elaboration done in 2020, based on the analysis and merging of the definitions in the articles and documents listed in the table in Annex 1.

3.2.2 "Systems thinking"

Table 5. The "Systems thinking" competence definition and classification (^{1})

<table>
<tr>
<td rowspan="2">Competence</td>
<td>Systems thinking</td>
<td>The Systems thinking competence allows us to see the "big picture". Specifically, to see and understand the relationships between the local and global perspectives; among our thinking, actions, impacts and values; among the social, economic, environmental and cultural dimensions of sustainability/unsustainability issues. It allows to address the causes of socio-economic-environmental problems, and not only their symptoms.</td>
</tr>
<tr>
<td colspan="2">
<table>
<tr><th>Knowledge</th><th>Skills</th><th>Attitudes</th></tr>
</table>
</td>
</tr>
<tr>
<td rowspan="1">Components or concepts behind the competence</td>
<td colspan="2">

Knowledge	Skills	Attitudes
Knowledge of sustainability/ sustainable development principles	Capacity of understanding complex systems phenomena, including unintended consequences, path dependency, systemic inertia, and intentionality	Predisposition to the analysis of complex systems across different scales and domains of inquiry
Knowledge of sustainability issues and problems and of the need of systemic change	Ability to understand and work with graphics and data sets, cascading effects, inertia, feedback loops, buffers and multiple variables, nested scales, resilience, and tipping points...	Predisposition to the search for connectivity and cause-effect relationships
Holistic knowledge of interconnected ecological, social, economic systems		Appreciation of the interrelatedness of individuals and society
Insight into how individual lifestyle choices influence social, economic and environmental development		Global consciousness and ability to recognize global perspectives
Cross-disciplinary knowledge about the state of the planet (literacy and numeracy)	Lifecycle thinking, circular business models and eco-design principles	Acceptance of uncertainty and ambiguity, and to learn from change
Topical knowledge in sustainability and in other disciplines (e.g., climate change, water, energy, food, poverty, inequality, market and prices, international development...)	Analysing environmental, social and economic impacts	Awareness of the boundaries and assumptions we use to define issues
	Analysing environmental, social and economic risks	Commitment to more participative and interdisciplinary approaches to problem solving
Individual and collective understanding of consumer social responsibility in relation to the corporate social responsibility	Analysing power structures of inequality	Awareness of the urgent need for change
Basic knowledge of the interaction of pricing mechanisms with the consumer's attitudes and behaviour	Recognizing global implications of actions	Willingness to learn beyond "silos" or beyond our own formal education specialisation
	Working across disciplines	Attentiveness and giving importance to the connection to place, to others and the wider world
Insight into the practicalities of both the supply and demand sides of production and consumption, the market system and the role of business	Understanding others' viewpoints and expanding our world view	Making treasure of the influences of our values, self-perception and interpretations of the world
	Exploring the dialectic between tradition and innovation	Supporting global responsibility and active citizenship

</td>
</tr>
</table>

(^{1}) The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 6. Examples of "behavioural learning objectives" and contributions of the "Systems thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with "Systems thinking"
Thanks to system thinking (together with values clarification and empathy) people should, for ex., be able to: — "Explain why sustainability is "not first and foremost about the environment" and not just about technical solutions and engineering; but is instead a layered concept with justice and equity as foundational elements. This would involve broadening the perspective on justice and equity beyond environmental justice to also include more general and explicit forms of social and racial justice" (Brundiers et al. 2020, 10). — Include poverty reduction, social justice and anti-corruption considerations in their consumption decisions (UNESCO, 2017). — Develop criteria and make responsible consumption choices to support fair working conditions and efforts to decouple production from the impact of natural hazards and environmental degradation. — "Develop and evaluate ideas for sustainability-driven innovation and entrepreneurship" (UNESCO, 2017, 26).
Examples of the contribution of the "Systems thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours

A person with a multidisciplinary higher education should be better equipped to understand the interrelations between environmental, social and economic factors. E.g., a person with five-year studies in Environmental Sciences (that may require about: 250 h. of microbiology, 800 h. of biology and ecology, 250 h. of environmental economics, 200 h. of environmental legislation, 800 h. of physics, 900 h. of chemistry, 900 h. of maths, data analysis/ statistics/ modelling, etc.), especially if this education hasn't been delivered only with transmissive methods, should be well equipped for a better understanding of the multifaceted situation due to the Covid-19 pandemic (e.g., the set of data that are continuously communicated, zoonosis and its connections to the state of the environment and to production and consumption patterns, the ways in which contagion occurs, virus mutations, economic sectors risks and damages, pandemic management and restrictions…). Furthermore, the systemic thinking competence could also enhance the future thinking, the critical thinking and intrapersonal competences. For instance, a person with a five-year degree in Environmental Sciences will probably be sufficiently aware of the uncertainty of modelling and predictions with a wide range of changing variables or of the potential of changing predicted tendencies through behaviours. The person will probably better cope with uncertainty and be capable of comparing and select information, etc.

Systems thinking is particularly important for the EU policies which aim to achieve a circular and carbon neutral economy by 2050. For example, in a circular economy it is core to draw out waste, emissions and toxic effluents in the products design phase, instead of implementing only "end of pipe" solutions. Another example from the social sphere, could be that to address migrations from poorer countries it is important also to mitigate its causes in the countries of origin (e.g., climate change, natural resources exploitation, corruption, violence…). Especially the ones that citizens of hyper-consumerist countries, directly or indirectly, contribute to exacerbate (e.g., climate change and consequent extreme droughts or floods; resources unfair exploitation, such as minerals or biomass; etc.). People that are aware of these kind of interrelations between the environmental and social impacts of their actions, their values and what they care for, should better understand what are the more "environmentally and socially friendly" everyday consumption and production behaviours they could implement to contribute to a more sustainable economy. These persons will probably be more motivated to change their lifestyles because of their awareness of the direct or indirect consequences of their choices on the things they really care about (e.g., the future of their children or the polar bear or modern slaves or their jobs or wealth…). Consequently, their interwoven knowledge, skills and values will probably favour, for example, a positive attitude to energy or water savings, to buy EU eco-labelled products, or to avoid food waste. Their capacity of saving money in water, energy and food waste, together with their values, could favour spending more to repair things or to buy organic products. At work, these persons could show a positive attitude towards the use of the EU taxonomy for sustainable activities ([2]) or the implementation of Green Procurement ([3]). These behaviours contribute to reduce Green House Gases (GHG) emissions, resources depletion, biodiversity loss and inequalities. All together they are essential to promote a just, low carbon and circular economy.

([1]) Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

(²) https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en
(³) https://ec.europa.eu/environment/gpp/index_en.htm

Source: Author's elaboration done between October 2020 and February 2021.

3.2.3 "Futures thinking" (or Anticipatory)

Table 7. The "Futures thinking" competence definition and classification (^{1})

<table>
<tr>
<td rowspan="2">Competence</td>
<td colspan="3">Futures thinking   The Futures thinking (or anticipatory) competence allows to analyse predicted scenarios, to discover possible futures and to imagine alternative, better or favourite futures. It helps building scenarios, imagining possibilities and to find direction, to plan how to make positive futures happen. It offers energy, aspiration and motivation to take responsibility for a better future and to be actively involved.</td>
</tr>
<tr></tr>
<tr>
<td rowspan="3">Components or concepts behind the competence</td>
<td>Knowledge</td>
<td>Skills</td>
<td>Attitudes</td>
</tr>
<tr>
<td>Knowledge of the world mega trends, related to environmental, social, economic, cultural, technology and other sustainability issues

Knowledge of local socio-economic-environmental trends</td>
<td>Scenario creation capacity (forecasting and back casting)

Envisioning, analysis, and evaluation of possible futures, including scenarios with multi-generational timescales

Reflecting upon the basis of our socio-cultural values and assumptions

Risk prediction

Application of precautionary principle

Prediction of reactions

Dealing with risks and changes

Recognizing the implicitly held (and largely unrecognized) assumptions about how society works and how they influence the status quo and critically reflecting on how they might influence futures thinking

Ability to collectively analyse, evaluate, and craft sustainability problem solving frameworks

Integrating tradition with future thinking</td>
<td>Predisposition to long-term thinking

Intergenerational equity</td>
</tr>
</table>

(1)   The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 8. Examples of "behavioural learning objectives" and contributions of the "Futures thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with "Futures thinking"
Thanks to "futures thinking" people should be able to: — "Engage with new visions and models of a sustainable, inclusive economy and decent work" (UNESCO, 2017, 26). — "Evaluate various forms of industrialization and compare their resilience" (UNESCO, 2017, 28). — "Anticipate, estimate and assess the impact of personal, local and national decisions or activities on other people and other world regions" (UNESCO, 2017, 36).
Examples of contribution of the "Futures thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours
A person with a high degree of development of the future (or anticipatory) competence, should better envision how the world could be in 10-20 years' time if we don't do anything about climate change, resources depletion, biodiversity loss, poverty, human and workers' rights. The capacity of reading trends and of envisioning their consequences could make the person more motivated to change in behaviour or to act as an agent of change in his family, office or organisation. The futures thinking competence is tightly related to critical and system thinking and to the intra-personal competences. The first (critical thinking), for the probable capacity of choosing and understanding information, the second (systems thinking) because the ability to imagine futures needs knowledge from different disciplinary fields (e.g., meteorological extreme events, invasive alien species, resources scarcity, conflicts, migrations, and violence may characterise the image of 2050 if the challenges are not addressed). The third (intra-personal), because being aware of overwhelming data and trends could require, for example, learning to learn and stress management competences. A person with the future thinking competence should also better envision alternative positive futures in which humanity would have solved many of the wicked problems it faces today. These positive futures may inspire moving towards sustainability in the person's home or organisation. For example, the vision of positive futures may be used to plan how to change and transform an organisation (e.g., a farmer or wine producer that moves from conventional agriculture to organic agriculture). The futures thinking competence needs also other competences to fulfil its potential. For instance, it may be reinforced by the individual and collective risk management competence, classified among the intra-personal competences.

(1)   Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

Source: Author's elaboration done between October 2020 and February 2021.

3.2.4 "Values thinking" (or Normative)

Table 9. The "Values thinking" competence definition and classification ([1])

<table>
<tr>
<td rowspan="2">Competence</td>
<td>Values thinking</td>
<td colspan="2">The Values thinking (or normative) competence helps to clarify our own values, to differentiate between espoused and practiced values, to understand other people's values, the diversity of values and their implications. Allows personal reflection and conscious decision making regarding personal and professional actions for sustainability.</td>
</tr>
<tr>
<td>Knowledge</td>
<td colspan="2"></td>
</tr>
<tr>
<td rowspan="2">Components or concepts behind the competence</td>
<td>Knowledge</td>
<td>Skills</td>
<td>Attitudes</td>
</tr>
<tr>
<td>Knowledge of and awareness of justice, fairness, happiness, wellbeing, risk, trade-offs, and ethical questions

Knowledge of the principles of social justice, social entrepreneurship and business ethics

Awareness of how beliefs and values underpin actions and how values need to be negotiated and reconciled

Knowledge of the meanings of concepts such as liberty or basic needs, of human rights…</td>
<td>Ability to be of service to others

Ability to define what one considers to be a good quality of life and to be able to identify the values upon which this is based

Ability to map, apply, reconcile, and negotiate sustainability values, principles, goals, and targets</td>
<td>Willingness to be of service to others

Commitment to the common good (affinity for all life)

Care for the planet

Care and interest for others

Care for oneself

Concern for justice, peace and cooperation

Concern for quality

Responsibility

Ethics

Engagement

Valuing diversity, environment, justice</td>
</tr>
</table>

(1) The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 10. Examples of "behavioural learning objectives" and contributions of the "Values thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with "Values thinking"
Thanks to values clarification and sustainability related values (but also thanks to the systems, futures, action, intra and inter-personal competences), people may be able to: — Integrate values into scientific inquiry, countering the positivistic perception that "values are outside of the realm of science" as science "is considered to be objective" and the positivistic instruction that "scientists should not deal in values" (Brundiers et al. 2020). — "Act in favour of people threatened by climate change" (UNESCO, 2017, 36). — "Change their production and consumption practices in order to contribute to the combat against hunger and the promotion of sustainable agriculture" (UNESCO, 2017, 14). — "Connect with local groups working towards biodiversity conservation in their area" (UNESCO, 2017, 40).
Examples of contribution of the "Values thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours
People that are aware of the core values that guide their lives, should be better equipped to be able to notice their contradictions. For example, between their values and their behaviours. This consciousness should open opportunities for reflection and correction of inconsistent behaviours. Mastering this competence may help avoiding cognitive dissonance, the NIMBY (as long as Not In My Back Yard) and the DAD (Decide-Announce-Defend) syndromes. Educational activities on values should foster the exploration of alternative values and other people's values. The value thinking competence might also reinforce inter-personal competences like empathy or conflict management and resolution.	People that have clarified which are their core values and interests should be keener to behave consistently. If these clarified values are related to sustainability and not to unsustainability (e.g., not to the only pursue of profit), then people will probably be keener to act more sustainably. For example, parents that love their children and connect their future (also thanks to the system and future thinking competences) with the way they personally invest or deposit their money savings, may be keener to put their savings in an ethical bank that invests only in the real economy and in businesses with positive socio-economic-environmental impacts.

(1) Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

Source: Author's elaboration done between October 2020 and February 2021.

3.2.5 "Critical thinking"

Table 11. The "Critical thinking" competence definition and classification (^{1})

<table>
<tr>
<td rowspan="3">Competence</td>
<td>Critical thinking</td>
<td>The Critical thinking competence helps us examine and question the assumptions that influence our way of seeing the world (to question norms, practices and opinions, and to reflect on our own values, perceptions and actions). It helps us to identify the root causes of problems, instead of just their symptoms.

It allows to react to the multiple messages, information and advertising that flood our lives. It feeds our motivation to take a position in the sustainability discourse and to participate in change, both individually and collectively, and to develop a sense of our own power to shape our own lives.

Some confuse it with 'making criticisms', but critical and reflective thinking in Education for Sustainability is a much deeper process that involves acute research, understanding, and analysis of information and its sources.</td>
</tr>
<tr>
<td colspan="2"></td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">Components or concepts behind the competence</td>
<td>Knowledge</td>
<td>Skills</td>
<td>Attitudes</td>
</tr>
<tr>
<td>Knowledge of social networks

Bases of marketing principles

Knowledge of authoritative sources of information

Knowledge of reliable fact-checking agencies</td>
<td>Ability to analyse a problem by evaluating results or weighing values to form the most objective judgement

Ability to make critical, reflected decisions

Information management skills (ability to recognize, decode and reflect critically upon messages from the media and the market; ability to evaluate critically the relevance and reliability of assertions, sources, models and theories; ability to understand graphics and data sets)

Ability to critically question assumptions and recognise bias and power behind institutions, governments, media, companies and the people around us

Ability to explore power relationships in our communities, schools, workplaces and wider world and questions the motivations, interests and powers behind hierarchies and leadership

Ability to challenge norms, practices, and opinions

Ability to explore the influence of our culture in shaping our views of the world and our interpretation of information/ messages, so to reflect on individual and cultural models</td>
<td>Predisposition to ask critical questions

Predisposition to dedicate time for contrasting information

Commitment to reflection on one's own values, perceptions, and actions</td>
</tr>
</table>

(^{1}) The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (DigComp, EntreComp and LifeComp).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 12. Examples of "behavioural learning objectives" and contributions of the "Critical thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with "Critical thinking"
The persons with a developed critical thinking competence, for example, may be able to: — "Include health promoting behaviours in their daily routines" (UNESCO, 2017, 16). — "Research their country's dependence on the sea" (38), land and air. — "Identify and analyse different types of causes and reasons for inequalities" (30). — "Take on critically on their role as an active stakeholder in the market" (34). — "Critically assess issues of peace, justice, inclusion and strong institutions in their region, nationally and globally" (42).

Examples of contribution of the "Critical thinking" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours

A person that has a high level of development of critical thinking should know in which media to find trustworthy information; would probably usually check more than a perspective of a conflictive issue or may know good resources for fact checking. Because of checking alternative sources of information, the person may be more capable of finding missing perspectives and of doubting of fake news.

The critical thinking competence may be connected to an intra-personal competence like time management because accurate analysis may be time consuming. Furthermore, it may be linked to the systems thinking (e.g.: analysing complex data sets and information must consider also the different interests characterising their authors) and the inter-personal competences. The latter, for example, when independent and trustworthy sources of information may be or be connected to friends and the personal networks.

Additionally, the possibility to apply and grow the critical thinking competence, may also depend on factors that are independent from the person's will. For instance, the opportunity of smart working permits to save time in moving to the workplace. This may positively influence time consuming pro-environmental behaviours, like informing oneself on what happens in the world.

A person that has a high level of development of critical thinking, together with systemic thinking (e.g., holistic knowledge and know-how) and the strategic action-oriented competence (e.g., an experience in sustainable purchasing and labels reading), could probably more easily distinguish a fake "eco-label" from a trustworthy one. For example, eco-labels saying "Natural…" might result being less interesting. Logos like the EU organic agriculture or EU ecolabel, or the FSC (Forest Stewardship Council) and the MSC (Marine Stewardship Council) labels, will more probably be considered for the person's choices, together with price, expiring date and other criteria. Another example may be that a smaller packaging with higher quantities of product (e.g., a box of cereals) may be preferred to a bigger packaging with less product in it (this is checkable looking at the weight of the content). Obviously, all these analysis and choices are also consequence of personal values clarification and other sustainability competences like the ones mentioned some lines above. The weights given to all the possible criteria when choosing a product (reduced environmental or ecological impacts, price, quantity, quality, expiration date…) may vary a lot and influence differently people's more sustainable choices.

[1] Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

Source: Author's elaboration done between October 2020 and February 2021.

3.2.6 "Strategic action-oriented" (or Agency/ implementation/ integrated problem solving)

Table 13 The "strategic action-oriented" competence definition and classification ([1])

<table>
<tr><td rowspan="2">Competence</td><td colspan="2">Strategic action-oriented</td><td>The Strategic action-oriented (or agency/ implementation/ integrated problem solving) competence allows acting fairly and ecologically, at individual and collective levels. It implies wise decision-making, creative problem solving, strategic skills and spirit of initiative and empowerment to apply or bring change for sustainability. It permits, individually and collectively, to design and implement interventions and transitions toward sustainability, at the individual and collective levels.</td></tr>
<tr></tr>
<tr><td rowspan="2">Components or concepts behind the competence</td><td>Knowledge</td><td>Skills</td><td>Attitudes</td></tr>
<tr><td>Knowledge of the sustainability instruments to foster systemic change (e.g., Education for Sustainability, energy, water, materials saving and efficiency, Life Cycle Assessment, Eco-innovation, Eco-design, Stakeholders management, Fair Trade, organic agriculture...)</td><td>Ability to apply knowledge in practice

Ability to act fairly and ecologically and engage in sustainability activities

Ability to analyse environmental, social and economic impacts

Ability to reduce environmental and social impacts

Ability to act decisively under uncertainty, improvising and "making do"

Ability to take action in a proactive and considered manner and to act in a cautious and timely manner even in situations of uncertainty

Creative and complex problem-solving skills

Ability to reflect on, and deal with, possible risks

Ability to strategically design, plan and implement interventions, transitions, and transformative governance strategies toward sustainability

Ability to see the paths for change and following through

Ability to assess and evaluate, to self-assess and self-evaluate

Ability to lead by example and to motivate others</td><td>Feeling empowered

Disposition to speak up against injustices and start positive change

Meaningful use and integration of competences to solve sustainability problems and foster a prosperous future

Predisposition to take responsibility for motivating others</td></tr>
</table>

([1]) The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 14. Examples of "behavioural learning objectives" and contributions of the "Strategic action-oriented" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours [1]

Examples of "learning objectives" and behaviours associated with the "Strategic action-oriented" competence
The persons with a developed Sustainability action-oriented competence, should be able to: — "Articulate sustainability science as a solution-oriented field, which employs the same rigor, using systems-, values-, futures-, and strategic-thinking competencies, to researching solutions to sustainability challenges as to researching sustainability problems" (Brundiers et al. 2020, 10).   — Become change agents to realize the SDGs and to take on their role as active, critical, global and sustainability citizens (UNESCO, 2017).   — "Support climate-friendly economic activities" (UNESCO, 2017, 36).   — Reduce their individual water footprint and save water in their daily habits.   — Identify, access and buy sustainably harvested marine life like ecolabel certified products.   — "Apply and evaluate measures in order to increase energy efficiency and sufficiency in their personal sphere and to increase the share of renewable energy in their local energy mix" (24).   — "Promote sustainable production patterns" (34).   — "Evaluate whether their private and job activities are climate friendly and –where not– to revise them" (36).

Examples of contribution of the "Strategic action-oriented" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours

People with a good development of the strategic action-oriented competence, may have the capacity to contribute to sustainability, for example, by putting into practice the knowledge they acquired on energy, water, food or money saving.

Of course, they also might have the motivation to act, maybe because they had clarified their values (value thinking) or/and because they see the connections between their actions, their values, the economic implications, planet and people's wellbeing (systemic thinking). To be able to notice these relations, they probably participated in courses or informed themselves on the ways to save energy, water, food, money, etc.

The more a society has developed the competences related to the strategic action-oriented competence, the more it should be able to avoid phenomena like energy poverty and unhealthy diets.

A person with a good development of the strategic action-oriented competence, could be keener to use public transport also if the network is not so good, maybe because strategic thinking and problem solving will help finding strategies, for example, to save time while using public transport (e.g., reading on a bus or train).

The person could probably be keener to home composting if the municipality had not provided the trash bins for organic waste yet. Furthermore, the capability of putting knowledge into practice might facilitate a good home composting.

The person could probably buy less superfluous stuff so to increase the budget for more ecological choices (e.g., durable products and organic food).

As for the competences described in the previous pages, in all these pro-environmental behaviours, other interwoven competences (Systems, future, value thinking…) also play a role.

[1] Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

Source: Author's elaboration done between October 2020 and February 2021.

3.2.7 "Intra-personal" (or Self-awareness)

Table 15. The "Intra-personal" competence definition and classification (¹)

<table>
<tr>
<td rowspan="2">Competence</td>
<td>Intra-personal</td>
<td colspan="2">The Intra-personal (or Self-awareness) competence enables us to reflect on our role in the local community, and national and global society. Hence it allows self-awareness, self-regulation and self-empowerment to grow and persist as a change agent for sustainability. It permits to hold contradictory feelings and thoughts; to cope with complexity and manage personal and group stress; to cultivate awareness; to find inner peace, compassion, meaning making; to experience love, respect and connection.</td>
</tr>
<tr>
<td colspan="3"></td>
</tr>
<tr>
<td rowspan="3">Components or concepts behind the competence</td>
<td>Knowledge</td>
<td>Skills</td>
<td>Attitudes</td>
</tr>
<tr>
<td>Knowledge of the instruments for self-efficacy, self-awareness and self-regulation

Knowledge continuous update</td>
<td>Ability to nurture self-motivation and to motivate others

Ability to cope with complexity and uncertainty

Ambiguity and frustration tolerance (Coping with conflicts, competing goals and interests, contradictions, and setbacks)

Stress management, meaning making, and capacity for inner peace

Capacity to adapt to new situations

Lifelong learning skills and continuous reflection for sustainability skills (judge consequences, act upon reflection…)

Capacity to respond through applied learning

Wise decision-making capacity

Time management

Spirit of initiative

Self-efficacy and self-reflection

Ability to cope with one's emotions and self-control

Self-awareness, care and regulation

Ability to manage personal finances and physical resources (effective saving and control, maintenance, reuse and replacement)</td>
<td>Willingness to contribute to changes that will contribute to sustainability

Willingness/ motivation to continuous learning on the different sustainability/unsustainability issues

Optimistic realism

Genuine engagement

Predisposition to:

   Perseverance

   Patience

   Openness

   Flexibility and adaptability

   Personal involvement

   Affinity for life

Courage

Humility

Consistency (head, heart and hands)

Integrity</td>
</tr>
</table>

(1)   The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 16. Examples of "behavioural learning objectives" and contributions of the "Intra-personal" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with the "Intra-personal" competence
Thanks to the intra-personal or self-awareness competence (together with the ability to cope with complexity), people can: — "Challenge cultural and societal orientations in consumption and production" (UNESCO, 2017, 34). — Use all opportunities for their own education throughout their life and apply the acquired knowledge in everyday situations to promote sustainable development. — Become agents of change in local decision-making and speak up against injustices.
Examples of contribution of the "Intra-personal" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours

The intra-personal competence bundles competences such as, for example, the ones that help a person to cope with uncertainty and complexity. As a person with a good level of development of sustainability competences, such as systems or future thinking, could sometimes feel overwhelmed by some social, environmental and economic trends, mechanism of stress management and self-regulation may help to maintain general wellbeing. Other competences like, for example, the ability to nurture self-motivation, helps the implementation of sustainable behaviours and the learning to learn competence. The ability to motivate others is crucial to extend change towards sustainability and to achieve a critical mass of more sustainable consumers and producers, so to transition more rapidly to a low carbon and circular economy.	Time management (that we classified as a component of the intra-personal competence) is important especially for citizens that at the same time have a job and that want to implement sustainable behaviours. Because, for instance, to be able to eat "Healthy Diets From Sustainable Food Systems", as the EAT Lancet Commission suggests (Willett, Rockström and Loken, et al. 2019), time management and organisation are important. A healthy diet is very rich of fruit, vegetables, grains and legumes. Thus, if a family reduces meat consumption, as the EAT Lancet or Mediterranean diets suggest, it could save money that can be used to increase the quality of the food, for example. Especially, if one chooses the local organic farmer option, the time for preparation drags on, as the products may be dirty of earth, sand and little insects. If the delivery, is once a week for example, also systems, future or strategic (problem solving) thinking are essential to be able to plan the meals avoiding food waste. Intra-personal competences such as for example to be nature friendly, is also important because many little animals (spiders, caterpillars, slugs…) must be taken off the vegetables. Furthermore, also gender issues that sometimes may influence the work distribution on the different family members (intra and interpersonal competences), may affect the pro-environmental behaviours of the whole family unit. Motivation and values also have a substantial role. Furthermore, the number of members of the family unit or the possibility of smart working are also elements that influence time consuming pro-environmental behaviours.

(1) Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal".

Source: Author's elaboration done between October 2020 and February 2021.

3.2.8 "Inter-personal" (or Collaboration)

Table 17. The "Inter-personal" competence definition and classification ([1])

Competence	Inter-personal	The Inter-personal (or collaboration) competence allows to motivate and facilitates collaborative and participatory sustainability research, problem solving and implementation. It enables to understand and respect the needs, perspectives and actions of others (empathy), and to deal with conflicts in a group. It permits impactful stakeholder engagement and wise transformation for sustainability.
Components or concepts behind the competence	**Knowledge**	**Skills**	**Attitudes**
	Knowledge of the historical and differentiated responsibilities of the unsustainability issues	Emotional intelligence, empathy and change of perspective Trans-cultural understanding and cooperation capacity Active listening and non-violent communication skills Cooperative action, mediation and conflict resolution skills to reconcile interests and challenge world views Mindfulness Collaboration, networking, developing alliances and building teams capacity Multidisciplinary team-work capacity Stakeholder management capacity Capacity to promote synergies to put together partners' resources and talents Capacity to lead by example and to involve and motivate people's engagement in sustainability Communication and use of media	Appreciation of nature and of human diversity and multiculturalism Predisposition to grasp the historical and differentiated responsibility Social justice and inclusion Respect for others Generosity Social responsibility Justice, ethics Compassion Solidarity

([1])   The limits between Knowledge, Skills and Attitudes are sometimes blurred. Therefore, some components may be transversal to more than a Sustainability competence or component, and also appear in the other EU frameworks of competences existing to date (*DigComp*, *EntreComp* and *LifeComp*).

Source: Elaborated by the author between October 2020 and February 2021, based on the analysis, merging and integration of 36 sets of competences. The authors of the 36 articles and documents reviewed for this proposal are listed in the table in Annex 1.

Table 18. Examples of "behavioural learning objectives" and contributions of the "Inter-personal" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours ([1])

Examples of "learning objectives" and behaviours associated with the "Inter-personal" competence
Thanks to the development of inter-personal competences, people for example can: — Articulate the necessity of stakeholder engagement (a 'must' have) in sustainability science research (transdisciplinary approaches) (Brundiers et al. 2020). — "Observe and identify gender discrimination" (UNESCO, 2017, 20). — "Plan, implement and evaluate community-based sustainability projects" (32). — "Participate in and influence decision processes about their community" (32). — "Evaluate, participate in and influence decision-making processes about acquisitions in the public sector" (34). — "Contribute to conflict resolution at the local and national level" (42). — "Contribute to facilitating and implementing local, national and global partnerships for sustainable development" (44).
Examples of contribution of the "Inter-personal" competence to a low carbon and circular economy, to sustainable lifestyles and behaviours
Inter-personal competences like empathy and emotional intelligence help to better relate with other key partners in the path towards sustainability. For example, business leaders that want to transform towards sustainability their organisation and that have a developed emotional intelligence should have the ability to better involve their employees in change towards sustainability, and to leave them decide what to do exactly. People with a great capacity of putting themselves in somebody else's shoes, to empathise with others, will probably understand the suffering of people that are deprived of their basic human or worker rights (basic rights are often given for granted in the, so called Western cultures). Subsequently, people that know how products are generally produced (systemic thinking), that reflected on their core values, and that have developed empathy towards others, could be more inclined to buy only when strictly needed, and from producers that work to fight worker's rights violations. Furthermore, business leaders with all these competences, may be more inclined to reduce the social and environmental impacts of their company. Moreover, empathy towards people living in countries that are more vulnerable to climate extremes, and that at the same time have little responsibility in anthropogenic climate change, could favour pro-environmental behaviours in transport, energy and food, as these behavioural spheres especially contribute to greenhouse gases emissions. To be able to connect all these social and environmental issues and their solutions, and transform all that in motivation, systemic thinking and other competence must synergically interact.	Other examples of inter-personal competences, are conflict management or active listening, which may favour effective communication and collaboration towards sustainable goals (e.g., in expert and stakeholder groups, in private and public organisations, in families).

([1]) Before reading the examples of behavioural learning outcomes, we invite the reader to go through sections 3.2.4.5 "Learning outcomes" and 3.1.4.6 "Behavioural learning outcomes and premises to the examples associated with the set of competence proposal"

Source: Author's elaboration done between October 2020 and February 2021.

3.3 Preliminary analysis of the proposed Sustainability competences in the context of the EU competence frameworks for lifelong learning (*DigComp*, *EntreComp* and *LifeComp*)

As mentioned in the preamble to this report, it is important to remember that the proposed set of Sustainability competences presented in the previous sections, was based on an in-depth literature review and analysis done to prepare the initial steps towards the development process of the European Sustainability Competence Framework (GreenComp), published in January 2022. The brief preliminary comparison between the Sustainability competences proposed in this report and the EU frameworks (*EntreComp*, *DigComp* and *LifeComp*), existing at the time of the analysis (October 2020 and February 2021), does not take into consideration the final *GreenComp*, developed through expert and stakeholder consultations during 2021, and that is the sole document to be referred to as the European Sustainability Competence Framework.

3.3.1 Sustainability in the Recommendation on key competences for lifelong learning (2018)

The Recommendation on Key Competences for Lifelong Learning adopted by the Council of the European Union in May 2018, presents the European reference framework on key competences for Lifelong Learning. This framework includes eight key competences that are:

- the Literacy competence,

- the Multilingual competence,

- the Mathematical competence and competence in science, technology and engineering,

- the Digital competence,

- the Personal, social and learning to learn competence,

- the Citizenship competence,

- the Entrepreneurship competence, and

- the Cultural awareness and expression competence.

The concept of sustainability appears in the introduction with the mention of target 4.7 of Sustainable Development Goal 4, and in the Citizenship key competence definition, that is "the ability to act as responsible citizens and to fully participate in civic and social life, based on understanding of social, economic, legal and political concepts and structures, as well as global developments and sustainability". Additionally, the term "Sustainable" emerges also in the Knowledge, Skills and Attitudes descriptions, when the Council states that the Citizenship competence:

- includes an awareness of the aims, values and policies of social and political movements, as well as of sustainable systems, in particular climate and demographic change at the global level and their underlying causes;

- relates to the ability to engage effectively with others in common or public interest, including the sustainable development of society;

- includes support for social and cultural diversity, gender equality and social cohesion, sustainable lifestyles, promotion of culture of peace and non-violence, a readiness to respect the privacy of others, and to take responsibility for the environment (Council of the European Union, 2018, 11-12).

With the purpose of understanding the connections between the set of Sustainability competences proposed in this report, and the already existing EU competence frameworks, we propose a brief comparison in the following paragraphs.

3.3.2 Comparison with the existing EU frameworks (*EntreComp*, *DigComp* and *LifeComp*)

At a first glance:

- The set of Sustainability competence proposed in this report is composed by seven competences that are tightly intertwined and represent seven clusters of a variety of components selected

from the literature and classified in Knowledge, Skills and Attitudes. The seven competences drawn from the literature are: "Systems thinking", "Futures thinking", "Values thinking", "Critical thinking", the "Strategic action-oriented", the "Intra-personal" and the "Inter-personal" competences.

- The Entrepreneurship competence conceptual model defined in the Entrepreneurship Competence Framework (*EntreComp*) is made up of three intertwined competence areas that directly mirror the definition of entrepreneurship as the ability to turn ideas into action that generate value for someone other than oneself. The three competence areas Ideas and Opportunities, Resources and Into Action, and the **15 competences** that, interrelated and interconnected together, make up the building blocks of the entrepreneurship as a competence for all citizens. The 15 competences are: Spotting opportunities, Creativity, Vision, Valuing ideas, Ethical and sustainable thinking, Self-awareness and self-efficacy, Motivation and perseverance, Mobilising resources, Financial and economic literacy, Mobilising others, Taking the initiative, Planning and management, Coping with uncertainty, ambiguity and risk, Working with others and Learning through experience (Bacigalupo et al., 2016).

- The *DigComp* conceptual reference model is made up of five competence areas (dimension 1 ([8])) and 21 competences (dimension 2). The five competence areas are: Information and data literacy, Communication and collaboration, Collaborating through digital technologies, Digital content creation, Safety and Problem solving. The **21 competences** are: 1.1 Browsing, searching and filtering data, information and digital content, 1.2 Evaluating data, information and digital content, 1.3 Managing data, information and digital content, 2.1 Interacting through digital technologies, 2.2 Sharing through digital technologies, 2.3 Engaging in citizenship through digital technologies, 2.4 Collaborating through digital technologies, Digital content creation, 2.5 Netiquette, 2.6 Managing digital identity, 3.1 Developing digital content, 3.2 Integrating and re-elaborating digital content, 3.3 Copyright and licences, 3.4 Programming, 4.1 Protecting devices, 4.2 Protecting personal data and privacy, 4.3 Protecting health and well-being, 4.4 Protecting the environment, 5.1 Solving technical problems, 5.2 Identifying needs and technological responses, 5.3 Creatively using digital technologies, 5.4 Identifying digital competence gaps (Vuorikari et al., 2016).

- The EU "Personal, social and learning to learn competence" framework (*LifeComp*) is made up of three intertwined competence areas: 'Personal', 'Social', and 'Learning to Learn'. Each area includes three competences, for a total of **nine competences**: Self-regulation, Flexibility, Wellbeing (Personal Area); Empathy, Communication, Collaboration (Social Area); Growth mindset, Critical thinking, and Managing learning (Learning to learn Area) (Sala et al., 2020, 8).

3.3.2.1 Comparison with EntreComp

As in the case of the other EU competence frameworks, some competences appear in both the Entrepreneurship Competence Framework (*EntreComp*) and the proposed set of Sustainability competences. In particular, the *EntreComp* competences that, with nuances, appear also in the proposed set of Sustainability competences are: Creativity, Vision, Self-awareness and self-efficacy, Motivation and perseverance, Mobilising resources, Financial and economic literacy, Mobilising others, Taking the initiative, Planning and management, Coping with uncertainty, ambiguity and risk, Working with others and Learning through experience.

Nevertheless, the aims and contexts of use of the competences are different. In *EntreComp*, entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social (FFE-YE, 2012). In Sustainability competences the final aims are always to solve sustainability complex and interrelated challenges (e.g., climate change, biodiversity loss, resources depletion and social inequalities) and to advance sustainable development in a range of different contexts, including private, social and institutional (Engle et al. 2017, Waltner et al. 2019). In entrepreneurship, these final aims are not excluded and they may be pursued in some green entrepreneurial projects.

([8]) The concept of "dimension" in this work is used in the same way that it is used in the eCompetence framework for ICT professionals. In both works, the word 'dimension' refers to the structure of the framework, i.e., the way in which the content of the framework is displayed. In this case the dimensions refer to: Areas identified to be part of the digital competence; Competence descriptors and titles that are pertinent to each area; Levels of proficiency for each competence; Examples of the knowledge, skills and attitudes applicable to each competence.

Besides, the hints in *EntreComp* are straightforward and could be adapted to describe some of the proposed Sustainability competences.

Furthermore, in the *EntreComp* framework, the "Ethical and sustainable thinking" competence captures special attention because its wording and descriptors ([9]) could well summarise many of the concepts in the proposed Education for Sustainability competence framework. Nevertheless, to be really effective in sustainability terms, the "Ethical and sustainable thinking" competence should also include the words "and acting for sustainability". In addition, it should be transversal to all the competences in the *EntreComp* framework. This is because in the cases in which entrepreneurship pursues only financial value, and not authentic social and environmental positive impacts, entrepreneurship will very likely contribute to increase sustainability challenges. As in the case of the *DigComp* on environmental protection, that we will mention in the next section, the "Ethical and sustainable thinking" competence depends on the development of all the proposed Sustainability competences and may be learned through life experiences and lifelong learning, but especially through Education for Sustainability provided by ES professionals who have acquired the competences in the frameworks for ES educators by UNECE (2011) and Vare et al. (2019).

To this analysis of the wordings, it is interesting to add that, if we look at the visual representation of *EntreComp*, when the "Ethical and sustainable thinking" competence overlaps with all the others in the framework, as in the centre of the flower, then "Ethical and sustainable thinking" may become an integral part of the framework.

3.3.2.2 Comparison with DigComp

The concepts that in the proposal presented in this report have been called "Competences", in *DigComp* correspond to "Competence areas" (Dimension 1). The concepts that here have been called "components", and have been classified in knowledge, skills and attitudes, in DigComp are called "competences" (Dimension 2)".

Some of the proposed Sustainability "components" are similar to *DigComp* "2 – Communication and collaboration" and "5 – Problem solving". Although the contexts and objectives of use of these competences are different, the definition of "Problem solving" used in *DigComp* could also be appropriate for the proposed set of Sustainability Competence, but probably not complete enough because it does not express the "situation" to which problem-solving is applied in the Sustainability set of competences. The definition of problem-solving that has been used in Dig Comp is: "...an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen" (OECD, 2014, 30). Instead, in the sets of competences found in the literature and that have been merged in the proposed set of Sustainability competences, "problem solving" appears with different nuances such as: *"Predisposition to more participative and interdisciplinary approaches to problem solving", "sustainability problem-solving frameworks", "creativity and complex problem-solving skills" and "participatory sustainability research, problem solving and action".*

DigComp competence area "4-Safety" includes the competence "4.4 Protecting the environment (To be aware of the environmental impact of digital technologies and their use)". This digital competence depends on the development of all the Sustainability competences and can be learned through life experiences and lifelong learning, but especially through Education for Sustainability provided by ES professionals who have acquired the competences in the frameworks for ES educators by UNECE (2011) and Vare et al. (2019).

To complete the comparison, it must be also pointed out that the Sustainability competence classification proposed in this report includes the following components that somehow relate to digital competences: *"Knowledge of social networks"* (In the Sustainability Critical thinking competence) and *"Communication and use of media"* (In the Sustainability Inter-personal competence).

3.3.2.3 Comparison with LifeComp

In the Recommendation on key competences for lifelong learning adopted by the Council of the European Union in May 2018, the "Personal, social and learning to learn competence is the ability to reflect upon oneself, effectively manage time and information, work with others in a constructive way, remain resilient and

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([9]) This competence has three descriptors: Assess the consequences of ideas that bring value and the effect of entrepreneurial action on the target community, the market, society and the environment; Reflect on how sustainable long-term social, cultural and economic goals are, and the course of action chosen; Act responsibly.

manage one's own learning and career. It includes the ability to cope with uncertainty and complexity, learn to learn, support one's physical and emotional well-being, to maintain physical and mental health, and to be able to lead a health-conscious, future-oriented life, empathize and manage conflict in an inclusive and supportive context" (Council of the European Union, 2018, 10).

Instead, a *Sustainability competence* comprises the entirety of individual dispositions comprising knowledge, skills, motives, and attitudes necessary to solve sustainability-related problems and advancing sustainable development in a range of different contexts, including private, social and institutional (Engle et al. 2017, Waltner et al. 2019, cited by Brundiers et al. 2020). As Brundiers et al. (2020, 10) point out, one of the main learning objectives of Education for Sustainability is "to be able to explain why sustainability is 'not first and foremost about the environment' and not just about technical solutions and engineering; but is instead a layered concept with justice and equity as foundational elements".

Both the competences are future-oriented competences enabling to cope with complexity, uncertainty and change in global contexts. In addition, the Sustainability competences equip people "to take responsibility for one's action to be able to engage in and address sustainability-related issues" (Ofei-Manu and Didham 2018, 1181). Of course, to do this, the life competences, as described in the EU recommendation, are essential. That is why they are present in the Inter and Intra-personal competences, in many of the Sustainability sets of competences in the literature, and in the final proposal.

All the names of the competences in *LifeComp* appear at least once in the Sustainability sets of competences analysed in the literature review, mainly in the Critical Thinking, Intra and Inter-personal sustainability competences. Maybe not all the terms have been selected for the proposal presented in this report, but all the concepts had been mentioned in the literature. Nevertheless, the main difference is in the aims, and there could be nuances in the wording and the meaning of the concepts. In the Sustainability competences frameworks, it is intended that the "collaboration" competence is crucial for people to collaborate and find solutions that respect the natural limits of the planet (resources and all species) and that pursue global social wellbeing. For example, to achieve sustainability, collaboration is fundamental to find solutions in groups of stakeholders with different interests and perspectives. It could be in a business organisation to be able for example to reduce Green House Gases (GHG) emissions, trying at the same time to convert it in a competitive advantage. In public institutions collaboration (for sustainability) is useful for development or urban planning. For example, neighbourhood renovation planning with the aim of buildings retrofitting, people wellbeing or public transport improvements. This kind of projects may involve its inhabitants in the decision-making process, from its beginning. Another example is "Empathy" that as sustainability competence is used to achieve people's and planet wellbeing. E.g., empathy may be used to better "active listen" in a group of stakeholders working on a sustainability issue, or to foster consumption behaviours that promote the defence of human rights along the supply chain, thanks to the empathy with the workers of developing countries where worker's rights regulations are weak.

Furthermore, because of the meaning of the term "sustainability", cross-disciplinarity (at least the environmental, social and economic dimensions) permeates all the Sustainability competences. So that while "learning to learn" for sustainability is intended to be cross-disciplinary, cross-disciplinarity does not seem to be mentioned in *LifeComp*. In practice, in Sustainability "Learning to learn" entails a multidisciplinary learning to learn that goes beyond the update in one's own disciplinary working field. This is because the "silos view" promoted by traditional education systems (that promote higher specializations, moving from primary to post graduate education) is, as an example, one of the "sustainability blunders" Doppelt (2003, 2008) identified. In this case learning to learn is tightly intertwined with the "*Systems, future, value thinking and strategic action-oriented*" Sustainability competences. In addition, also to the *Intra and Inter-personal competences*, as in the proposed set of Sustainability competences we have assigned "Learning to learn" to the Intra-personal competence, but it can also be said that cross-disciplinary learning to learn also contributes to communication and collaboration in multidisciplinary groups (inter-personal competence). The learning to learn in the Sustainability competence proposal needs knowledge and comprehension of the interconnections among the environmental, social and economic phenomena taking place because of our way of consuming and producing; the ways these phenomena interrelate in the past, present and future; and our way of living our values through our actions.

Another difference is in the definitions of Critical thinking (see the two definitions in Table 19), a competence that appears in both *LifeComp* and in the proposed set of sustainability competences.

The descriptor "Adoption of a sustainable lifestyle that respects the environment, and the physical and mental wellbeing of self and others, while seeking and offering social support" of competence P3 "Wellbeing" of *LifeComp*, especially reminds the "*Strategic action-oriented (for sustainability)*" competence. Yet, as in the

case of the environmental protection competence in *DigComp* and the sustainable thinking competence in *EntreComp*, this "Adoption of a sustainable lifestyle…" depends on the development of the Sustainability competences that are in *LifeComp* partially as this framework focuses on personal and social development mainly. The Sustainability competences can be learned through life experiences and lifelong learning, and especially through Education for Sustainability provided by Education for Sustainability (ES) professionals who have acquired the competences in the frameworks for ES educators designed by UNECE (2011) and Vare et al. (2019).

Table 19. Definitions of "Critical thinking" in LifeComp and in the proposed set of Sustainability competences

"Critical thinking" in "LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence":	Assessment of information and arguments to support reasoned conclusions and develop innovative solutions (L2.1 Awareness of potential biases in the data and one's personal limitations, while collecting valid and reliable information and ideas from diverse and reputable sources, L2.2 Comparing, analysing, assessing, and synthesising data, information, ideas, and media messages in order to draw logical conclusions, L2.3 Developing creative ideas, synthesising and combining concepts and information from different sources in view of solving problems) (Sala et al., 2020).
Critical thinking in the proposed set of Sustainability competences (Definition obtained putting together all the analysed sets of competences)**:**	The Critical thinking competence helps us examine and question the assumptions that influence our way of seeing the world (to question norms, practices and opinions, and to reflect on our own values, perceptions and actions). It helps us to identify the root causes of problems, instead of just their symptoms. It allows to react to the multiple messages, information and advertising that flood our lives. It feeds our motivation to take a position in the sustainability discourse and to participate in change, both individually and collectively, and to develop a sense of our own power to shape our own lives. Some confuse it with 'making criticisms', but critical and reflective thinking for Sustainability is a much deeper process that involves acute research, understanding, and analysis of information and its sources.
Definition of "Critical thinking" as a sustainability competence by UNESCO (2017):	"…the ability to question norms, practices and opinions; to reflect on one's own values, perceptions and actions; and to take a position in the sustainability discourse". (UNESCO, 2017, 10)

Source: Elaborated by the author based on the cited authors.

The similarity between the EU *LifeComp* and the proposed set of Sustainability competences could be explained by the fact that in practice sustainability competences are competences to live better in the present, but especially to build a better future, in which people, Planet and nature thrive.

Since the main objectives of the study presented in this report was to provide an initial proposal of set of sustainability competences for possible users (policy makers, courses managers, educators of any level…) to get a comprehensive idea of all the main Sustainability competences, the proposal brings together all the concepts useful for lifelong learning for Sustainability and a blend of the wordings found in the literature of the Sustainability and Education for Sustainability fields. In brief, with adaptations to the "pursuit of a prosperous future", all the broad definitions of the *LifeComp* could help understanding many of the Sustainability competences of our proposal, especially the ones in the Intra-personal sustainability competence.

3.4 Benefits of scaling up (^{10}) Education for Sustainability and the Sustainability competences in Europe

"Human-induced climate change, limited and recklessly exploited resources, rising temperatures and sea levels, poverty and unsustainable economic structures are just a few of the challenges governments and populations face around the world" (UNESCO, 2021a). The decade that just started, is crucial to address these pressures. Yet, since the COVID-19 outbreak, the world's attention has been focused on the pandemic and the coordination of the emergency response to the crisis. Meanwhile, major sustainable development challenges, remain unresolved (UNESCO, 2021b).

Simultaneously, the ongoing Covid-19 pandemic:

- Puts pressure on us to reflect on how we lead our lives, how we live together, and in the one planet we share.

- Amplifies existing weaknesses and injustices in our systems like a magnifying glass.

- Presents a special opportunity to change, a chance to turn around from the disastrous path of climate and other emergencies by 'redesigning' our societies (UNESCO, 2021a).

To achieve the SDGs, policymakers have instruments such as policy, information and assistance, monitoring, finance, incentives, legislation and regulation. However, such change cannot happen without learning (Sterling, 2014) because global issues urgently require a shift in our lifestyles and a change of the way we think and act. To achieve this transformation, we need new skills, values and attitudes (UNESCO, 2017). Unless stakeholders, policymakers, legislators, businesses, agencies, NGOs, the media and civil society are involved in learning processes, the proposed SDGs will not be achieved (Sterling, 2014).

The development of sustainability competences has never been so urgent (UNESCO, 2017). Education has been recognized as a crucial element that empowers people to take action by promoting values, problem solving and critical thinking skills (UNESCO, 2021b).

In the following pages, we present a list of benefits, compiled from the Sustainability and Education for Sustainability literature, which the spreading of quality Education for Sustainability could generate:

- Responding to **citizens desire to contribute to a better future**, because as UNESCO (2002) acknowledged most people in the world have an immediate and intuitive sense of the urgent need to build a sustainable future. They may not be able to provide a definition of 'sustainable development' or 'sustainability' (even experts debate that issue) but they clearly sense the danger and the need for informed action. (UNESCO, 2002).

- A **renewed vision for educational policy and practice** in tune with the needs of the 21st century (Sterling, 2014).

- **Enabling students** to appreciate the complexity of our world and the 'wicked problems' we have caused, to develop the competencies and motivation to pursue visions of the future and to co-design solutions and drive change (Quality Assurance Agency for Higher Education and Advance HE, 2020).

- **Empowering people of any age**, in any education setting, to be 'global citizens' who engage and assume active roles, both locally and globally, to become proactive contributors to creating a more just, peaceful, tolerant, inclusive, secure and sustainable world (UNESCO, 2014). Overcoming psychological and context-related (structural, economic, social) barriers with environmentally and socially responsible behaviours.

- **Overcoming the seven sustainability blunders that prevent organisations from successfully moving towards sustainability**. These blunders have been detected by Bob Doppelt (2003) and they are: 1. Patriarchal Thinking, 2. A "Silo" Approach to Environmental and Socio-Economic Issues, 3. No Clear Vision of Sustainability, 4. Confusion over Cause and Effect,

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(^{10}) There is no universally agreed definition of scaling. However, there seem to be consensus in that scaling means moving from a small to a large impact (Ford Foundation, 2006). Scaling can occur along different dimensions, while scaling up implies scaling vertically, in other words, integrating an initiative into policymaking (Ford Foundation, 2006). The implication is that scaling up considers both the quality and quantitative aspects in terms of impact. (UNESCO, 2018a)

5. Lack of Information, 6. Insufficient Mechanisms for Learning, 7. Failure to Institutionalize Sustainability.

- Driving Europe's **competitiveness and innovation** (European Commission, 2020).

- **Accelerating sustainable solutions** (UNESCO, 2018a), defined as those that address society's developmental problems in economically viable and culturally acceptable ways, while at the same time maintaining or improving ecological systems (air, freshwater, oceans, forests and soils), rather than harming them (UNDP/UNEP, 2013; Wolfenson, 2013).

- Achieving a **societal transformation** to enable a transition to greener economies and societies (UNESCO, 2014).

- **Addressing urgent global challenges**, such as the ones addressed in the 2030 Agenda for Sustainable Development: billions of citizens that continue to live in poverty and are denied a life of dignity; the inequalities within and among countries; unemployment, particularly youth unemployment; global health threats; more frequent and intense natural disasters; spiralling conflict, violent extremism, terrorism and related humanitarian crises and forced displacement of people. Furthermore: natural resource depletion and adverse impacts of environmental degradation, including desertification, drought, land degradation, freshwater scarcity and loss of biodiversity; climate change, increases in global temperature, sea level rise, ocean acidification (United Nations, 2015).

- A role of **leadership** in action to achieve the SDGs and the Paris agreement targets.

3.5 Organisations' recommendations for scaling up Education for Sustainability

There is "a sense of urgency with regard to the need to re-double efforts to further the sustainability agenda" (UNESCO, 2018a, 179). Today, overall, action to meet the Goals is not yet advancing at the speed or scale required. 2020 needs to usher in a decade of ambitious action to deliver the Goals by 2030. The "ten years to transform our word" call for accelerating sustainable solutions to all the world's biggest challenges, from poverty and gender to climate change or inequality (United Nations, 2020). Accelerating progress on the SDGs targets needs identifying critical constraints to faster progress (Westman et al., 2017).

We believe the EU can be the champion in implementing the SDGs and in demonstrating the valuable contribution of learning in all its forms. Sustainability should not just be an aspiration for countries of the Global South but a guiding principle for the EU and its Member States as part of their global collective responsibility towards the well-being of their people and the planet (Lifelong Learning Platform -LLLP-, 2020).

Institutions and stakeholders, as for example UNESCO and its key partners ([11]) in the Global Action Programme on Education for Sustainable Development and the Quality Assurance Agency for Higher Education and Advance HE (QAA & Advance HE), have analysed how to tackle the critical decade that just started. They suggest important recommendations to address the sustainability and educational challenges humanity and Europe face.

For their consideration in the definition of further steps for the development and spreading of the Sustainability competences and of Education for Sustainability in Europe, in the following pages, we compiled some of the mostly shared "recommendations on the strategic role of education, training and lifelong learning in paving the way towards a sustainable future for Europe and beyond" (LLLP, 2020b, 5). These recommendations were drawn from the literature review and an "ad hoc" internet search. It considered relevant reports and position papers of respected European stakeholders in the field of education and sustainability, such as: the Lifelong Learning Platform (LLLP) representing European civil society for education, the European Association of Regional & Local Authorities for Lifelong Learning (EARLALL), the European Forum of Technical and Vocational Education and Training (EfVET), the European Association for the Education of Adults (EAEA), the 17th European Forum on Eco-innovation organised by the European Commission in 2014 and the European Forum on Science & Education for Sustainability (EFSES).

([11]) In 2013, the 37th session of the General Conference of UNESCO endorsed the Global Action Programme (GAP) on ESD as the follow-up to the UN Decade of ESD (2005-2014). The GAP involves more than 500 stakeholders and 80 key partners working across five networks to promote Education for Sustainable Development throughout the world.

3.5.1 Synergies between sustainable development and education

Barriers/Challenging problems:

While the EU policies on education and training are welcome and needed initiatives to pursue, they are just some of the pieces of the puzzle. They must be part of a broader, more ambitious vision on how education contributes to sustainable societies, beyond its albeit important role in helping to 'green' the economy and labour market (LLLP, 2020b).

In fact, sustainable development can be promoted through policy instruments, but these tend to be effective for only as long as they are applied. Yet, the key role of education in realising sustainable development is often ignored, downplayed and underestimated – or viewed in isolation from the other instruments of change. Thus, we are in an undesirable situation where much sustainable development discourse and policy underplays the role of education, whereas much education discourse and policy underplays, or ignores, sustainable development (Sterling, 2014).

Recommendations/Challenging solutions:

The fundamental challenge is how education can more strongly impact on sustainable development and how sustainable development can be embedded at the heart of education and learning. Their mutual benefits can accelerate positive effects to win break through towards an economically secure, ecologically stable and socially just world (Sterling 2014). Full policy coherence between the education and the sustainable development sectors must be ensured. **ESD should be mainstreamed into both education and sustainable development policies** (UNESCO, 2020). The reorientation of education systems towards sustainable development can be driven by the alignment of local and national sustainable development goals and strategies with education polices (UNESCO, 2014).

3.5.2 Competence framework

Barriers/Challenging problems:

Unless steered with a purpose, the rapid advance of science and technology may widen inequities, exacerbate social fragmentation and accelerate resource depletion. If students [and people of all ages] are to play an active part in all dimensions of life, they will need to navigate through uncertainty, across a wide variety of contexts: in time (past, present, future), in social space (family, community, region, nation and world) and in digital space. They will also need to engage with the natural world, to appreciate its fragility, complexity and value (OECD, 2018).

Recommendations/Challenging solutions:

EARLALL and EfVET (2020) recommend the development of a specific European framework for green skills or the integration of the development and acquisition of green skills into existing ones. The European Forum on Science & Education for Sustainability (2020) talks about developing a common project framework for ESD competences, as "all courses must equip students with the cross-cutting skills necessary for addressing sustainability challenges, such as critical thinking, lateral thinking and systems thinking (European Alliance for Sustainability Leadership in Education – EAUC – and Change Agents UK, 2020).

3.5.3 Strengthening Education for Sustainability (in quality and quantity) in formal, non-formal and informal contexts

Barriers/Challenging problems:

Although Education for sustainable development has gained recognition as target 4.7 of SDG 4, implementation of the target remains weak (LLLP, 2020b). There is a general assumption based on the belief that the size, number of beneficiaries or geographic locations covered constitutes an indicator of an initiative success and positive influence on people (Snapp and Heong, 2003; UNESCO, 2018a). However, it makes no sense to invest in quantity (greater number of equipment, programs, recipients…) rather than in **quality** (effective changes in people's thinking and behaviour), giving more relevance to the short-term product, rather than the long-term change process (Rodríguez and García, 2009).

Recommendations/Challenging solutions:

To **bring ESD – or ES - into the mainstream of formal, non-formal and informal education** means to develop system-wide interventions, teacher training, curricular reform and pedagogical support (UNESCO, 2016b).

- Stakeholders in education need to set out agendas to integrate ESD into the various processes and structures of the sector. They need to allocate and to mobilise resources to translate these policies into actions.

- Civil society organisations can urge governments to take the necessary actions, or they can pursue their own initiatives to complement the actions of the public sector, bridging the gap between policy and practice (UNESCO, 2014). They can also promote a green culture among citizens and facilitate the provision of (non-formal) training in green-related issues with a lifelong learning perspective (EARLALL and EfVET, 2020).

- Policymakers working in climate change, disaster risk reduction, sustainable consumption and production, biodiversity, and other sustainability challenges are invited to recognise and to adopt ESD to tackle these issues (UNESCO, 2014). Policy makers should support learning aimed at promoting climate and environmental literacy, sustainable lifestyles and understanding of human-nature interdependencies. Furthermore, they should provide further support for learning providers active in this field (LLLP, 2020b).

- Universities have the responsibility to provide their staff (both office staff and teaching staff) with training for sustainability because interdisciplinary or cross-disciplinary learning and problem solving are valuable ways to get learners out of their disciplinary silos and to start understanding the interconnectivity of systems (EAUC and Change Agents UK, 2020).

- Businesses also have a responsibility to train their existing staff in the sustainability skills and knowledge, because for businesses to become sustainable, it is not enough to wait until current graduates with sustainability knowledge are in a position high enough to make significant change (EAUC and Change Agents UK, 2020). It is important to promote a green culture in the business sectors/industries/enterprises; to facilitate the upskilling and reskilling of employees not only in industries dealing with the green economy, but also for the entire workforce (EARLALL and EfVET, 2020).

3.5.4   Changing the education systems

Barriers/Challenging problems:

Education should play an important role in enabling people to live together in ways that contribute to sustainable development. However, at present, education often contributes to unsustainable living. This can happen through a lack of opportunity for learners to question their own lifestyles and the systems and structures that promote those lifestyles. The recasting of development, therefore, calls for the reorientation of education towards sustainable development. (ECE group on competences on ESD, cited by UNECE, 2013).

Policymakers need to unite the greening and skills dimensions of the circular economy and green skills should be as ubiquitous as IT skills (17th European Forum on Eco-innovation - European Commission, 2014).

Recommendations/Challenging solutions:

In this sense, lifelong learning (learning 'from cradle to grave' and across all aspects of life) must be at the centre of the debate on achieving sustainable societies (LLLP, 2020b). This vision must have at its heart a profound shift in the way we approach education. Mainstreaming sustainable development education across all education sectors should be framed within the imperative to make our education and training systems themselves sustainable (EFSES, 2020). Sustainable development requires education to change (UNECE, 2013). Policies for ESD cannot consist solely of efforts to add topics such as climate change and sustainable development to the curriculum. Rather, they must explore ways to transform education systems in a model of sustainability (UNESCO, 2018a). There is a need to change from transmissive towards transformative learning, but this in turn requires a transformed educational paradigm, that as well is the result of a transformative learning process (Sterling, 2001). The Global Action Programme on ESD recognizes that ESD at local level focuses on transforming education content and pedagogy to address context-relevant sustainability issues in a more participatory, action-oriented, learner-centred way; the GAP advocates for the mainstreaming of ESD in all education sectors (UNESCO, 2018a). Member State education policies should align with the United Nations' 2030 Agenda for Sustainable Development and the Sustainable Development

Goals (EARLALL and EfVET, 2020). Green skills need to be integrated into existing training programmes (17th European Forum on Eco-innovation – European Commission, 2014).

3.5.5 Make lifelong learning the primary guiding principle for policies related to education and training

Barriers/Challenging problems:

Learning has transformative potential across all forms of education (formal, non-formal and informal) and all levels (from early childhood to adulthood and into old age) and it should integrate sustainability (LLLPb, 2020). Nevertheless, EAEA (2018) reports that the adult education sector is increasingly affected by cuts in government budgets and privatisation, and that the commercialisation of education exclude those from more disadvantaged backgrounds. In the European context, experience shows that private service providers in adult education tend to offer education services of lower quality than public ones, often employing low-paid trainers or teachers and cutting on costs wherever they can. As a result of the economic crisis, most policymaking in adult education shifted its focus to Vocational Education and Training (VET). The argument for VET is often made in reference to the large numbers of the unemployed in many European countries and on the vacancies for specialised jobs. Upskilling and reskilling for employability is a priority not only of the European institutions, but also of governments at the national level. Non-formal adult education has stepped to the background, despite recent studies such as the BELL study that have shown that learning, in its many forms, can lead to individual and societal well-being and prosperity (EAEA, 2018).

Recommendations/Challenging solutions:

Adult education in SDGs is a precondition for the achievement of the SDGs (EAEA, 2018). There is a tendency to look at education strictly in its separate categories, but it will be impossible to achieve coherent policies on lifelong learning and its contribution to sustainable development if they are not guided by this integrative perspective (LLLP, 2020b).

In consideration of the necessity of effective action towards the SDGs in the next ten years, to mitigate emergencies such as climate change, biodiversity loss and inequalities intensifications, the strengthening, in terms of quantity and quality, of adults learning for sustainability is crucial. Ways to spread effective sustainability competence learning in adults formal, non-formal and informal education, could also have a positive rebound effect on childhood and youth family education for sustainability.

3.5.6 Teacher training and education

Barriers/Challenging problems:

Teacher education must be a central feature of any educational programme aimed at promoting the SDGs. Whilst there has been significant progress in many regions of the world in promoting sustainable development within training courses for teachers, in the vast majority of countries these themes are still seen as optional and marginal to the main purposes of teacher education (Bourn, Hunt and Bamber, 2017).

Recommendations/Challenging solutions:

For educators and trainers to help the transition to a sustainable society, they must first acquire the necessary knowledge, skills, attitudes and values. They must also develop motivation and commitment, so that building the capacities of these change agents is a priority to facilitate ESD (UNESCO, 2018a). It is fundamental to provide long-term support and training for educators in adopting pedagogical approaches suited to sustainable development education, including active, participatory and learner-centred methods. These methods see learners as active agents of change rather than passive recipients of pre-defined knowledge. In this way, the development of transformative learning, pedagogy or andragogy (in the case of adult learners) can be supported (LLLP, 2020b). Likewise, the ECE group on competences on ESD (UNECE, 2013) suggests the professional development in education governing and managing of institutions, so to increase the capacities of educators and trainers to deliver ESD and to enhance structural change more effectively. The ESFSES (2020) talks about embedding the key topics covered by the SDGs in programmes and projects supporting teacher education.

3.5.7 Training and awareness of key stakeholders and decision-makers to transform them into change-agents

Barriers/Challenging problems:

The UNESCO Preliminary Monitoring Report focusing on the GAP Key Partners, reported a persistent concern in that awareness is low, especially among **policy makers**. Furthermore, that **media** are not sensitised to engage with ESD-related issues to ensure adequate coverage (UNESCO, 2016a).

Recommendations/Challenging solutions:

The education change that Sustainable development requires can be supported through a process of engagement designed to give key decision makers and other stakeholders of the education systems an opportunity to reflect on the knowledge, skills and attitudes required by educators whose task is to prepare learners, young and old, for a fulfilling, productive and environmentally sustainable life in the twenty-first century (UNECE, 2013).

UNESCO (2018a) acknowledges the importance of raising public awareness of sustainable development issues and of providing adequate and relevant training for decision-makers and key local stakeholders to transform them into change-agents. EARLALL and EfVET (2020) suggest raising awareness at local level about the urgency to provide citizens with the right level of green skills needed for their personal and professional development.

ESD is about much more than preaching and teaching on sustainable development. It is also about practicing sustainable development and transforming learning and training environments. This concerns also with changing the ethos and governance structure of the whole institution. School principals, directors of Vocational Education and Training (VET) centres, presidents of universities, community colleges and private companies, community leaders, parents, learners and trainees are important partners to transform learning and training environments to integrate sustainability principles into education (UNESCO, 2018a).

3.5.8 Education for Sustainability adequate funding and European funding programs

Barriers/Challenging problems:

Mainstreaming sustainability education across all learning sectors will be difficult without adequate, long-term funding (LLLP, 2020b). The average EU expenditure on education decreased constantly from a share of 5.5% of GDP in 2009 to only 4.7% in 2018 (LLLP, 2020a).

The GAP Preliminary Monitoring Report highlighted, at a global level, some challenges of ESD implementation that include funding and broader resource mobilisation. Furthermore, GAP partners identified that there is a lot of demand for ESD-related input, and it is important to learn to say 'no' so that their organisation can stay on mission and avoid being spread too thin. In general, ESD is a voluntary activity for a lot of teachers. In addition, also other factors militate against wider ESD implementation: the curriculum is quite full in many contexts and the implementation of ESD, is highly participatory. Moreover, it would need ample class time and low student-to-teacher ratios. These requirements also have an implication on costs (UNESCO, 2016a).

Recommendations/Challenging solutions:

Among the various enablers for scaling ESD there are funding availability, partnerships and networks, capacity-building opportunities, research and existing structures. In some cases, lack of funding may be a constraint (UNESCO, 2018a). Furthermore, if we really want to train people to adequately manage the complex problems of our world, it is essential that the institutions involved dedicate more human and financial resources to research and training (Rodríguez and García, 2009).

Advancing policy in order to mainstream ESD into both education and sustainable development policies means setting up ESD-specific funding priorities for international projects with multi-professional and cross-sectoral teams (EFSES, 2020). In addition to granting authority for implementation, ESD policies also need to ensure that the necessary institutions, resources and capacities exist to ensure effective delivery (UNESCO, 2018a). More specifically, in order to unlock the full potential of education for sustainable development across all learning sectors, adequate long-term funding should be ensured, at European, national, regional and local levels, including through the next EU Multiannual Financial Framework (2021-2027) and Next Generation EU (LLLP, 2020b). Furthermore, public authorities at national/regional level should increase, optimise and (where necessary) create funding mechanisms to support the provision of green skills (EARLALL and EfVET, 2020).

Developing a common project framework for ESD competences and minimum standards to be embedded in all Erasmus+ and Horizon Europe projects is a way to mainstream ESD into both education and sustainable development policies (EFSES, 2020). Policy makers are recommended to incorporate Sustainable Development in education and training policies and programmes such as the European Education Area or Digital Education

Action Plan, aligning them with SDG 4.7. This would help mainstreaming sustainable development education and training in Erasmus+, European Social Fund (ESF+), Horizon Europe (LLLP, 2020b). EFSES (2020) as well, advocates the leveraging of the full transformative power of ESD by promoting synergies with research programmes such as Horizon Europe and by continuing to mainstream ESD in educational programmes such as Erasmus+, as well as in national programmes to utilise its full transformative power. EARLALL and EfVET (2020) also mention the European Social Fund and add the European Regional Development Fund and LIFE to promote green skills and research on green skills.

3.5.9 Promote cooperation among relevant stakeholders

Barriers/Challenging problems:

The Global Action Programme on ESD, endorsed by UNESCO (2018b), calls for policymakers, institutional leaders, educators, youth, local authorities, and civil society organizations to commit to undertake action to scale up ESD at all levels and in all areas of education, and in all sustainable development sectors (UNESCO, 2018b).

Recommendations/Challenging solutions:

EARLALL and EfVET (2020) recommend: EU institutions to promote cooperation among different stakeholders (e.g., national/regional TVET organisations); representatives of the business sector to prioritize collaboration with stakeholders that respect sustainability principles and the environment; civil society organisations to promote collaboration with stakeholders on green skills (EARLALL and EfVET, 2020). To promote cooperation between different learning sectors and generations of learners to foster a long-term holistic view on learner development and lay the ground for more innovative approaches to teaching and learning (LLLP, 2020b) is also considered important.

4   Conclusions, main limitations of the study, the Sustainability competence proposal and way forward

This study[12] has been carried out between October 2020 and February 2021 to help the JRC preparing the initial steps towards the European Sustainability Competence Framework (GreenComp, published in January 2022) and for the spreading of these competences in the European Union. The main takeaways of this study may be summarised as follows:

- The Education for Sustainability literature shows that concepts, such as systemic thinking, future thinking, critical thinking, values thinking and participation/collaboration, can be traced back in documents, available online, of the 1970s and 1990s. This clearly indicates that these concepts, in different ways, have been guiding Environmental and Sustainability Education for the last 30-50 years, long before they were organised in competences and frameworks of competences.

- Hence, Education for Sustainability, with its history, evolution of approaches and practices, can be considered as a fundamental tool to facilitate the learning of sustainability competences. But, as UNESCO (2017) recapitulates, only a holistic and transformative ES can make possible the development of the key competencies needed for promoting sustainability. ES does not only integrate contents such as climate change, poverty and sustainable consumption into the curriculum. It also requires interactive, learner-centred and transformative pedagogical approaches which support self-directed learning, participation and collaboration, problem-orientation, inter and trans-disciplinarity. In short, Education for Sustainability pedagogical approaches do not consist of a series of handbooks with a list of "one-fits-all" activities that anyone can effectively facilitate.

- The analysis of the Education for Sustainability literature widened the lifelong learning and the historical perspectives and added definitions and competences for professionals such as educators, eco designers and managers. Altogether, the 36 sets of competences analysed in this study, provided nuanced and comprehensive sets of key competences and of competences, that have been merged and classified in the following seven competences: "Systems thinking", "Futures thinking" (Anticipatory), "Values thinking" (Normative), "Critical thinking", "Strategic action-oriented competence (Agency/ implementation/ integrated problem solving)", "Intra-personal (Self-awareness)" and "Inter-personal (Collaboration)".

- To avoid confusion with the EU lifelong learning key competences, the set of Sustainability competences proposed in this report has been organised in 'competences' with their clusters of 'components'. The latter serve to enrich the short definition of the competence and to favour a more comprehensive and nuanced understanding that could help inspire self-learning or teaching activities. Albeit presented as lists in tables, the competences are intertwined. In practice, they cannot always be learned totally independently one from the other and most of the times the development of one of them enhances the others. This interwovenness may be sensed in the examples in the tables called 'Examples of "behavioural learning objectives" and contributions of the... competence to a low carbon and circular economy, to sustainable lifestyles and behaviours'.

- The Sustainability competences (e.g., systems thinking, future thinking...) presented in the study, can be learned through life experiences, lifelong learning and, especially through Education for Sustainability provided by ES professionals who have developed the competences themselves, who know the pedagogical approaches of ES and have developed the motivation and skills to apply them.

- Concerning the comparison of the set of Sustainability competence proposed in this report, with the existing EU competence frameworks for lifelong learning (DigComp, EntreComp and LifeComp), it highlighted some similarities, especially between the competences in LifeComp and the Intra and Inter-personal sustainability key-competences.

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[12] This report remained unpublished as the JRC priority was to develop the GreenComp and related expert and stakeholder consultations during 2021.

- On one side, the main benefits of promoting the learning of the competences in Europe, include for example: responding to the citizens' desire to contribute to a better future; enabling students to appreciate the complexity of our world; empowering people of any age to be 'global citizens'; driving Europe's competitiveness and innovation.

- On the other, among the numerous experts' recommendations for scaling up Education for Sustainability and the learning of the competences, the following may be highlighted: the building of synergies between sustainability and education; the training and awareness of key stakeholders and decision-makers to transform them into change-agents; the strengthening of Education for Sustainability (in quality and quantity) through adequate funding.

In relation to the limitations of the Education for Sustainability literature review presented in this study, not all the fields that have developed 'competences', 'skills' or 'characteristics' for Sustainability could be analysed. Therefore, an additional literature review or expert consultations could enrich the proposed classification. Specifically, we refer to frameworks from the fields of Global Citizenship Education (GCED) and Sustainability Leadership (SL) that were at a first stage considered. Hence, it was decided not to include these fields in the study, for the following reasons:

— the theoretical foundations, purposes and magnitude of the production of sets of "characteristics" or "qualities" for Sustainability Leadership,

— the similarity ([13]), in terms of competences, between the Global Citizenship Education frameworks and the Education for Sustainability ones,

— the purpose and magnitude of this study in light of the different needs of the European Commission,

— the possibility of receiving feedback for eventual integrations, during the following phases of the design process of the EU Sustainability Competence framework, as for example in expert consultations.

Most importantly, we are conscious that the design of a framework of competences is not enough for the acquisition of the competences in Europe. That is why in the previous section "3.5 Experts' recommendations…" we collected suggestions for possible ways forward, based on the information on barriers and possible solutions drawn from the recommendations of a variety of European stakeholders.

The criteria for the selection, classification and building of the descriptions of the competences, that have been used to design the proposed set of competences, have been chosen trying to be as objective as possible, taking into account the future possible uses of the final framework and the views of the Joint Research Centre and DG EAC. It has to be highlighted in these conclusions that "the final framework" mentioned is *GreenComp* (Bianchi et al., 2022), the EU Sustainability competence framework, designed through expert consultations in the year following the present study, but for its importance published before the present study. Indeed, at the time of conducting the study described in this report, we were aware that the final choices would probably be different from the final framework.

([13]) GCED was introduced in the UN Secretary-General's Global Education First Initiative in 2012, but elements such as peace and human rights education, which are key to GCED, had been advocated by countries long before GCED was introduced on the global agenda. In some countries, these concepts are encompassed by ESD, just as ESD related themes can be included in GCED, creating room for commonality between the two (UNESCO, 2014).

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List of abbreviations and definitions

CEDEFOP   European Centre for the Development of Vocational Training

DAD   Decide-Announce-Defend

DE   Development Education

EAUC   European Alliance for Sustainability Leadership in Education

EAEA   European Association for the Education of Adults

EC   European Commission

EE   Environmental Education

ENSI   Environment and School Initiatives

ES or EfS   Education for Sustainability

ESD   Education for Sustainable Development

EfVET   European Forum of Technical and Vocational Education and Training

EFSES   European Forum on Science & Education for Sustainability

EARLALL   European Association of Regional & Local Authorities for Lifelong Learning

GHG   Green House Gases

LLLP   Lifelong Learning Platform

NIMBY   Not In My Back Yard

OECD   Organisation for Economic Co-operation and Development

PCE   Parliamentary Commissioner for the Environment

QAA & Advance HE   Quality Assurance Agency for Higher Education and Advance HE

SD   Sustainable Development

SDGs   Sustainable Development Goals

SE   Sustainability Education

SEED   School Development through Environmental Education

UN   United Nations

UNECE   United Nations Economic Commission for Europe

UNEP   United Nations Environment Programme –

UNESCO   United Nations Educational, Scientific and Cultural Organization

WCED   World Commission on Environment and Development

WWF   World Wildlife F und

List of boxes

List of tables

Annexes

Annex 1. Table with the list of authors and characteristics of the frameworks and sets of competences that have been merged in the set of Sustainability Competence presented in the report.

Sustainability competence frameworks	Id. N.		Author/s	Year	Name of FW	By who/method	Characteristics/ comments	Lifelong Learning level
Key competencies in Sustainability for academic program development	1		**Redman and Wiek**	Under review (in 2020-2021)	KEY competencies in SUSTAINABILITY for academic program development	Sttarting from their 2011 study (Wiek et al., 2011), literature review to draw a coherent and comprehensive framework of key competences in sustainability	key competences must be inherently interlinked and integrated with each other, as opposed to just being "laundry lists". Key competences in sustainability: 5 established (in bold), 3 emergent (in italic); complemented by other professional, disciplinary, and general competences	HE
	2		**Brundiers et al.**	2020	KEY competencies in SUSTAINABILITY for academic program development	14 international experts in sustainability education / Delphi study to review Wiek et al., 2011, 2016, funded by the US National Council for Science and the Environment (NCSE)	3 europeans (germany and Spain) and 14 from Canada, US, newZeland, UNESCO Delhi	HE
	3		**Wiek et al.**	2016	KEY competencies in SUSTAINABILITY for academic program development	Most influential framework	Authors add problem-solving competence, which as the authors argued was already implicit in the 2011 study	HE
	4	Preliminary review by Bianchi (2020) for JRC	**Wiek, Withycombe, and Redman**	2011	KEY competencies in SUSTAINABILITY for academic program development	Most influential framework, from broad literature review (2000-10)	key competences in sustainability as opposed to "regular or basic" competences, such as but not confined to "critical thinking, communication, pluralistic thinking, research, data management, etc." (Wiek et al., 2011, p.211), not critically important to sustainability, and they can be learnt through regular academic education and they are not exclusive to sustainability education - 5 interlinked and interdependent competences, as each contributes its part to sustainability problem-solving processes	HE
Competence frameworks in Sustainability Education (SE) and Education for Sustainable deveopment (ESD) - 2010-2020	5		**Pacis & Van Wynsberghe**	2020	Key Competencies for Sustainability	Literature Review		
	6		**Giangrande, White, East, Jackson, Clarke, Coste, Penha-Lopes**	2019	Competency Framework for ESD which applies to all learning (F,I,NF)	20 experts from formal & informal ed. and NGOs	7 european authors (UK, France, Portugal)	LL
	7		**Trad**	2019	ESD Collective Competences* for tertiary education (focus on engineering)	Literature review and tested in engineering curricula	Mixed comp and components!! - Faculty of Engineering and IT, University of Technology, Sydney, New South Wales, Australia	HE (engineering)
	8		**Rieckmann/**	2018	Key	conceptual paper and	Compares OECD,	LL??

Category	#		Author	Year	Topic	Method		Notes
			UNESCO		competences for ESD	UNESCO report 2018 - Author of the chapter in Unesco 2017	Gestaltungskompetenz (shaping competencies), Riesckmann 2012, Wals 2015, Wiek et al. 2016, Glasser and Hirsh 2016. Extracts what in common.	
	9		Lozano, Merrill, Sammalisto, Ceulemans, Lozano	2017	Competences for ESD in HE			
	10		Dimante, Benders, Atstaja, Tambovceva	2016	Competences for the Circular Economy in business education	Analysis based on literature review and academic courses at three HEIs in Latvia		business education
	11		Quendler & Lamb,	2016	Competences, Knowledge, Skills for ESD (desirable professional profile)	Two surveys: one for HEIs and one for companies to define C, K, S needs for ESD		HE and business education
	12		Glasser & Hirsh	2016	Learning for Sustainability Core Competencies	Based on Wiek et al., 2011, authors added 5 core competences		HE?
	13		Rieckmann	2012	Key competencies for SD	70 Experts from Latin America (Chile, Ecuador, Mexico) and Europe (Germany, Great Britain)		
Green skills/ Sustainability competences among professionals working in sustainability-related professions 2020-2020	14		Pruneau et al.	2013	Competences for adaptation to climate change among municipal employees	Municipal employees in Canada involved in a problem-solving exercise to find a solution to local sea level rise.		
	15		Heiskanen, Thidell, Rodhe	2016	Competencies of sustainability professionals	Survey and interviews with sustainability professionals, previously enrolled in a sustainability real-life solution-oriented consultancy project (alumni) at a Swedish University		
	16		Demssie, Wesselink, Biemans, Mulder	2019	Sustainability competencies relevant to the Bottom of the Pyramid context	Delphi study involving experts from academia and industry from the Ethiopian context		
	17		Krasna et al	2020	Competences for public health professional trained in climate change	Job postings (2003-2019) for public health professionals and survey to employers based in the US		
	18		MacDonald, Clarke, Ordonez-Ponce, Chai, Andreasen	2020	Sustainability management competencies (municipality employees)	Interview analysis of 26 sustainability professionals employed by Canadian municipalities		
	19		O*NET		categorization of skills done by O*NET in 35 main skills grouped as shown below in six categories:			
Frameworks 2000-2010 reviewd by	20	Extended	ACPA.org	2008	Change agent	(http://www2.myacpa.org/; cf. Svanstro¨m et al. 2008)	Authors (2000-2010) in the literature review by Wiek, Withycombe, and Redman	

Wiek, Withycombe, and Redman (2011) for the design of their framework for Higher Education (Considered for a lieflong learning and historical perspective and a wider definition of terms and concepts)	21	Sipos et al.	2008	Head, hands and heart		(2011)	
	22	Rowe	2007	Problem solving			
	23	de Haan (cf. Barth et al. 2007; van Dam-Mieras et al. 2008)	2006	''Gestaltungskompetenz'' [Design/organization of competences??			
	24	Kelly	2006	Globo sapiens			
	25	Sterling and Thomas	2006	Values, knowing, skills, understanding	(Capabilities)		
	26	Kearins and Springett	2003	Critical theory			
	27	Crofton	2000	Sustainability obligations of professional engineers			Engineers
Education for Sustainability and for Sustainable Consumption Frameworks and sets of comp. (Considered for a lieflong learning and historical perspective and a wider definition of terms and concepts)	28	Tilbury and Wortman-IUCN (Sterling author of a chapter)	2004 (recalls a 1993 book!)	core components of education for sustainability or key elements of education for sustainability practice. (26 26 Fien, J. (1993) Education for the Environment: Critical curriculum theorising and environmental education. Deakin University Press, Geelong)	Uses Fien, J. (1993) to categorise the experiences collected in the chapters of the report	Complete definitions - At the same time Components, elemnts of EES or learning components, or approaches	not specified (ES projects form all over the World)
	29	Tilbury	2004 In: Corcoran P.B., Wals A.E.J.	In an other book chapter by Tilbury 2004 The terms 'critical reflection', 'values clarification' and 'participative action research' have become core components of Environmental Education for Sustainability (see Sterling et al., 1992; Fien & Trainer, 1993; Gough & Robottom, 1993; Huckle & Sterling, 1996; Huckle, 1997; Robottom, 1987; Fien & Tilbury, 1996; Hesselink et al., 2000; Tilbury, 1993; 2001a; 2001b).	or key learning components	They are perceived as critical to addressing capacity building and education needs for sustainable development. Potentially any subject is a resource for learning for change towards sustainability through environmental education (Alabaster & Blair, 1996). It solely requires that these key learning components form part of the curriculum in higher education.	HE
	30	UNEP and	2010	Competences of	UNEP and	Genral comp and specific	not

		ESC Work group		Educ. for Sustainable Consumption, divided in ESC General and subject specific competencies "The basic learning outcomes of ESC can be defined as attitudes, knowledge, skills and behavior leading to: ü Critical awareness ü Ecological responsibility ü Social responsibility ü Action and involvement ü Global solidarity"	Marrakech Task Force on Education for Sustainable Consumption led by Italy (Ministry of Environment)	comp	specified (all)
	31	Tilbury-UNESCO	2011	ESD learnings		Complete definitions	not specified (ES projects form all over the World)
	32	Murray	2011	Sustainable self: qualities/attributes for a sustainable living	Different perspective of a sustainable construction professor	More goals than comp: Different cocepts/perspectives from all previous	not specified (all)
Sustainability competence frameworks for professionals (educators, cicular designers, managers)	33	UNECE	2011	"core competences in ESD for educators" - 42 sentences (competences) for educators	EU experts work group	The clustering of competences in the table rows is inspired by the report of the International Commission on Education to UNESCO (Learning the treasure within- Delors)	Educators
	34	Vare et al.	2019	Rounder sense of purpose	Distillation of the 42 UNECE comp	Distillation of UNECE FW	Educators
	35	Sumter et al.	2020	circular economy competencies for design- Competeces for designers of products and services for a circular economy.			Desgners
	36	Eizaguirre, García-Feijoo and Laka	2019	Core Competencies in Business and Management	three di erent geographical regions (Europe, Latin America, and Central Asia), and the perspective of four di erent stakeholders (graduates, employers, students and academics). of the so-called Tuning projects, and starting from a list of generic competencies from the "Degree in business and management"	The factor detected in each region associated with sustainability does not reflect its economic dimension. This is probably due to the very nature of the studies. Probably in business and management studies these aspects are developed through the specific competencies of the degree, and not through the generic ones (which are those included in the lists used for this research). Besides, it could be also assumed that students in these areas would have a background in	HE

| | | | | | | | economics.... Our interpretation is that competencies that in other disciplines can be seen as important generic competencies (strategic planning, social responsibility, or systemic vision) in business and management studies are considered as crucial specific competencies and are not expressly linked to sustainability. starting from a list of generic Author from marketing Wider conclusions for country. Competencies from the "Degree in business and management" | |

Source: Elaborated by the author between October 2020 and February 2021, based on the extension of the preliminary review presented in Bianchi (2020).

Annex 2. Inventory table of the Sustainability competences and frameworks found in the Education for Sustainability literature and merged in the set of Sustainability Competence presented in the report.

	1 — Redman and Wiek (Under review)	2 — Brundiers et al. (2020)	3 — Wiek et al. (2016)	4 — Wiek, Withycombe, and Redman (2011)
Chiara's proposal				
Complexity and Systems thinking (REPETITIONS: 29 full and 3 half in 36 FWs <- 19 B7+ 17B4)	**Systems thinking - Disciplinary competences: related to specific disciplines**	**Systems thinking** — As in Wiek et al., 2011, p. 207 - Topical knowledge: content knowledge in sustainability and in other disciplines (e.g., climate, water, energy, food, international development)	**Systems thinking**	**Systems thinking** — "ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks." (Wiek et al. 2011, p. 207)
Futures-thinking / anticipatory (REPETITIONS: 25 full in 36 FWs)	**Futures-thinking** — Planning competencies: Systems thinking, futures thinking, values thinking, and strategies thinking contribute to drafting sustainability action plans. These can lead to positive sustainability outcomes if successfully implemented (implementation competence)	**Futures-thinking** — To be able to iterate and continuously refine one's own futures thinking (visions, scenarios, etc.), in productive and explicit tension to the status quo; recognizing the implicitly held (and largely unrecognized) assumptions about how society works and how they influence the status quo and critically reflecting how they might influence futures thinking	**Anticipatory**	**Anticipatory** — Anticipatory/futures-thinking competency "ability to collectively analyze, evaluate, and craft rich "pictures" of the future related to sustainability issues and sustainability problem-solving frameworks". (Wiek et al. 2011, pp. 208–209)
Values-thinking (or normative) (REPETITIONS: 17 full and 4 half)	**Values-thinking** — Planning competencies: Systems thinking, futures thinking, values thinking, and strategies thinking contribute to drafting sustainability action plans. These can lead to positive sustainability outcomes if successfully implemented (implementation competence)	**Values-thinking** — Described as a lead-competency: it provides normative orientation and value clarification for all the competences embedded in the framework. - To be able to differentiate between intrinsic and extrinsic values in the social and natural world; to recognize normalized oppressive structures; to identify and clarify one's own values; to explain how values are contextually, culturally, and historically reinforced; to critically evaluate how particular stated values align with agreed-upon sustainability values; and to differentiate between espoused values and practiced values.	**Normative**	**Normative** — Normative/values-thinking competency "ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets". (Wiek et al. 2011, p. 209)
Critical thinking (REPETITIONS: 12 full, 1 half, 3 say "taught in HE) [For Wiek, complementary to key competences in sustainability. Not for other authors]	**Critical thinking** — Planning competencies: Systems thinking, futures thinking, values thinking, and strategies thinking contribute to drafting sustainability action plans. These can lead to positive sustainability outcomes if successfully implemented (implementation competence) Critical thinking is in "Complementary to key competences in sustainability." •General competences: acquired in higher education	Basic competences: acquired in higher education	Basic competences: acquired in higher education	Basic competences: acquired in higher education
Action comp (REPETITIONS: 33 full and 4 half) **Strategic-thinking [and acting] - Agency!** Implementation, Integration or Integrated problem solving (Extra comp in Wiek, Redman, Brundiers)	**Strategic-thinking** (REPETITIONS: 19 full and 4 half) — Planning competencies: Systems thinking, futures thinking, values thinking, and strategies thinking contribute to drafting sustainability action plans. These can lead to positive sustainability outcomes if successfully implemented (implementation competence)	**Strategic-thinking** ¡Below the difference between strategic and implementation, integrated problem solving!	**Strategic or action oriented comp** — In article: Strategic thinking or action-oriented competence "Graduates competent in strategic thinking are able to develop and test systemic interventions, transformational actions and transition strategies toward sustainability, accounting for unintended consequences and cascading effects. They are able to develop plans that leverage assets, mobilise resources, and coordinate stakeholders to overcome systemic inertia, path dependencies and other barriers to reach envisioned outcomes. Graduates are also able to describe the need for strategic thinking in sustainability problem solving, for example, in designing and carrying out plans, interventions and actions to mitigate sustainability problems and make progress toward sustainability visions. Finally, graduates are able to position job activities in a way that contributes to sustainability transitions."	**Strategic** — Strategic-thinking competency "ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability". (Wiek et al. 2011, p. 210) [Here Strategic thinking implies implementation]
	Integration (REPETITIONS: 9 full)	**Integrated problem-solving** Below the ¡difference between strategic and implementation, integrated problem solving!	**Integrated problem-solving** — In article: "Graduates competent in integrated problem-solving are familiar with and able to apply different problem-solving frameworks to complex sustainability problems and develop viable solution options. This capacity enables graduates to meaningfully integrate problem analysis, sustainability assessment, visioning and strategy building." In report B7: Integrated problem-solving competency is a meta-competency of meaningfully using and integrating the five key competencies [left] for solving sustainability problems and fostering sustainable development (Wiek et al. 2016, p. 243). It is the ability "to apply different problem-solving frameworks to complex sustainability problems and develop viable solution options" in order to "meaningfully integrate problem analysis, sustainability assessment, visioning and strategy building" (Wiek et al. 2016, p. 251)	
	Implementation **** (REPETITIONS: 5 full) **** In this framework, they are categorized as Professional skills — Responsible project management is in "Other PROFESSIONAL skills (out of "Key Competencies in SUSTAINABILITY" for HE)	**Implementation*** ** Implementation competence needs further elaboration ¡difference between strategic and implementation, integrated problem solving! -> Implementation competency is about taking conscious action, i.e., doing the actions associated with the solution process that is the (intellectual) result of integrated problem-solving competency in the first place — "collective ability to realize a planned solution toward a sustainability-informed vision, to monitor and evaluate the realization process, and to address emerging challenges (adjustments), recognizing that sustainability problemsolving is a long-term, iterative process between planning, realization, and evaluation. Implementation competency is essentially action competency, using actionable knowledge that has been created through strategic-thinking competency."		Strategic-thinking competency "ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability". (Wiek et al. 2011, p. 210) [Here Strategic thinking implies implementation]
Sustainability change agent leadership - Intra -personal (REPETITIONS: 5 full and 16 half)[Isn't it a group of particular competences??] (there could be anything behind...also aambitious for money) ...¿Also systems, future and strategic ar intarpersonal??or only self awareness??]	**Intra - personal ****** — Key professional skills in sustainability, such as inter- and intrapersonal competences guarantee collaboration and self-care which are necessary for long-term success [**** In this framework, they are categorized as Professional skills] Creativity is in "Complementary to key competences in sustainability:" •General competences: acquired in higher education	**Intra -personal (or self-awareness)** — No full agreement on whether intra-personal (or self-efficacy) is a competency or a mindset		
Sustainability change agent leadership - Inter personal or collaboration (REPETITIONS: 17 full and 11 half) (there could be anything behind..) [Isn't it a group of particular competences??]	**Inter-personal** (Impactful stakeholder engagement and collaborative team work) — Key professional skills in sustainability, such as inter- and intrapersonal competences guarantee collaboration and self-care which are necessary for long-term success Compassionate communication is in "Other PROFESSIONAL skills (out of "Key Competencies in SUSTAINABILITY" for HE) Communication is in "Complementary to key competences in sustainability:" •General competences: acquired in higher education	**Interpersonal**	**Interpersonal** — In article: Collaboration or interpersonal competence	**Interpersonal** — Interpersonal/collaborative competency "ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving". (Wiek et al. 2011, p. 211)

Competence frameworks in SE and ESD

5 Pacis & Van Wynsberghe (2020)		6 Giangrande, White, East, Jackson, Clarke, Coste, Penha-Lopes (2019)		7 Trad (2019)	8 Rieckmann/ UNESCO (2018)		9 Lozano, Merrill, Sammalisto, Ceulemans, Lozano (2017)		10 Dimante, Benders, Atstaja, Tambovceva (2016)		11 Quendler & Lamb (2016)	
• Applying systems thinking and dynamics;	State of planet literacy and numeracy: Knowledge and understanding:	System	(ability to work with Feedback loops, systems and sub-systems, buffers and multiple variables, nested scales, resilience, and tipping points);	•Complexity and systems thinking, Triple Bottom Line (systems thinking (applying a TBL); complexity & systems thinking (TBL); transdisciplinary); self-awareness & global responsibility (interpersonal competence; values-based thinking; global citizenship; global resource knowledge; self-awareness; capacity for empathy, compassion and solidarity); •Lifecycle analysis (strategic competence; lifecycle analysis); •Decision-making for sustainability (decision-making for sustainability development when designing; interdisciplinary) *each collective competence includes a subset of sustainability competences (in italic);	Systems thinking	"the ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty"	•Systems thinking	Analysis of complex systems across different scales and domains of inquiry • Comprehension, empirical verification, and articulation of a system's key components, structure, and dynamics • Attention to systemic features such as feedback, inertia, stocks and flows, and cascading effects • Understanding of complex systems phenomena, including unintended consequences, path dependency, systemic inertia, and intentionality • Understanding of connectivity and cause-effect relationships • Application of modelling (qualitative or quantitative)	•Systems thinking	•Life cycle thinking (or life cycle assessment understanding); •Understanding of eco-design principles;	SD competence: •System orientation	SD Skills: •Analysing environmental impacts; SD Knowledge: •General SD knowledge; •Economics; •Value of nature; •Social aspects of SD
• Integrating tradition with future thinking;	State of planet literacy and numeracy: Knowledge and understanding:	Anticipatory	(working with scenarios, forecasting and backcasting; intergenerational equity)	•Change management and envisioning a better future (change management; envision a better future; anticipatory competence);	Anticipatory	"the ability to understand and evaluate multiple futures – possible, probable and desirable – and to create one's own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes"	•Anticipatory	Envisioning, analysis, and evaluation of possible futures, including scenarios with multi-generational timescales • Application of precautionary principle • Prediction of reactions • Dealing with risks and changes	•Long-term thinking		SD competence: •Future orientation	
•Commitment to the common good (affinity for all life); •Care and interest for others; •Care for self	Values and commitments:	Normative	(knowledge of the sustainability of current or future states; knowledge of and awareness of justice, fairness, happiness, wellbeing, risk, trade-offs, and ethical questions)	•Value-based thinking, self-awareness & global responsibility (interpersonal competence; values-based thinking; global citizenship; global resource knowledge; self-awareness; capacity for empathy, compassion and solidarity);	Normative	"the ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions"		•Justice, responsibility, and ethics	•Principles of social entrepreneurship; •Business ethics;			
				critical thinking; included in each collective competences as a sustainability competence (defined as; objective analysis of a problem by judging results or weighing values to form the most sustainable judgement).	Critical thinking	"the ability to question norms, practices and opinions; reflect on own one's values, perceptions and actions; and take a position in the sustainability discourse"	•Critical thinking and analysis	Ability to challenge norms, practices, and opinions • Reflection on one's own values, perceptions, and actions • Understanding of external perspectives				
•Modelling?? sustainable behaviour;		Strategic planning	(decision making strategies; awareness of success factors; obstacles to change; knowledge of behavioural change; organisational development skills)		Strategic	"the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield" [From a LL point f view Not much difference between strategic thinking and implementation and Integrated problem solving, agency, action...]	•Strategic action	Ability to design and implement interventions, transitions, and transformations for sustainability • Active and responsible engagement in sustainability activities • Development and application of ideas and strategies • Planning and executing projects • Ability to reflect on, and deal with, possible risks • Organisation, leading, and controlling processes, projects, interventions, and transitions • Identification of scopes of creativity and participation				SD Knowledge: •How to analyse environmental impacts; •How to reduce environmental impacts;
					Integrated problem-solving:	"Integrated problem-solving competency: the overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive and equitable solution that promote sustainable development – integrating the above-mentioned competencies"		•Assessment and evaluation •Interdisciplinary work	•Multidisciplinary approach to problem solving;			
• Implementing transformative change	Social skills and agency: [ability to act]										SD skills: •Implementing sustainability [similar to strategic]	
		Intrapersonal	(ability to hold contradictory feelings and thoughts; personal and group stress management; cultivating awareness; finding inner peace, compassion, meaning making, experiencing love and connection)	self-awareness & global responsibility (interpersonal competence; values-based thinking; global citizenship; global resource knowledge; self-awareness; capacity for empathy, compassion and solidarity); •Life-long learning skills and continuous reflection for sustainability (learning for life; judge consequences; act upon reflection; self-learning; distanced reflection on individual and cultural models);	Self-awareness (or intrapersonal competency)	"the ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires"		•Personal involvement •Tolerance for ambiguity and uncertainty (Coping with conflicts, competing goals and interests, contradictions, and setbacks)	•Creativity skills		SD competence: •Social responsibility	
• Wise, compassionate decision-making; •Empathy, mindfulness and social learning;	Social skills and agency:	Interpersonal	(collaborative skills; mediation; leadership; cooperation; empathy; teamwork)	self-awareness & global responsibility (interpersonal competence; values-based thinking; global citizenship; global resource knowledge; self-awareness; capacity for empathy, compassion and solidarity); •Stakeholder engagement and collaboration (collaboration in decision-making; normative competence; sustainability growth and development; conflict resolution);	Collaboration	"the ability to learn from others; understand and respect the needs, perspectives and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership); deal with conflicts in a group; and facilitate collaborative and participatory problem-solving"	•Interpersonal	...relations and collaboration • Empathy and change of perspective •Communication and use of media	•Ability to work in interdisciplinary groups; •Negotiation skills;		SD skills : •Communicating; •Leadership and teamwork	

	12	13		14		15		16		17		18		19
	Glasser & Hirsh		Rieckmann	Pruneau et al.		Heiskanen, Thidell, Rodhe		Demssie, Wesselink, Biemans, Mulder		Krasna et al		MacDonald, Clarke, Ordonez-Ponce, Chai		O*NET
	2016	2012		2013		2016		2019		2020		2020		
Systems thinking	•Knowledge about the state of the planet;	•Systemic thinking …		•Local knowledge; •Mathematics competences;*** •Linking thinking;** ***to create links between elements of the problem		Systems-thinking / •Subject-specific competences: life cycle assessment, carbon footprint, environmental management systems, economics and environmental law;		Systems-thinking / •Disciplinary competence;*knowledge about sustainability in relation to one's own discipline •Transdisciplinary competence; •Competence to balance sustainable development dimensions;		Systems thinking; / •Knowledge of climate mitigation/adaptation; •Climate-health justice; •Direct/indirect and downstream effects of climate on health; •Health impact assessment; •Risk assessment; •Pollution-health consequences and causes; •Interdisciplinary understanding;		Systems thinking / •Sustainability knowledge;		•Systems skills: used to understand, monitor, and improve socio-technical systems (systems analysis and evaluation);
Anticipatory		Anticipatory		•Futures thinking;	•Risk prediction; •Hindsight;* *to recall details of past climate events	Anticipatory competence		Anticipatory competence				Future-oriented thinking		
Normative						Normative competence / /responsibility		Normative competence / Social justice and inclusion competence;				Sustainability values		
		Critical thinking		•Critical thinking;								•Information seeking;		
Strategic	•Wise decision-making; (in implementation??) •Modelling ???? sustainable behaviour; •Transformative social change			•Competency for planning and realising innovative projects; •Competency for evaluation; •Competency for acting fairly and ecologically		Strategic competence / Action skills •Acting decisively under uncertainty, improvising and "making do";		Action competence - Strategic competence / •Resource utilization competence; •Competence to utilize indigenous resources for sustainability		•Geographic Information System mapping; •Communication/ writing; •Economic evaluation; •Policy analysis;		Strategic thinking / •Change-management •Project management; (not essential sustainability comp in LL)		•Resource management skills: used to allocate resources efficiently; •Technical skills: used to design, set up, operate, and correct malfunctions involving applications of machines or technological systems (e.g.,
				•Problem-solving;										•Complex problem solving skills: used to solve novel, ill-defined problems in complex, real-world settings;
	•Affinity for life			; •Competency for ambiguity and frustration tolerance (linked with "handling complexity in System thinking) - and handling of complexity;				•Flexibility and continuous learning competence;						•Basic skills: facilitate learning or the more rapid acquisition of knowledge (e.g. critical thinking, active listening, etc.);
Interpersonal				•Competency for cooperation in (heterogeneous) groups; •Competency for participation; •Competency for empathy and change of perspective; •Competency for interdisciplinary work; •Competency for communication and use of media;		Interpersonal competence / •Interdisciplinary and inclusive communication within and outside the workplace •Emotional intelligence		Interpersonal competence / •Communication and information acquiring competence; •Stakeholder and policy coordination competence; •Social justice and inclusion competence;				Interpersonal competence / Communication •Multi-disciplinary collaboration for intervention formulation and implementation;		•Social skills: used with people to achieve goals (e.g., negotiation, coordination, etc.);

20	21	22	23	24	25	26	27	28	
ACPA.org (http://www2.myacpa.org/; cf. Sypertz... et al. 2008)	Sipos et al.	Rowe	de Haan (cf. Barth et al. 2007; von Barn Harm et al.)	Kelly	Sterling and Thomas	Kearins and Springett	Crofton		Tilbury and Wortman-IUCN Sterling as author but not in citation!!!
2008	2008	2007	2006	2006	2006	2003	2000		2004 (recalls a 1993 book!!)
Seeing the big picture, understanding need for systemic change / Understanding the functioning and interconnectedness of systems / Analyzing power structures of inequality / Recognizing global implications of actions / Spanning boundaries	Systems thinking Transdisciplinarity		Interdisciplinary work	Global consciousness	Holistic or systemic thinking and analysis / Knowledge of interconnected ecological, social, economic / Knowledge of the principles of sustainable development / Knowledge of sustainability issues and problems / Working across disciplines		Identifying connections between multiple scales, holistic thinking	• Chapter 6: Systemic thinking	Systemic thinking... • Looks at the whole, larger context, resisting our tendency to simplify problems and solutions • Sees the larger properties of whole systems that emerge from the interaction of individual parts • Integrates decision making and adaptive management, and encourages more participative and interdisciplinary approaches to problem solving • Helps us to look at multiple influences and relationships when we explore and participate in resolving problems • Helps us appreciate others' viewpoints • Expands our world view and helps us to be more aware of the boundaries and assumptions we use to define issues • Helps restore a sense of connection to place, to others and the wider world • Recognises the influences of our values, self perception and interpretations of the world, as well as our intuitional and non-rational ways of knowing • Helps us accept uncertainty and ambiguity, and to participate and learn from change • Identifies strategies that better generate sustainable solutions for system change, emphasising self-organisation and resilience.
Scenario creation			Foresighted thinking	Trans-generational thinking			Anticipatory thinking extending to future generations	• Chapter 2: Imagining a better future	Envisioning: Provides a non-threatening learning space conducive for discussion • Creates the ability to identify and critically question what participants want for a sustainable future • Assists in ensuring relevance to people's own lives and social/cultural context • Incorporates and is inclusive of indigenous and intercultural perspectives as well as non-expert knowledge • Uncovers and deconstructs what we value and why we value, as well as what other people value • Provides an opportunity to consider conflicts, contradictions and similarities with other peoples' visions • Helps participants see the process of change as a series of steps, and helps them to reflect on factors/choices that bring about different types of change • Emphasises that participants are the owners of their vision, process and outcomes. This action paves the way forward for collaboration, solutions and action
					Valuing diversity, environment, justice		Understand the diversity of values and their implications		
			Reflection on individual and cultural models			Reflexivity Critique		• Chapter 3: Critical thinking and reflection	Critical thinking... • Challenges us to critically question assumptions and recognise bias and power behind institutions, governments, media, companies and the people around us • Deconstructs our socialised views of the world to comprehend that others around us see the world in similarly complex ways • Explores power relationships in our communities, schools, workplaces and wider world and questions the motivations, interests and powers behind hierarchies and leadership • Helps to identify root causes of problems, instead of just their symptoms • Together with values clarification helps us to explore the influence of our culture in shaping our views of the world • Gives us the ability to participate in change, both individually and collectively, and to develop a sense of our own power to shape our own lives
Seeing the paths for change and following through / Challenging the status quo	Empowering	Change-agent skills		Considering changes to current ways of life	Taking action to bring change	Social action/engagement			
Solving sustainability problems		Problem-solving capacity							
			Planning and implementation						
Being a leader and a follower / Integrity / Courage	Creativity		Self-motivation and motivating others	Generosity, openness, and serious engagement / Courage	Dealing with uncertainty [or in Systemic thinking??]				
Collaboration, networking, developing alliances, building teams / Mediating and resolving conflicts	Collaboration Conflict resolution Inclusivity		Participation / Empathy, compassion and solidarity / Trans-cultural understanding and cooperation		Cooperative action and conflict resolution		Communication and collaboration skills	• Chapter 4: Participation in decision-making • Chapter 5: Partnerships	The process of participation in education for sustainability • Is broadly inclusive, involving all learners throughout the process • Increases the confidence of learners to participate, particularly in groups that may be marginalised in a community • Actively builds knowledge among learners through dialogue • Builds the capacity of learners for self-reliance and self-organisation, and increases community identity • Engages learners with the skills, motivation and confidence to participate in political, legal and physical actions for change • Embeds in learners the capacity for ongoing, long-term participation in change towards sustainability The content of participation in education for sustainability... • Helps recognise the rights of all groups to participate, particularly minorities, women and youth • Helps design and facilitate processes which engage people in sustainability • Helps work towards develop locally relevant solutions • Helps put decision making and responsibility for outcomes in the hands of participants / Partnerships... • Create synergies between organisations to work for change • Foster building shared visions among partners • Allow partners to combine resources and talents • Increase capacities to attract financial and technical support • Help to break hierarchies and power relationships by linking partners at different levels and across different disciplines • Bring together people and partners with different perspectives to reconcile interests and challenge world views • Add value to local initiatives while maintaining relevance25 • Help motivate partners to work toward long-term, institutional change

29		30		31		32
Tilbury		**UNEP and ESC Work group**		**Tilbury-UNESCO**		**Murray**
2004 In: Corcoran P.B., Wals A.E.J.		2010		2011		2011
These **approaches** provide opportunities for students; to engage in critically reflecting upon the basis of their socio-cultural values and assumptions; to identify how they are conditioned and confined by the socio-cultural structures they are operating in and, more significantly, to build their capacity as agents of change.		• Appreciation of the interrelatedness of individuals and society • Ability to recognize global perspectives	2. Realization of the complexity and often controversial nature of sustainable consumption issues 3. Insight into how individual lifestyle choices influence social, economic and environmental development 5. Knowledge of consumer rights and central consumer protection laws 6. Basic knowledge of the market system and the role of business 7. Knowledge of how the production processes are linked to the consumption system 8. Basic knowledge of the interaction of pricing mechanisms with the consumer's attitudes and behaviour 9. Insight into the practicalities of both the supply and demand sides of production and consumption and their outside-of-the-market relationships to community development 10. Awareness of a commodity's intangible and symbolic characteristics 14. Individual and collective understanding of consumer social responsibility in relation to the corporate social responsibility	⬜learning to think systemically;?? ?⬜learning to explore the dialectic between tradition and innovation	Learning to think systemically 'Imagine a world where decision-makers 'saw the whole picture' honouring the links between their actions and local, regional and global issues… Image a world where businesses and governments made decisions in a holistic way that embraced the benefits and effects on communities and environments… Imagine a world where people and communities had the skills to understand links between our thinking, actions and impact across our world…where they are empowered to address core problems and not just the symptoms.' 22	Awareness Knowledge [of the interconnections between environmental-social-economical aspects and personal values and interests]
			18. Ability not only to envision alternative futures but also to create reasonable paths of action leading to these.	⬜learning to envision more positive and sustainable futures;	Learning to envision more positive futures 'Imagine…a world in which people from all backgrounds and levels of expertise are engaged in a process of learning for improving quality of life for all within their community…as well as beyond, allowing for future generations… A world in which people recognise what is of value to sustain and maintain and what needs to change through reflecting…understanding…asking… making choices and participating in change for a better world….a world in which people share in the stories of inspiration and lessons learnt for all to benefit from…' 21	
Values clarification		• Concern for justice, peace and cooperation • Concern for quality • Willingness and ability to be of service to others	1. Ability to define what one considers to be a good quality of life and to be able to identify the values upon which this is based.	⬜learning to clarify one's own values;	NO highlighted definition	Skillfull means (skillful intentions)
Critical reflection		• Ability to make critical, reflected decisions • Information management skills	4. Ability to acquire, assess and use information on the consequences of consumption especially on the environment 11. Ability to recognize, decode and reflect critically upon messages from the media and the market 12. Knowledge of social networks responsible for shaping consumption patterns (peer pressure, status, etc)	⬜learning to ask critical questions;	Learning to ask critical reflective questions 'Every day we are exposed to a barrage of information, advertisements and stories in newspapers, on billboards and on television…information that tells us what is important in the world…advertisements that tell us about our priorities in life…and billboards that encourage us to consume. It may seem all too easy to just accept what we read and what we are told… but stop to think about what is really being said…what are we really being sold? …What are the real messages?... Who is telling them and why are they telling them? Who benefits from these messages? Next reflect on your own thoughts and perceptions …What assumptions are you making about the messages you read and hear? …How do your personal values influence these perceptions? …How has your family life, culture, gender or faith shaped the way you interpret these messages…the world?' 18 18	
		• Ability to apply knowledge in practice	13. Consciousness of civil society's power to initiate alternative ways of thinking and acting			Practice Empowerment
		• Self-awareness • Ability to cope with one's emotions • Capacity to adapt to new situations • Capacity for generating new ideas [same as creativity]	15. Ability to manage personal finances (budgeting, saving, investing, taxes and fees) 16. Ability to manage physical resources (effective control, maintenance, reuse and replacement)	⬜learning to respond through applied learning; and,	NO highlighted definition	Motivation
Participative action research		• Appreciation of nature and of human diversity and multiculturalism • Capacity for empathy/compassion	17. Knowledge of conflict resolution in general and in particular in relation to consumer related situations such as product safety, liability, compensation, redress and restitution.			

33		34		35		36	
UNECE		Vare et al.		Sumter et al.		Eizaguirre, García-Feijoo and Laka	
2011		2019		2020			2019
42 sentences in a matrix of 4 learnings (UNESCO Delors, 1996) and 3 essential characteristics of ESD, namely: a **A holistic approach**; b Envisioning change, c Achieving transformation		Systems Attentiveness Transdisciplinarity	The educator helps learners to develop an understanding of the world as an interconnected whole and to look for connections across our social and natural environment and consider the consequences of actions./ to understand fundamentally unsustainable aspects of our society and the way it is developing and increases their awareness of the urgent need for change./to act collaboratively both within and outside of their own discipline, role, perspectives and values.	(1) **Circular Impact Assessment (4) Circular Business Models, (also in futures!!]**		About 30 competences per geografical area!!! (Europe, Asia, latin America) more or less equivalen to the subcompetences already inserted	The ones belos are the ones in common in the 3 geographical areas!! From a constructivism perspective, to teach and learn in Europe, we only need the European selected competences!! Unleass you go to teach a course to newly entered latin america, for example
		Futures	to explore alternative possibilities for the future and to use these to consider how behaviours might need to change.				
		Values	The educator develops an awareness among learners of how beliefs and values underpin actions and how values need to be negotiated and reconciled.				The commitment, concern or responsibility for the care and preservation of ecology and the environment.
		Criticality	to evaluate critically the relevance and reliability of assertions, sources, models and theories.				
		Action Decisiveness [in uncertainty]	to take action in a proactive and considered manner/ to act in a cautious and timely manner even in situations of uncertainty.	(2) Design for Recovery, (3) Design for Multiple Use Cycles (5) Circular User Engagement			
			to contribute to changes that will support sustainable development.				
		Participation [includes implementation and action!!]Empathy Creativity Responsibility	to respond to their feelings and emotions and those of others as well as developing an emotional connection to the natural world./ The educator encourages creative thinking and flexibility within their learners/ to reflect on their own actions, act transparently and to accept personal responsibility for their work.	(6) Circular Economy Collaboration, and (7) Circular Economy Communication.			Both social responsibility and respect for diversity and multiculturality (or tolerance and respect for others)

Source: Elaborated by the author between October 2020 and February 2021 to collect, classify and merge the sustainability competences found in the Education for Sustainability literature.

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