D33: Report on a set of key competences for ENGAGE.EU

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Abstract	In this report a set of key competences is proposed that ENGAGE.EU learners need in facing the societal challenges of today and the future. Different existing models of key competences are discussed and the suggested ENGAGE.EU approach for key competences follows an existing integrative reference framework for sustainability academic programs. Based on that framework seven key competences for ENGAGE.EU are described as the starting point of the ENGAGE.EU Framework for learning.

Table of contents

Task group

The task group for this report on key competences of task 2.6 consists of:

Libera Università Internazionale degli Studi Sociali Guido Carli (LUISS) (Italy)	Anna Meneghin, Educational Development Unit Anna Pellegrino, Head International and Educational Development Simona Romani, Deputy Rector for Master Degree Programs
Norwegian School of Economics (NHH) (Norway)	Kjetil Sudmann Larssen, Head of Section Educational Quality
Tilburg University (Netherlands)	Hein Coppes, Policy Adviser Education
University of Mannheim (Germany)	Prof. Dr. Dirk Ifenthaler, Chair of Learning, Design and Technology Prof. Dr. Stefan Münzer, Chair of Psychology of Education Claudius Werry, Co-Director International Office
University of National and World Economy (UNWE) (Bulgaria)	Svetla Boneva, Secretary-general for Research Projects Savena Borisova, Science Directorate Rositsa Velinova, Center for Research and Educational Projects
Université Toulouse 1 Capitole (France)	Nathalie Valles
Vienna University of Economics and Business (WU) (Austria) (task lead)	Julia Höcher, Program Development & Policy Unit Oliver Vettori, Dean of Accreditations & Quality Management and Director, Program Management and Teaching & Learning Support
ENGAGE.EU Board of Learners	Marco Rupp

Introduction

This report is the first step towards an ENGAGE.EU Framework for Learning. The suggested competence framework in this report is a set of selected key competences that ENGAGE.EU learners will need when facing the big societal challenges of today and the future and are developing possible solutions. The ENGAGE.EU Framework for Learning, which will also encompass a distinctive ENGAGE.EU teaching and learning policy, recommendations and support for lectures addressing the key competences.

Key competences are an important orientation point for all learners, when developing their individual learning processes and goals, and for teachers when planning educational programs, instructional designs as well as assessment scenarios. To achieve an effective ENGAGE.EU Framework for Learning, the proposed ENGAGE.EU key competences have to be connected to:

- Degree programs by ENGAGE.EU,
- Shared Modules and Signature Courses by ENGAGE.EU,
- Micro-Credentials by ENGAGE.EU,
- Other offers by ENGAGE.EU that foster the further development of learners,
- Instructional designs and the ENGAGE.EU learning environment,
- Recognition procedures.

This report is understood as a concept note, which can give direction and goals - in line with the overall goals of ENGAGE.EU - and thus a starting point for teaching and learning (also in accordance with the concept of competence-based education). However, it is also clear that further engagement with teaching and learning in ENGAGE.EU and increasingly more practical experience, also feeds back into the competence framework. This means that the proposed competence framework described below must also be reflected upon repeatedly in the course of the development of the ENGAGE.EU Framework for Learning and, if necessary, adapted.

A research of reference frameworks for key competences was conducted, as a basis for this report. This included the recommendations on key competences for lifelong learning by the Council of the European Union (2018) and documents on the European Skills Agenda (European Commission, 2021). As shown below, many reference frameworks for key competences are very general, especially regarding the contextual focus as well as the educational level and they focus strongly on an individual readiness for the labor market. However, ENGAGE.EU has a special mission and a clear focus; hence, a more focused set of key competences is suggested. For more than a decade, a (academic) discussion has been ongoing about which key competences are needed for a more sustainable future and the proposed ENGAGE.EU key competences have been taken from this discussion. Some of the above-mentioned generic key competences are included in the ENGAGE.EU key competences but are contextualized to fit the ENGAGE.EU focus.

During the discussions in the task group, the potential for a follow-up project was identified, which could be started after the first three years of ENGAGE.EU. If we are serious about fully implementing the framework for learning and moving learners forward, the measurability of competences plays an important role. Competence measurement is a long-standing field of research e.g. in psychology. In a next phase of the project, a research project could be set up to develop ways to measure key competences, e.g. through self-evaluation with valid scales.

Definitions for this Framework

There is a broad variety of definitions of the term 'competence' (see for example Baartman and De

Bruijn, 2011, Westera, 2001, Kennedy et al, 2009, Chan et al, 2017, Le Deist and Winterton, 2005). The definition may differ depending on the type of discourse it is used in, e.g., policy discourse or scientific discourse but also different disciplines understand it differently. The specific understanding of the term 'competence' can have a big impact on the description of a competence, the implementation in practice as well as the way it is measured/assessed.

In such an international, diverse context as ENGAGE.EU, it is necessary to choose for this report one definition. Since the EUI operates within the EHEA, it was decided to use the definition according to the European policy discourse. This will certainly have to be communicated transparently in the further work on the Framework for Learning. It must be noted that this definition is primarily oriented to the policy discourse and that 'competence' is used significantly differently in different scientific disciplines. For example, in psychology, an essential characteristic of competence is measurability and some competences that are selected below have already proven to be not directly measureable in that way. For example, in the 1980s, research was conducted on how to measure complex problem-solving competence. However, this research has not led to valid conclusions about actual problem-solving skills. Reliability and validity of measurement were better when problem solving was broken down so that it became measurable (in this case, intellectual ability, domain-specific prior knowledge, and working memory capacity were measured) (Brünken et al, 2019).

In this framework the term **'competence'** is used in accordance with its understanding for the Dublin descriptors: "[...] 'competence' is used in the descriptors in its broadest sense, allowing for gradation of abilities or skills. It is not used in the narrower sense identified solely on the basis of a 'yes/no' assessment" (Bologna Working Group on Qualifications Frameworks, 2005m p.194). 'Competence' is understood as a complex combination of knowledge, skills and attitudes that enables learners to successfully carry out a task or solve a problem and to take responsibility. A competence can be generic or subject-specific and it is the product of a learning process and it belongs to the learner. (ECTS User's Guide 2015, Crick, 2008, Wiek et al, 2016, Baartman and De Bruijn, 2011, Lokhoff et al, 2010).

In this report '**key competences**' "are relevant across different spheres of life and for all individuals [...] but do not replace domain-specific competences, which are necessary for successful action in certain situations and contexts" (Barth and Michelsen, 2013, p. 109). Hence, the competences in this framework will not be the only competences learners develop, so it is not an exhaustive list, but the competences, which are identified as the most relevant ones to problem-solving regarding the societal challenges ENGAGE.EU focuses on.

The learners at Engage. EU and therefore the educational offerings will be very heterogeneous, in part to support the goal of lifelong learning. In order to ensure that the key competences are compatible with all educational offerings, the key competences were developed independently of a specific level of the European Qualifications Framework (EQF).

For teaching and learning, these key competences have to be operationalized for the specific educational setting. First in that process, '**learning objectives**' are defined, which are more specific and detailed than competences. Second, for the concrete teaching, learning and assessment, '**learning outcomes**' are defined. These "are statements of what the individual knows, understands and is able to do on completion of a learning process" (ECTS Users' Guide, 2015, p. 10). The main characteristic of learning outcomes is that they are measurable to ascertain how the defined outcome has been acquired or developed. "Learning outcomes are not properties unique to each student, but statements which allow higher education institutions to measure whether students have developed their competences to the required level." (Lokhoff et al, 2010, p. 21)

The overall goal of ENGAGE.EU is to tackle the big societal challenges of today and the future, this can

also be referred to as a 'sustainable future'. In this framework for learning and with regard to the key competences, the term '**sustainability**' is understood as "the collective willingness and ability of a society to reach or maintain its viability, vitality, and integrity over long periods of time, while allowing other societies to reach or maintain their own viability, vitality, and integrity" (Wiek et al, 2016, p. 241). While the ENGAGE.EU approach and one of its strengths is a multidisciplinary perspective on the grand societal challenges, contentwise a focus is on business and economies. Economic and business organizations are central to sustainability and the grand societal challenges – as part of the problem as well as of possible solutions. Hence, sustainability at ENGAGE.EU is seen in relation to economies and economic actors, but due to the complexity of the challenges, multidisciplinary approaches and perspectives are used.

Existing frameworks for key competences

Three relevant approaches to key competences have been identified:

- 21st century competences (wide variety of competences for "modern life")
- ESD-related competences (Education for Sustainable Development)
- Integrative reference framework for sustainability academic program development

21st century competences

Frameworks for 21st century key competences were developed because a need was seen for new skills and competences to navigate life in the modern, changing world. The frameworks for 21st century key competences are universal for all educational levels and very broad as they prepare individuals for "life" and mostly have a focus on supporting employability and serving the needs of the labor market.

Some of the often used reference frameworks are by intergovernmental institutions such as the Council of the European Union (2018) or the OECD (2005). These focus strongly on the connection of employability and the acquisition of the recommended key competences with regard to lifelong learning. The eight key competences by the Council of the European Union (2018) are:

- communication in the mother tongue,
- communication in foreign languages,
- mathematical competence and basic competences in science and technology,
- digital competence,
- learning to learn, social and civic competences,
- sense of initiative and entrepreneurship, and
- cultural awareness and expression.

The OECD-DeSeCo program (OECD, 2005) recommends three competence categories:

- Using tools interactively (language, symbols, texts, knowledge, information, technology),
- interacting in heterogeneous groups (relate well to others, co-operate, work in teams, manage and resolve conflicts), and
- acting autonomously (act within the big picture, form and conduct life plans and personal projects, assert rights, interests, limits and needs).

Several other, often-cited frameworks were developed by or in cooperation with companies such as Apple, Intel, Cisco and Microsoft, which also focus strongly on employability (Voogt and Roblin 2012). While there are differences between the frameworks, they often include the same or similar competences, which might stem from the strong link of the frameworks to labor market needs.

Voogt and Roblin (2012), van Laar et al (2017) and Chalkiadaki (2018) provide via systematic literature reviews an overview of several frameworks of key competences. There is no agreed-upon definition of 21st century key competences. However, the different frameworks overlap and include among others communication, collaboration, learning, leadership, critical thinking, problem-solving, ICT literacy, creativity, autonomous acting, self-motivation and self-management, cultural awareness (Chalkiadaki, 2018). There is hardly any distinction between knowledge, skills, attitudes, behavior or values, they are listed as similarly important and achievable in an educational context.

Critique on 21st century key competences and skills in higher education reaches from the challenges implementing them (Chan et al, 2017) to the strong focus on employability and questions the novelty of the competences and skills for the 21st century (Tight, 2020).

ESD-related competences

ESD-related competences are a set of competences that are identified as key within the education for sustainable development. Lozano et al (2017), Shephard et al (2019) and Sterling et al (2017) provide analyses of some of the often referred to sustainability competence frameworks. In addition, UNESCO (2017) developed a set of key competences as well as learning objectives for each SDG based on a combination of different frameworks.

ESD-related competences focus on sustainability but have similar characteristics to the 21st century key competences especially with regard to their structure and inclusion of all forms of knowledge, skills, personal qualities and values. They are rarely developed for a specific educational level and are rather viewed as a set of competences everyone should develop. However, ESD-related competences do not focus on individual employability but individual support of sustainable development in every part of one's life. Therefore, these competences are more focused than the generic 21st century key competences.

Lozano et al (2017) synthesize from several international ESD-frameworks the following competences:

- systems thinking;
- interdisciplinary work;
- anticipatory thinking;
- justice, responsibility, and ethics;
- critical thinking and analysis;
- interpersonal relations and collaboration;
- empathy and change of perspective;
- communication and use of media;
- strategic action; personal involvement;
- assessment and evaluation; and
- tolerance for ambiguity and uncertainty.

Critique of the ESD-related competences is similar to the critique of the 21st century key competences with regard to the selection process, specific definitions and the implementation. Additionally, the Eurocentric perspective in the key competence debate is viewed especially critical with regard to sustainable development (see for example Brundiers et al, 2021, Redman, 2020, and Rieckmann 2012).

Integrative reference framework for sustainability academic program development

A major point of critique of frameworks for key competences is the selection process, as they often

seem like arbitrary "laundry" lists of competences, skills, behaviors, attitudes and values without a specific connection between them and rarely explanations for their inclusion. To overcome this issue, Wiek et al (2011, 2016) proposed an integrative framework for key competences based on existing ESD-related competences but with two main differences. First, the focus is on sustainability academic programs and it is not viewed as a universal framework for all educational settings (later it is extended to academic programs beyond "just" sustainability). Second, the rationale behind this framework is a comprehensive approach to sustainability research and problem solving that requires the integration of the five key competences" (Wiek et al 2011, p. 205). The five key competences are:

- systems-thinking competence,
- anticipatory competence,
- normative competence,
- strategic competence and
- interpersonal competence.

These competences are integrated by linking it to a process how sustainability research and problem solving are carried out (see Figure 1 for a revised version of the integrative framework). Since then the framework was refined, among others by Brundiers et al (2021) who made the originally implied meta-competence "integrated problem-solving" explicit, added "intrapersonal competency" and "implementation competency" and identified "value-thinking" as a lead competence as sustainability is a value-laden concept, which distinguishes the definitions of the competences from other, generic frameworks (see Figure 1).
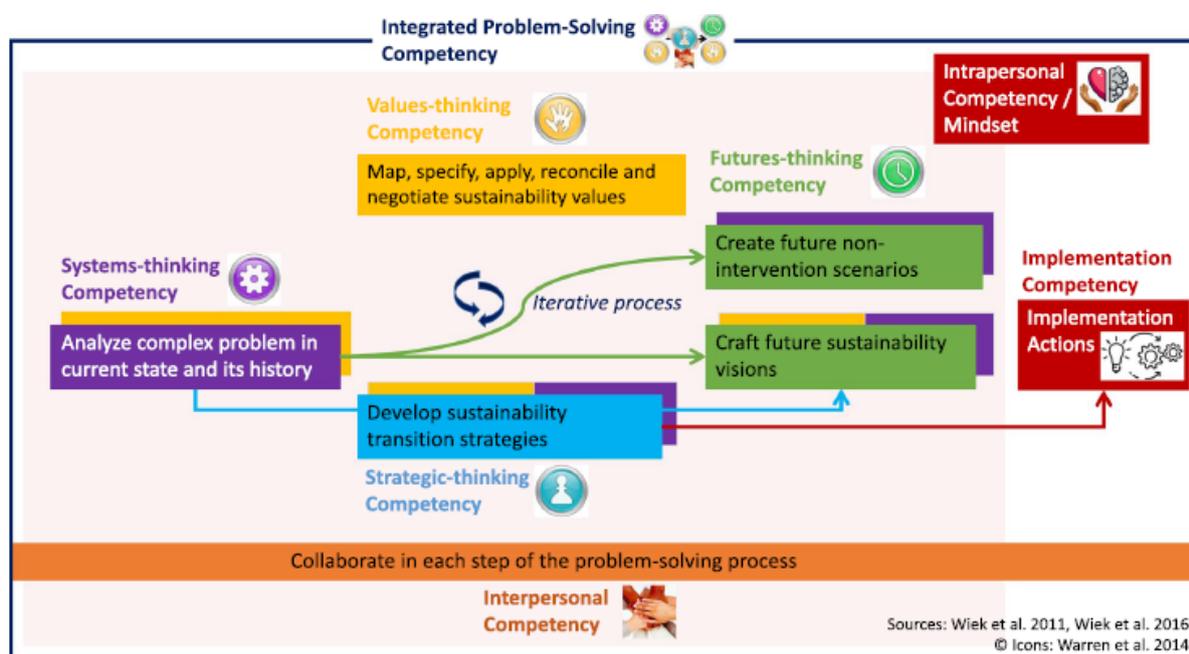

Figure 1: Refined framework for sustainability problem solving linked to key competences (Brundiers et al 2021, p. 21)

Some of the main characteristics of the framework are:

- It is not expected that all students develop specialized expertise in all competences but to achieve a balance between specialization in some competences and general literacy in all of them. This balance can be derived by students themselves ("student empowerment") or

through the program development process. Following Redman (2020) and Wiek et al (2016) who suggest using this framework for a variety of sustainability-related study programs (e.g. urban planner or investment banker), the areas of specialization would depend on the respective professional profile.

- Entry into the integrated framework can be done at any point, for example it can be started from a vision of a desired future (backcasting) or with a system-analysis to identify a problem. However, some suggest that the values-thinking competence is leading as it is underpinning the other competences and they should be clarified from the beginning. (Brundiers et al, 2021)
- Basic/general competences like literacy, communication or critical thinking are not included as the focus is on key competences in sustainability problem-solving but the framework builds upon these competences (Wiek et al, 2011). Similarly, topical/discipline-specific knowledge is not included in the framework but can be similarly linked to the key competences, as depending on the respective professional profile or sustainability issue, certain general and specialized topical knowledge is needed (Brundiers et al, 2021).

The integrative framework has been also put into practice, especially at Arizona State University, USA, and Leuphana University, Germany (Wiek et al, 2016, Brundiers et al, 2021, Birdman et al, 2021).

Conclusion on the existing frameworks for key competences

There are numerous academic articles, (inter)governmental policies, and frameworks on key competences. Some of these are very generic others have a thematic focus. However, most of them have in common that they do not establish how the defined key competences contribute to achieving the set goal. They also hardly identify cross-links between the key competences. This not only makes these "lists" relatively open for criticism, since the selection of the individual elements is hardly explained, they also make implementation more difficult, since the sense-making lies mainly with the individual stakeholders. Hence, the implementation depends highly on the commitment of the individual "user" or is only possible with a high level of support if a specific standard should be achieved.

An integrative framework that defines competences based on the process of how problems are solved or scientifically addressed provides a solution to this „weakness" of most frameworks, as it gives a context, establishes links between all elements of the framework and it takes over a large part of the sense-making for the stakeholders.

However, one point of criticism that has hardly been resolved in most of the discourse is the strong Eurocentric perspective in the selection of key competences. Individual attempts have been made to incorporate other perspectives (e.g. Rieckmann, 2012), but there is still room for development in this area.

Proposed key competences for ENGAGE.EU based on the integrative framework for sustainability problem-solving

Recognizing the special circumstances of Engage.EU like the complexity of a cooperative institution as an EUI, the planned heterogeneous educational offers (from micro credentials to joint academic programs on different levels), the diverse groups of learners and the wide span of topics, it is proposed to build upon the above presented integrative framework for key competences in sustainability.

The integrative reference framework for sustainability academic program development is currently one of the most cited in this specific field. For example the set of key competences for SDG education by UNESCO (2017) also references this framework by Wiek et al (2011, 2016) as a base for their work. The shown framework by Brundiers et al (2021) (Figure 1) is a proposal of further development of the

one by Wiek et al (2011, 2016). Other often-cited work on key competences for sustainability are the ones mentioned for education for sustainable development (ESD), which have been included in the development of the integrative framework, for example de Haan (e.g. 2010) and Rieckmann (e.g. 2012) and whose authors also reference the integrative reference framework.

The integrative framework is suggested for ENGAGE.EU, as it is developed with the goal to find an agreed-on framework for sustainability higher education. Hence, it is based on several academic works on key competences with regard to sustainability education and the selected key competences are in many of the often-cited frameworks similar. Additionally, the attempt of the integrative framework to link the competences to a specific process and so to each other, makes it an interesting, rather innovative approach, as hardly any competence framework (sustainability or generic) is doing that. One of the reasons behind these specific links between the competences is, to make the rationale for their selection more transparent as they usually are. The link to a process also supports the practical implementation to make sense of the selected competences for ENGAGE.EU, since the competences do not exist in a "vacuum". This could help understanding the purpose of each competence better, when defining program- or course-specific learning objectives/outcomes, especially as these competences are rather broad.

It is proposed that ENGAGE.EU uses for the time being a version of the existing integrative framework of key competences (Wiek et al, 2011 and Brundiers et al, 2021) and contributes to the advancements in the acquisition and assessment/measurement of these key competences in the coming years. There has been extensive research on competences for sustainability over the last 10 to 15 years but less focus on relevant pedagogical approaches to enable the acquisition of the identified key competences and their assessment (see Lozano et al, 2017, Redman, 2020, and Redman et al, 2021). There have been some studies, especially in the last two years on these issues but there is still room for innovation and systematic development especially with regard to assessment and different forms of educational settings (Brundiers et al, 2021, Redman, 2020, and Redman et al, 2021). As this might feedback into the suggested competences framework, it is understood as a starting point for further development within the ENGAGE.EU Framework for Learning.

Following the integrative reference framework (Figure 1) these seven key competences are proposed and below defined (Table 1) (Wiek et al, 2011 and Brundiers et al, 2021)

- Systems-thinking competence – Identify and analyze problem constellations
- Futures-thinking competence - create sustainability visions and explore scenarios without interventions
- Value-thinking competence – Map, specify, apply, reconcile and negotiate sustainability values as sustainability is a value laden concept.
- Strategic-thinking competence - Develop and testing sustainability transition strategies
- Implementation competence – Realize, monitor, evaluate and further develop strategically planned solutions
- Interpersonal competence – communicate and collaborate with and motivate and engage different stakeholders
- Integrated problem-solving competence (meta-competence) – complex integration of the different steps of the problem-solving competence while drawing on relevant disciplinary and interdisciplinary knowledge

It is suggested to not include an intra-personal competence, as it is contested whether it is actually a competence or a mindset. Furthermore, it is difficult to assess such attitudes in an educational setting to assure that graduates have achieved them. This does not imply that they are not important for

ENGAGE.EU graduates but that they would not be part of the identified key competences, which ENGAGE.EU could "certify".

The key competences are identified as especially relevant for problem-solving with regard to the Grande challenges of today and in the future. These are highlighted because of the specific purpose of ENGAGE.EU but of course, there are other important competences in higher education and general competences that are the basis to develop the selected key competences. Such "basic competences" include:

- Scientific competence (e.g. conduct responsible scientific research in compliance with the rules and ethical standards)
- Communication competence (e.g. communicate effectively both orally and in writing to different target groups)
- Critical thinking (e.g. critically reflect on ideas, assumptions and beliefs of others and themselves)
- Digital competence (e.g. use technologies and media in an effective and responsible way)
- Learning (e.g. ability of lifelong-learning and openness to new research and ideas)

The definitions and exemplary learning objectives of the key competences and the connections between them in Table 1, are based on Wiek et al (2011, 2016), Brundiers et al (2021), Redman (2020), Roorda (2010), Rieckmann (2012), de Haan (2010), and UNESCO (2017).

	Definition	Learning objectives (examples)	Link to other key competences
Systems-Thinking Competence	Systems-thinking competence is the ability to holistically analyze complex systems and identify, formulate and analyze sustainability problems across different domains (society, environment, economy, technology etc.), different scales (local to global) and different perspectives (disciplinary, interdisciplinary etc.), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and problem-solving frameworks.	Comprehend, empirically verify and describe complex systems' structures, key components, dynamics, patterns, relationships, impacts, unintended consequences, context, interactions, and tipping points. Apply modeling and complex analytical approaches, including qualitative and quantitative data, narratives and "thick descriptions".	Systems-thinking is the basis to develop transition strategies towards sustainability (strategic-thinking). It is critical to identify intervention points and to anticipate future developments (futures-thinking) and to set up transition processes and analyze the impact of action plans and interventions (strategic-thinking and implementation).
Futures-Thinking Competence	Futures-thinking competence is the ability to anticipate futures states and dynamics of complex systems and sustainability problems and create visions of (multiple) futures related to sustainability issues and sustainability problem-solving frameworks.	Carry out or construct simulations, forecasts and scenario analyses of how sustainability problems might evolve or occur over time, considering inertia, path dependencies and triggering events and deal with uncertainty. Create sustainable and desirable future visions, considering evidence-supported alternative development pathways. Recognize and reflect implicitly held assumptions about how systems "work" and how that influences the status quo and might influence futures-thinking.	Futures-thinking competence is strongly linked to the identification of sustainability problems and the analysis of possible future paths towards visions of a sustainable future (system-thinking), the development, testing and adaption of transition strategies (strategic-thinking).
Value-Thinking Competence	Value-thinking competence is the ability to comprehend in-depth how complex	Map, specify, compare, apply, reconcile, and negotiate sustainability values,	Value-thinking competence clarifies the values embedded in all other

	Definition	Learning objectives (examples)	Link to other key competences
	systems evolved, function and might further develop, recognize the normative nature of "sustainability" and provide normative orientation related to sustainability issues and sustainability problem-solving frameworks.	principles, goals, and targets informed by concepts of justice, equity, socio-ecological integrity, responsibility, ethics, conflicts, trade-offs etc., in various processes, including visioning, assessment and evaluation. Explain how values are contextually, culturally, and historically reinforced and recognize normalized oppressive structures. Distinguish between facts, opinions, and presumptions. Critically evaluate how particular stated values align with agreed-upon sustainability values and differentiate between espoused values and practiced values. Identify and clarify one's own values.	competences and gives all the orientation and purpose. E.g., it gives orientation for identifying desirable and undesirable visions the futures and directs transition strategies towards sustainability.
Strategic-Thinking Competence	Strategic-thinking competence is the ability to design and test viable interventions, transitions, and transformations toward sustainability.	Develop plans that leverage assets, mobilize resources, and coordinate stakeholders to overcome systemic inertia, path dependencies, resistance and other barriers to reach envisioned outcomes. Recognize the historical roots and embedded resilience of deliberate and unintended unsustainability and the	Strategic-thinking competence and the resulting strategies fo transformative changes are closely linked to systems-thinking (as analysis of the current state), value-thinking (the "goal" of sustainable states), futures-thinking (path dependencies and undesirable and desirable futures) and implementation (realization of the strategies and plans).

	Definition	Learning objectives (examples)	Link to other key competences
		barriers to change. Weigh unweighable aspects and choices, acknowledge uncertainties and inconclusiveness and take intentional decisions to enable transitions toward a sustainable future.	
Implementation Competence	Implementation competence is the ability to realize sustainability strategies/plans, including implementation, transfer and scaling, in effective and efficient ways.	Realize a planned solution toward a sustainable future, monitor and evaluate the realization process, and address emerging challenges (adjustments), recognizing that sustainability problem solving is a long-term, iterative process between planning, realization, and evaluation. Recognize the right time and identify opportunities, triggers and supporting factors to implement sustainability plans.	The implementation competence brings to the ground the strategies for transformative changes (strategic-thinking) and integrated problem-solving, mostly through collaboration (interpersonal competence).
Interpersonal Competence	Interpersonal competence is the ability to engage diverse stakeholders and to empathically work with collaborators' and citizens' different ways of knowing and communication in sustainability efforts.	Motivate, enable, initiate, support and facilitate different forms of collaboration including working in heterogeneous teams and engagement of stakeholders from government, business and civil society. Understand, embrace, and facilitate diversity across cultures, social groups, communities, and individuals. Know and recognize the limits of	Interpersonal competence is connected with all other competences. Collaborative approaches are important for all of them, e.g. so stakeholders take responsibility for the results and support the implementation process.

	Definition	Learning objectives (examples)	Link to other key competences
		collaboration and empathy. Integrate and negotiate diverse and/or conflicting perspectives and resolve conflicts. Recognize and respect perspectives of others and listen to opinions and emotions.	
Integrated Problem-Solving Competence (meta-competence)	Integrated problem-solving competence is the ability to meaningfully combine and integrate different competences to develop viable, inclusive and equitable solution options while drawing on pertinent disciplinary, interdisciplinary, transdisciplinary, and other ways of knowing.	Develop, apply, promote, make decisions to advance sustainability by using viable, equitable, and inclusive solution processes, procedures, frameworks, schemes, etc.	Integrated problem-solving is a meta-competence as a combination of all competences is needed to solve sustainability problems. Furthermore, there is no single way but multiple ways to achieve sustainability.

Table 1: ENGAGE.EU key competences: Definitions, examples of learning objectives and links to other competences. Based on Wiek et al (2011, 2016), Brundiers et al (2021), Redman (2020), Roorda (2010), Rieckmann (2012), de Haan (2010), and UNESCO (2017).

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