TEACH4SD
Lead the transition
Centres of Vocational Excellence

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Teach4SD Teacher Handbook

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Project coordinated by VIA University College

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1 Introduction

Summary: TEACH4SD is a European project supported by the Erasmus+ Centres of Vocational Excellence programme. Its goal is to develop and share education for sustainable development (ESD) practices in VET and higher education, together with industry partners. The project supports the European Green Deal and aims to help teachers play a leading role in the green and socially fair transition. TEACH4SD focuses on empowering teachers and students with sustainability skills and competences needed for future jobs.

This handbook is designed for educators in vocational and higher education at different EQF levels. It offers practical guidance on education for sustainability, with a strong focus on the GreenComp framework and the competences for sustainability described therein.

The handbook explains the difference between education *about* sustainability (knowledge) and education *for* sustainable development (skills, values, and attitudes) (ESD). ESD helps learners to be aware of their values, think critically, solve problems, and act for a more sustainable world. Through this teacher handbook, the GreenComp framework supports educators in integrating competences for sustainability across subjects, so learners learn to actively contribute to positive change.

For your convenience, we have added a summary at the start of every chapter, which allows for a quick understanding, while you can find more in-depth information in the main body text.

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1.1 This handbook

This handbook is aimed at teachers and trainers at different European Qualifications Framework (EQF)[1] levels in Vocational Education and Training (VET) and in Higher Education. It is a step-by-step guide through the world of education for sustainability, with a focus on the GreenComp competences. This guide is created in a way that teachers and trainers who have some (or much) experience with education for sustainability can instantly search for the information they are looking for. Since sectors, curricula, levels of proficiency, and national contexts vary widely, a single plan cannot accommodate all situations. Instead, the following pages and materials outline approaches that trainers and teachers can tailor to their own specific context and students.

You are, therefore, invited to read the content from start to finish. For those with less experience, we hope that this guide can be a starting point for education for sustainable development, an encouragement to discover more about this topic, and to hopefully include some sustainability competencies in their teaching.

[1] The EQF is a common European reference framework designed to improve the transparency, comparability, and transferability of qualifications across different countries and education systems in Europe. It consists of eight levels, each defined by learning outcomes describing what a person knows, understands, and is able to do.

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1.2 What is ESD? A one-page primer for teachers

Purpose: Give teachers a fast, shared language and a practical bridge from Education for Sustainable Development (ESD) to daily teaching choices.

1.2.1 Definition: what ESD is (and isn't)

Education about sustainability builds knowledge of environmental, social, and economic issues such as climate, biodiversity, and justice, but it often stops at understanding. Education for Sustainable Development (ESD) goes beyond "about" to foster the skills, values and agency learners need to contribute to a more sustainable world; it emphasises transformative learning, critical thinking, problem-solving and active participation across subjects. To design for this in practice, use competence frameworks such as GreenComp to deliberately cultivate systems thinking, collaboration, and problem-solving across disciplines, supported by real-world learning.

1.2.2 Why now: EU policy context in one paragraph

The Erasmus+ Centres of Vocational Excellence (CoVEs) place VET at the centre of green and digital transitions by creating skills ecosystems with business, higher education institutions and regions; they explicitly encourage learner-centred, competence-based approaches and the use of European competence frameworks such as GreenComp, anchored in the European Green Deal and EU skills policy. TEACH4SD itself is framed within this CoVE orientation, connecting industry, research and education to support a fair, just green transition and teacher empowerment.

1.2.3 What it means in class: from intent to practice

In class, ESD means helping learners analyse real sustainability dilemmas, justify choices with evidence, and reflect on impacts and personal growth: "do, demonstrate, reflect." Case- and problem-oriented pedagogies bridge the gap between knowledge and action by engaging students with realistic, context-rich scenarios where systems thinking, ethics and strategy are practised (Barth et al., 2007; Lozano et al., 2013, 2017; Rieckmann, 2012; Wiek et al., 2011). This is consistent with constructivist learning traditions that emphasise active knowledge construction and guided inquiry. (Savery, 2006).

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The map (Figure 1) shows a progression: ESD sets the overall purpose; transformative learning is the mechanism that shifts learners from knowing to doing to becoming; GreenComp provides the competence structure (values, complexity, futures, action); and "Methods" are the practical levers teachers choose to realise those competences. The four example methods illustrate how you operationalise GreenComp in class: CBL for authentic dilemmas, portfolios for growth and agency, LCA for evidence-based trade-offs, and rubrics to make competence expectations transparent.

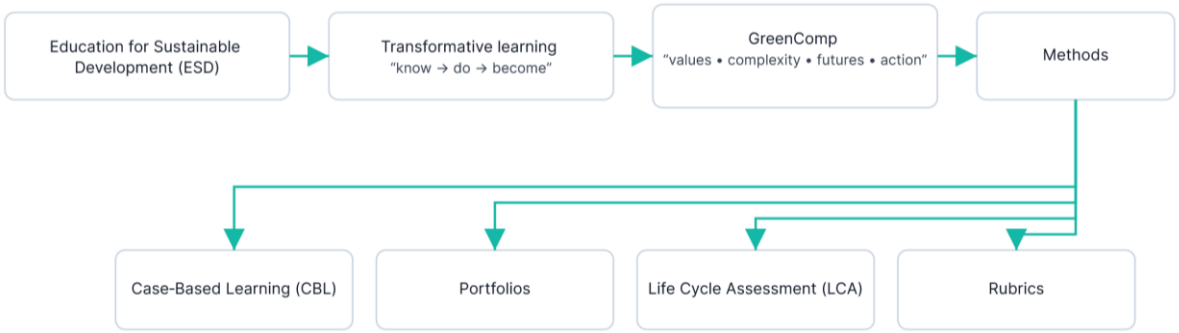

Figure 1: ESD Linkage Map

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1.3 Teach4SD

TEACH4SD is an innovative project supported by the esteemed Erasmus+ programme “Centres of Vocational Excellence”, dedicated to leading the development, testing, and validation of education for sustainable development (ESD) practices. Our mission is to fully integrate ESD approaches across vocational and educational training (VET) institutions and higher education institutions (HEIs) throughout Europe, in collaboration with key industry partners.

The project is oriented towards the ambitions put forward by the European Green Deal on tackling climate and environmental-related challenges. TEACH4SD will mobilise industry, research and innovation capacities and link them (in new and innovative ways) with the education and training sector. For sustainability transitions to become successful, it is the guiding principle for TEACH4SD to empower and educate teachers to take on a leading role as change-makers and thereby contribute to the European ambition that the green transition be socially fair and just.

TEACH4SD will empower and educate teachers to take on a leading role as change-makers in the sustainable transition. We wish to empower European students and workforce through the green skills and competences needed to successfully make a sustainable transition and transformation.

We are happy you are joining us on the journey of making a better future.

Figure 2: TEACH4SD project partners

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1.4 Education for sustainable development

This section is inspired by:

UNESCO. (n.d.). *Education for sustainable development - Learning to act for people and planet*. https://www.unesco.org/en/sustainable-development/education

Bianchi, G. (2020). *Sustainability Competences - A systematic literature review*. Publications Office of the European Union. https://doi.org/10.2760/200956

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures*, *44*(2), 127–135. https://doi.org/10.1016/j.futures.2011.09.005

Wilhelm, S., Förster, R., & Zimmermann, A. B. (2019). Implementing competence orientation: Towards constructively aligned education for sustainable development in university-level teaching-and-learning. *Sustainability*, *11*(7), 1891. https://doi.org/10.3390/su11071891

To make clear what education for sustainable development is about, it is important to recognise the difference between education *about sustainability* and education *for sustainable development.* This is necessary because both terms are often used as synonyms, while they refer to two distinct types of education.

Education *about* sustainability is aimed at building knowledge of environmental, social, and economic sustainability issues. It equips learners with an understanding of key concepts such as climate change, biodiversity, resource management, and social justice. This knowledge serves as the basis for informed decision-making and responsible action. Teaching about sustainability involves exploring real-world challenges, analysing their causes and impacts, and understanding global frameworks like the Sustainable Development Goals (SDGs) and the European Green Deal. Within the GreenComp framework, education about sustainability provides essential content that supports the development of sustainability competences, ensuring that learners can critically engage with sustainability topics and apply their knowledge in various contexts.

Education for Sustainable Development (ESD) goes beyond teaching about sustainability by fostering the skills, values, and attitudes necessary for learners to contribute actively to a more sustainable world. (Bianchi, 2020). It emphasises transformative learning, critical thinking, problem-solving, and active participation in addressing global challenges such as climate change, biodiversity loss, and social inequality. By integrating sustainability concepts across subjects and promoting interdisciplinary learning, ESD helps students understand the interconnectedness of environmental, economic, and social issues. ESD promotes participatory and experiential learning approaches, such as project-based learning, real-world problem-solving, and community engagement, helping students develop agency and responsibility. When aligned with the GreenComp competences, ESD supports the development of sustainability competences by integrating sustainability into all subjects and equipping students with the capacity to make informed decisions and drive positive change.

Obviously, one should not see ESD as something independent from education about sustainability. In most cases, education about sustainability is included in courses dealing with ESD, given the fact that one should have knowledge about sustainability to develop sustainability skills, values and attitudes.

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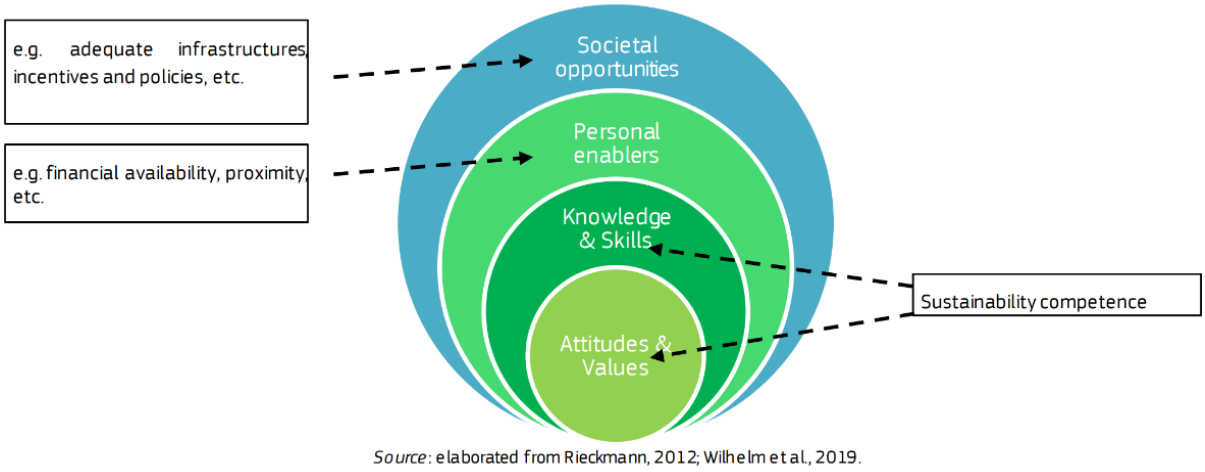

Figure 3: Sustainability competences and context for sustainable behaviour performance (Bianchi, 2020, p.9)

In education for sustainable development (ESD), teaching **knowledge, skills, attitudes, and values in relation to one another** is essential because sustainability challenges are complex and require more than just awareness. A holistic approach not only informs the students but also empowers them to take meaningful **action.**

1. **Knowledge** provides the foundation for understanding sustainability issues, such as climate change, biodiversity loss, and social inequalities. Without this, learners cannot make informed decisions or critically engage with sustainability topics.
2. **Skills** equip learners with the ability to apply their knowledge in real-life situations. Critical thinking, problem-solving, collaboration, and systems thinking are essential for addressing sustainability challenges and developing innovative solutions.
3. **Attitudes** shape how individuals approach sustainability. A mindset of responsibility, resilience, and openness to change fosters a proactive approach to environmental and social challenges rather than passive acceptance.
4. **Values** guide ethical decision-making and long-term commitment to sustainability. Concepts like equity, justice, and intergenerational responsibility help learners develop a sense of global citizenship and personal accountability.

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1.5 The GreenComp framework

This section is inspired by:

Bianchi, G., Pisiotis, U., & Cabrera Giraldez, M. (2022). *GreenComp: The European sustainability competence framework* (Y. Punie & M. Bacigalupo, Eds.; EUR 30955 EN). Publications Office of the European Union. https://doi.org/10.2760/13286

Learning about sustainable development is complex, requiring not just knowledge but also the skills, attitudes, and values. That is where the **sustainability competence framework** comes in. These frameworks help teachers define and develop the key competences students need to navigate and contribute to a sustainable future.

One of the most widely recognised frameworks is **GreenComp**, developed in 2022 by the European Commission. GreenComp outlines four key areas of sustainability competence and twelve underlying competences:

Area	Competence	Description
1. Embodying sustainability values	**1.1 Valuing sustainability**	To reflect on personal values, identify and explain how values vary among people and over time, while critically evaluating how they align with sustainability values.
	1.2 Supporting fairness	To support equity and justice for current and future generations and learn from previous generations for sustainability
	1.3 Promoting nature	To acknowledge that humans are part of nature, and to respect the needs and rights of other species and of nature itself in order to restore and regenerate healthy and resilient ecosystems.
2. Embracing complexity in sustainability	**2.1 Systems thinking**	To approach a sustainability problem from all sides; to consider time, space and context in order to understand how elements interact within and between systems.
	2.2 Critical thinking	To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions.
	2.3 Problem framing	To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time and geographical scope, in order to identify suitable approaches to anticipating and preventing problems, and to mitigating and adapting to already existing problems.
3. Envisioning sustainable futures	**3.1 Futures literacy**	To envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.
	3.2 Adaptability	To manage transitions and challenges in complex sustainable situations and make decisions related to the future in the face of uncertainty, ambiguity and risk.
	3.3 Exploratory thinking	To adopt a relational way of thinking by exploring and linking different disciplines, using creativity and experimentation with novel ideas and methods.

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4. Acting for sustainability	**4.1 Political agency**	To navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.
	4.2 Collective agency	To act for change in collaboration with others.
	4.3 Individual initiative	To identify one's own potential for sustainability and to actively contribute to improving prospects for the community and the planet.

Figure 4: GreenComp areas and competencies. Source: Bianchi et al. (2022).

Sustainability competence frameworks like GreenComp can help teachers to integrate sustainability competences across subjects, helping learners to **develop the ability to make a real impact** in their personal and professional lives. Because when learners acquire these competences, one could indeed state that they not only acquire certain knowledge or attitudes, but will also act, which is detrimental to a successful education for sustainable development.

→ Curious for more? Discover more GreenComp content on the TEACH4SD ESD Academy.

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1.6 How to use this handbook in 10 minutes: first-time user introduction

This short introduction is written for first-time readers who want to start using the Teacher Handbook today. In about ten minutes of reading, you will know what the handbook is for, how it is organised, and how to pull out exactly what you need to plan and deliver a sustainability-aligned lesson.

What this handbook is, and isn't

The handbook is a practical guide for teachers and trainers across VET and higher education levels (EQF) who want to integrate Education for Sustainable Development (ESD) using the GreenComp framework. It is designed to be adaptable across sectors, programs, and national contexts, and it provides chapter-opening summaries to help you grasp the essentials before diving deeper. You do not need to read it cover-to-cover before you act; instead, dip into the sections that match your immediate teaching goals.

How the handbook is organised

Use the Table of Contents to see the map at a glance. The spine of the handbook runs from foundations (GreenComp) to planning (guidelines and checklists) to ready-to-adapt teaching material (example lesson plans), and then into the method that ties everything together: Case-Based Learning (CBL). The CBL section explains why the method fits ESD and outlines a five-step process you can use across subjects and sectors.

Fast path to your first sustainability-aligned lesson

1. Pick your entry point. If you need something to run next week, open the Examples of lesson plans and choose the one that best fits your context (VET or HE). Each plan already incorporates GreenComp competences and can be quickly adapted to your domain. If you prefer to understand the backbone method first, turn to Case-Based Learning (CBL) and skim the summary of the five steps you will guide students through: problem exploration, delineation and analysis, exploring scenarios, choice and justification, reflection and evaluation.
2. Make competences explicit from the start. Open the GreenComp framework and decide which competence areas you will target in your next session: values, complexity, futures or action, and why they matter for your learners. Then look at Mapping GreenComp onto the five-step CBL model to see exactly how each CBL phase connects to specific competences and learning foci. Naming these targets at the outset makes your intentions visible and assessable for students.
3. Outline your session with the CBL flow. Use the CBL section's five-step sequence to sketch the hour-by-hour flow: begin by framing the problem and stakeholders; guide students through analysis with data or perspectives; invite them to explore scenarios; require a justified choice; and end with reflection that links learning to values and future action. For practical prompts, tools and examples you can lift into your plan (e.g., stakeholder mapping, thinking routines, reflection journals, and GreenComp-aligned rubrics), skim the Educator's Guide to integrating GreenComp into CBL and the sections on moving From Case to Competence and on Reflection & Evaluation.

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4. Check alignment in five minutes. Before you finalise your plan, open the Checklist for developing a lesson plan and verify that your learning outcomes use action verbs, your methods align with the intended competences, and at least one outcome addresses values or responsibility. Confirm that students will engage with a real sustainability issue and that you have a clear plan for assessment and reflection.
5. Commit to one adaptation. If you selected a lesson plan, localise one or two details to your learners (e.g., sector-specific cases, artefacts to produce, time allocations) and add your chosen GreenComp areas at the top of the brief. If you are designing from scratch, choose a case from your sector and write three prompts you will use for analysis, choice and reflection; attach one reflection tool (e.g., a short learning log or a GreenComp-aligned self-assessment) so evidence of learning is captured.

Why CBL is the recommended backbone

If you are wondering why the handbook centres on CBL: the method is structured, concrete, and adaptable across sectors; it helps students connect theory to practice and wrestle with real sustainability trade-offs; and it supports systems thinking, critical thinking, and responsible decision-making. The five steps map cleanly onto GreenComp, which keeps values, complexity, futures, and action visible throughout the learning cycle. If you want a bit more depth, the section on embedding sustainability in practice-oriented education through CBL synthesises the research base and provides additional examples you can translate into your context.

Planning beyond a single session

When you are ready to go further, the Action planning and guidelines section helps you transform existing courses by matching methods to competences over time and by using the lesson-planning checklist to maintain constructive alignment across outcomes, teaching, and assessment. The handbook also clarifies the educator's role at each step, how to prompt early ethical awareness, stakeholder sensitivity, and value clarification, and how to scaffold analysis, choice, and reflection, so that you develop both disciplinary and sustainability competences in tandem.

What to read now, at a glance

- Ten-minute skim: Table of contents; CBL five-step summary; GreenComp overview; lesson-planning checklist.
- One-hour preparation: a lesson plan you will adapt; Mapping GreenComp to CBL; Educator's Guide to prompts, tools and rubrics.
- Deeper dive (optional): embedding CBL in practice-oriented education; action planning and guidelines for course-level change.

If you only remember one thing

Make GreenComp explicit in your learning outcomes, activity design, assessment, and reflection. Doing so turns sustainability from an implicit backdrop into an intentional, assessable part of students' development, and it anchors your practice in the shared language of this handbook.

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2 Action planning and guidelines to transform your lesson plan

Summary: Teaching sustainability is not only about giving knowledge but about helping students develop skills, values, and confidence to face real-world challenges. Teachers should choose teaching methods that match the sustainability competences they want students to develop. Active approaches such as problem-based learning, project work, group discussions, and case studies help students think critically, work together, and understand complex systems. Sustainability can also be integrated into existing learning goals, even if it is not yet explicitly mentioned in the curriculum. Firsthand experiences, such as outdoor activities or community projects, help students connect emotionally with sustainability and understand their own impact. Frameworks like the one by Lozano et al. support teachers in choosing suitable methods for the GreenComp competences. Because no single method covers all competencies, combining different teaching approaches in lesson planning is recommended. To help you, you can find a checklist for the development of a lesson plan and an example of a lesson plan in sections 2.2 and 2.3.

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2.1 Pedagogical approaches

This section is inspired by:

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(10), 1889. https://doi.org/10.3390/su9101889

Wang, Y., Sommier, M., & Vasques, A. (2022). Sustainability education at higher education institutions: Pedagogies and students' competences. *International Journal of Sustainability in Higher Education*, *23*(8), 174–193. https://doi.org/10.1108/IJSHE-11-2021-0465

Teaching sustainability is thus not simply about sharing knowledge; it is about helping students develop the skills, mindset, and confidence to tackle real-world challenges. To do this effectively, we need to use a **pedagogical approach that matches the sustainability competences** we want students to develop. Such a development depends on the goals of the education.

For example, if we want students to think critically and understand complex systems, methods like problem-based learning, case-based learning, and project-based learning are useful. These approaches encourage students to analyse real sustainability issues, make connections, and find solutions. If collaboration is key, group discussions, interdisciplinary teamwork, and participatory learning are great ways to develop communication and teamwork skills. To help students reflect on their values and role in sustainability, storytelling, role-playing, service learning, and venturing into society can be powerful tools. The exercise of choosing a certain method is obviously easier when one has explicitly mentioned sustainability in the learning goals. When one has not incorporated sustainability (yet) in its learning goals, one may start by interpreting the existing goals and objectives to see where sustainability fits best. If, for example, one has other learning goals about collaboration, one can try to involve sustainability in this topic (e.g. a group assignment in a course on the fundamentals of electricity, in which the teacher could also include the sustainability aspects of energy use and production).

Whatever method one chooses, try to make sure that you, as an educator, enable learners to encounter sustainability first-hand. Experiencing sustainability and nature firsthand plays a vital role in learning about sustainability, as the goal is to develop values, systems thinking, and action. When students engage directly with the natural world (meaning the part of the world that is not made by humans) through activities like outdoor exploration, gardening, or participating in community sustainability efforts, they form a personal and emotional connection to the environment. Moreover, this helps them to understand the significant impact they may have on nature and understand its vulnerability. This connection fosters intrinsic motivation and helps them internalise core sustainability values, making abstract concepts more tangible and meaningful. Firsthand experiences also support the development of systems thinking by revealing the complex interdependencies within ecosystems, which aligns with GreenComp's emphasis on embracing complexity. Moreover, such experiences encourage reflection and empower students to see themselves as capable of making a difference, thereby reinforcing competences related to personal responsibility and collective action. In this way, experiential engagement with sustainability and

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nature transforms learning into something lived and felt, helping learners not only understand sustainability but also embody it in their attitudes and behaviours.

The framework in Figure 5 provides a concrete and **practical guide** to help one choose the right teaching methods for different sustainability competences. Whether someone is new to sustainability education or looking for fresh ideas, these approaches will help your students not only understand sustainability but also take meaningful action. Here are some examples of how this framework can be applied to the GreenComp competence areas:

- **Embodying sustainability values:** This GreenComp area encompasses competences like valuing sustainability, supporting fairness, and promoting nature. Pedagogical approaches that foster personal engagement and ethical reflection are effective here. For instance, community service learning and participatory action research can help students internalise sustainability values by engaging them directly with community issues and ethical considerations.
- **Embracing complexity in sustainability**: This GreenComp area includes systems thinking, critical thinking, and problem framing. Approaches such as problem-based learning, case studies, and interdisciplinary team teaching are particularly suitable, as they encourage students to analyse complex systems and consider multiple perspectives.
- **Envisioning sustainable futures**: This GreenComp area involves futures literacy, adaptability, and exploratory thinking. Pedagogies like scenario planning, visioning exercises, and role-playing can stimulate students' ability to imagine and plan for sustainable futures. These methods encourage creative thinking and adaptability.
- **Acting for sustainability**: This GreenComp area covers political agency, collective action, and individual initiative. Experiential learning methods, such as community-based projects and service learning, empower students to act and develop a sense of agency in sustainability efforts.

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		Pedagogy											
		Universal					Community and social justice			Environmental education			
		Case studies	Interdisciplinary team teaching	Lecturing	Mind and concept maps	Project and/or problem-based learning	Community service learning	Jigsaw / interlinked teams	Participatory action research	Eco-justice and community	Place-based environmental education	Supply chain / Life cycle analysis	Traditional ecological knowledge
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												
	Tolerance or ambiguity and uncertainty												

Figure 5: Framework connecting sustainable development pedagogical approaches to competences, redrawn from Lozano et al. (2017). Green cells show that the competence is likely to be addressed, yellow cells imply a connection, and white cells show that the competence is not addressed.

It is important to note that no single pedagogical approach addresses all sustainability competences. Therefore, a combination of methods is recommended to provide a comprehensive sustainability education. This is best done by integrating various approaches into the lesson plan. This allows students to develop a well-rounded set of competences, preparing them to address complex sustainability challenges effectively.

As such, one should plan upfront to identify the right pedagogical approach(es) that enable the educator to acquire the necessary skills, attitudes, and knowledge. One can use the following checklist that may be of help in the development. Obviously, an educator may decide that this list needs to be expanded or altered based on the needs of the learners in the classroom.

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2.2 Checklist for the development of a lesson plan

Below, one can find a clear checklist of a lesson plan that can be used by educators. These include all the relevant aspects a lesson plan should contain.

1. Clarify the Purpose of the Lesson

☐ I know what sustainability challenge or theme this lesson addresses
☐ The lessons go beyond knowledge transfer
☐ I aim to develop skills, values, and agency, not only understanding

2. Select GreenComp Competences

☐ I have selected 1–4 GreenComp competence areas
☐ I can explain why these competences are relevant for these lessons
☐ The competences can be made explicit to students

Selected competence areas:
☐ Embodying sustainability values
☐ Embracing complexity in sustainability
☐ Envisioning sustainable futures
☐ Acting for sustainability

3. Translate Competences into Learning Outcomes
☐ Learning outcomes will describe what students can do, not just what they know
☐ Outcomes include verbs such as analyse, reflect, collaborate, envision, act
☐ At least one outcome addresses values or responsibility

4. Align Pedagogical Approaches with Competences
☐ Teaching methods match the intended competences
☐ I use more than one pedagogical approach
☐ Passive teaching (lecture-only) is avoided or complemented

Examples (tick those used):
☐ Problem-based learning
☐ Case-based learning
☐ Project-based learning
☐ Participatory/interactive learning
☐ Roleplay or storytelling
☐ Scenario planning or visioning

5. Include Experiential or Real-World Learning
☐ Students engage with real sustainability issues
☐ Learning includes interaction with nature, community, or stakeholders
☐ Students experience sustainability as something lived and felt, not abstract

Examples:
☐ Fieldwork / outdoor learning
☐ Community-based project
☐ Service learning
☐ Campus sustainability activity

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6. Design Active Learning Activities

☐ Students actively explore, analyse, create, or decide
☐ Activities encourage multiple perspectives
☐ Collaboration and dialogue are built into the plan

7. Align Assessment with Sustainability Competences

☐ Assessment evaluates process and reflection, not only results

Students are assessed on:

☐ Systems or critical thinking
☐ Ethical reflection
☐ Collaboration
☐ Action orientation

Suitable assessment methods used:

☐ Reflective journal
☐ Portfolio
☐ Group project
☐ Presentation or pitch
☐ Peer/self-assessment

8. Build in Reflection and Learning Awareness

☐ Reflection moments are explicitly planned
☐ Students reflect on values, assumptions, and learning process
☐ Reflection connects learning to future action

Examples of questions about reflection and awareness:

- *What changed in my thinking?*
- *How do I relate to this issue personally?*
- *What can I do differently in the future?*

9. Check Integration and Balance

☐ There is a balance between cognitive, emotional, and action-oriented learning
☐ No single method dominates the class
☐ The class supports competence development

10. Evaluate and Improve

☐ Student feedback is collected
☐ I reflect on what worked and what did not work
☐ Adjustments are planned for future iterations

11. Final Check

☐ My lesson supports learning about, for, and through sustainability
☐ Students are prepared to think, feel, envision, and act sustainably

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2.3 Examples of lesson plans

To further help teachers, we developed two lesson plans that can be used or adapted for your own courses. In these two lesson plans, we tried to include the GreenComp competences as much as possible, given the fact that they are the backbone of this handbook. Moreover, they include multiple methods to allow for an optimal integration of the GreenComp competences.

2.3.1 Lesson Plan 1 — Vocational Education and Training

Sector Example: Construction / Technical Professions / Electromechanics
GreenComp Focus: *Acting for Sustainability* and *Embodying Sustainability*
Target Group: VET learners (ages 16–19)
Duration: 90 minutes
Theme: Sustainable Material Selection in Professional Practice

1. Learning Outcomes (GreenComp-Aligned)

Upon completion of the lesson, learners will be able to:

1. Explain why sustainability is relevant in their professional field
   (GreenComp: Sustainability Values, Systems Thinking)
2. Compare materials based on environmental impact and professional usability
   (GreenComp: Critical Thinking, Impact Literacy)
3. Make a justified decision between alternative materials in a practical scenario
   (GreenComp: Responsibility, Collective Action)

2. Introduction (10 minutes)

The instructor shows images of varied materials (e.g., concrete, timber, recycled composite). Inform which materials appear to be most sustainable for the learners and why?

A brief explanation of the GreenComp framework follows, emphasising the role of sustainability competences in modern technical professions.

3. Main Activities (60 minutes)

A. Instructor Input (15 minutes)

Provide a short lecture covering:

- Material life cycle (LCA)
- CO_2 footprint of common construction materials
- Reusability, recyclability, and durability

This section explicitly links sustainable decision-making to systems thinking and acting for sustainability.

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B. Group Assignment: Material Analysis (30 minutes)

Learners work in teams of 3–4. Each team receives three materials for the same application (e.g., insulation, flooring, cable trays, packaging, structural profiles).

They evaluate each material on:

- Environmental sustainability
- Clarity of the supply chain
- Safety requirements
- Cost-efficiency
- Practical usability
  Teams complete a comparative table aligned with the GreenComp domains, making competence development explicit.

C. Group Presentation & Discussion (15 minutes)

Each team presents their selected material and the justification behind their choice.
Other teams ask critical questions, prompting peer reflection and critical thinking.

4. Assessment (10 minutes)

Formative evaluation using:

- A short reflective prompt ("Which criteria influenced your decision most strongly and why?")
- A checklist referencing GreenComp competences

5. Differentiation Strategies

It can be needed to differentiate in class. Advanced learners can be given the task to add a cost–benefit calculation or perform a simplified CO_2 impact calculation. Meanwhile, learners needing support can use scaffolded worksheets with icons, simplified text, and pre-filled tables.

6. Required Materials

- Material data sheets
- LCA visual diagrams
- Worksheets and comparison templates
- Optional digital tools (e.g., tablets, online LCA calculators)

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2.3.2 Lesson Plan 2 — Higher Education

Discipline Example: Business, Education, Engineering, Social Sciences
GreenComp Focus: *Envisioning Futures* and *Embedding Values*
Target Group: Undergraduate or graduate students
Duration: 2 hours
Theme: Futures Thinking & Sustainable Innovation in Professional Contexts

1. Learning Outcomes (GreenComp-Aligned)

After completing the session, students will be able to:

1. Analyse sustainability challenges from a systems and futures perspective
   (GreenComp: Systems Thinking, Futures Literacy)
2. Design alternative future scenarios relevant to their academic or professional field
   (GreenComp: Futures Envisioning, Change Agency)
3. Reflect on how their personal and professional values shape their sustainability perspective
   (GreenComp: Sustainability Values, Personal Responsibility)

2. Introduction (10 minutes)

Students watch a short TED-style video on sustainable transitions (e.g., circular economy, energy systems).
One can ask them the question "How might their field look in 2040 if sustainability becomes the default expectation?"

The instructor briefly introduces the GreenComp framework, highlighting the importance of *foresight competences* in higher education.

3. Main Activities (70 minutes)

A. Mini-Lecture (15 minutes)

Topics:

- Overview of the four GreenComp domains
- Introduction to foresight methodologies
  - Baseline scenario
  - Sustainable optimistic scenario
  - Risk/disruption scenario
- Application examples within different sectors
  This segment builds students' futures literacy.

B. Scenario Creation Workshop (40 minutes)

In the workshop, students work in disciplinary teams (e.g., engineering, business, teacher education, social sciences). Each group creates three 2035–2040 scenarios addressing:

- Technological developments
- Environmental trends

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- Changes in policy and governance
- Emerging professional roles and needed competences
- Potential innovations and risks
  Output:
- A completed scenario canvas
- A 2 to 3 minute pitch

C. Scenario Pitch & Peer Review (15 minutes)

Each group subsequently presents their scenarios to the other learners. Peer feedback focuses on:

- Sustainability relevance of the scenario
- Integration of systems thinking
- Ethical and societal implications
- Ambition level and realism
  Links to GreenComp criteria are highlighted.

4. Reflection & Assessment (20 minutes)

Students complete an individual reflection addressing:

- How their personal values influence their view of the future
- Which future skills they consider vital in their profession
- One concrete action they can implement during their studies or internship
  Assessment methods:
- Quality of the scenario canvas
- Coherence between scenario and GreenComp competences
- Depth of written reflection (qualitative rubric recommended)

5. Differentiation Strategies

One can differentiate the content of the lesson based on the knowledge and skills of the students. Advanced learners may, for example, explore additional foresight tools (backcasting, design fiction, strategic mapping). Whereas learners needing support may use simplified scenario templates and structured prompts.

6. Required Materials

- Scenario canvas templates
- Slide deck on GreenComp
- Whiteboards, markers, or digital collaboration tools (such as Miro, Mural, Jamboard)

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2.4 Case-Based Learning (CBL)

Summary: This section explains why Case-Based Learning (CBL) is used as the main method to teach sustainability competences. CBL is chosen because it is structured, concrete, and suitable for developing most GreenComp competences. Unlike Challenge-Based Learning, CBL starts from a predefined case and focuses on analysis, discussion, and well-argued decisions. CBL helps students connect theory with practice and understand sustainability trade-offs from environmental, social, economic, and ethical perspectives.

CBL is effective across many sectors, such as healthcare, trade, entrepreneurship, textiles, and construction, and helps students develop systems thinking, critical thinking, and responsible decision-making. We invite you to have a closer look at the cases for the different industries. The method follows five clear steps: problem exploration, analysis, exploring solutions, choosing and justifying actions, and reflection. These steps can be linked directly to the GreenComp competence areas. By guiding students through realistic sustainability cases, teachers support active, student-centred learning and help learners prepare for real-world sustainability challenges.

2.4.1 Case-Based Learning for ESD

This section is inspired by:

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(10), 1889. https://doi.org/10.3390/su9101889

As stated earlier, multiple methodologies can be relevant to use during the education of the GreenComp competences. We decided to further develop one of the methodologies in depth to provide educators with clear examples of how they can incorporate sustainability into their classes. We decided to develop case studies, not only because most of the competencies can be addressed with this method, but also because they can easily be developed in other learning material, like a starting point for class discussions or project-based learning.

Case-based learning differs in an important way from – but is often confused with - challenge-based learning. While both **challenge-based learning (ChBL)** and **case-based learning (CBL)** promote active student engagement, they differ notably in their structure and educational intent.

- First, the **starting point** in ChBL is typically an open-ended, real-world theme or societal issue from which students collaboratively define their own challenge, whereas CBL begins with a **predefined case** provided by the instructor to frame a specific problem.
- Second, the **outcome** in ChBL often involves a tangible, action-oriented solution with real-world impact, frequently engaging external stakeholders; in contrast, CBL emphasises analytical outcomes such as reasoned judgments or recommendations based on theoretical application.

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- Lastly, the **focus** of ChBL lies in student agency, interdisciplinarity, and social relevance, whereas CBL is more centred on **critical thinking**, domain-specific reasoning, and connecting theory to practice within a structured framework.

While both have their value, we decided to further develop the CBL, rather than the ChBL, as a case study is more concrete (due to being predefined) and more structured (both in starting point and outcomes). As such, we can more clearly guide an educator in the development of case studies. CBL enables students to engage deeply with real or realistic scenarios, allowing them to explore sustainability issues in a contextual and often interdisciplinary manner. Through structured analysis and discussion of cases, students are encouraged to consider multiple perspectives—environmental, social, economic, and ethical - and to develop solutions that reflect the complexity and interconnectedness inherent in sustainable development.

CBL supports several key sustainability competences, such as systems thinking, anticipatory thinking, normative competence, and strategic competence. This is because CBL uses detailed, realistic cases that mirror real sustainability challenges. By working on such cases, students practice identifying stakeholders, analysing impacts, navigating trade-offs, and collaboratively formulating strategies for sustainable action. By analysing these cases, learners engage in higher-order thinking that aligns strongly with the core competences in sustainability education. Moreover, CBL fosters reflective learning and bridges theory with practice, aligning well with the transformative learning goals of ESD. With transformative learning, we mean learning that fundamentally changes the way learners understand themselves and the world through critical reflection on their assumptions. As such, CBL promotes learner-centred education, where students take active roles in their own learning and become co-creators of knowledge, rather than passive recipients.

2.4.2 A comparative pedagogical perspective on CBL

This section is inspired by:

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(10), 1889. https://doi.org/10.3390/su9101889

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, 1(1), 9–20. https://doi.org/10.7771/1541-5015.1002

Herreid, C. F. (2011) In case you didn't know: Critical thinking and the case study approach to teaching science. *Inquiry: Critical Thinking Across the Disciplines*, *26*(3), 33–38. https://doi.org/10.5840/inquiryct201126326

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

In the next paragraphs, we will provide the reader with several case studies in different sectors. To examine the use of **case-based learning (CBL)** across various sectors in Europe, it is first essential to situate this pedagogical approach within the broader framework of **active learning strategies**.

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CBL is an instructional method that presents students with realistic, context-specific cases in which they must apply theoretical knowledge to reach a solution or make informed decisions. Unlike passive forms of knowledge transmission, CBL demands active cognitive and social engagement from students, aligning with constructivist theories of learning. Its emphasis on analytical reasoning, argumentation, and interdisciplinary collaboration makes it particularly well-suited to complex learning environments in fields such as law, medicine, business, and the social sciences. However, before sector-specific applications and empirical data from European contexts can be meaningfully compared, a thorough conceptualisation of CBL as an active learning strategy is essential for establishing a consistent analytical framework.

The diagram below presents a conceptual overview of CBL as an active learning strategy. By placing authentic, real-world cases at the centre of the learning process, CBL fosters deeper engagement, critical thinking, and the application of knowledge in complex, context-rich scenarios. This spider web diagram synthesises key dimensions of CBL—including its pedagogical foundations, learning outcomes, sector-specific applications, and inherent challenges—to provide a comprehensive visual framework. It draws upon established academic research to guide educators and curriculum designers in understanding the multifaceted nature of CBL and its relevance across disciplines.

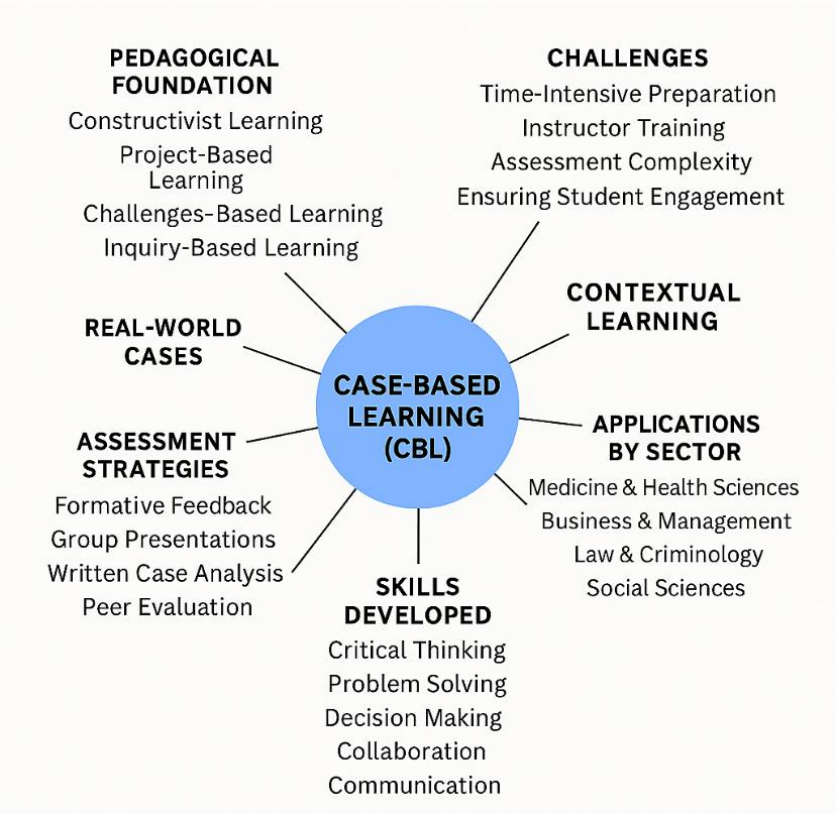

Figure 6: Conceptual diagram based on Herreid (2011), Prince (2004) and Savery (2006)

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2.4.3 The versatility of CBL across disciplines

This section is inspired by:

Kantar, L. D., & Massouh, A. (2015). Case-based learning: What traditional curricula fail to teach. *Nurse Education Today*, *35*(8), e8–e14. https://doi.org/10.1016/j.nedt.2015.03.010

McLean, S. F. (2016). Case-based learning and its application in medical and health-care fields: A review of worldwide literature. *Journal of Medical Education and Curricular Development*, *3*, 39–49. https://doi.org/10.4137/JMECD.S20377

CBL is widely adopted as a methodology across diverse educational sectors, demonstrating its versatility and impact. CBL can be used in different ways. For instance, at ESCP Business School, CBL is used to immerse students in complex business scenarios that require strategic analysis and decision-making, closely mirroring real-world managerial challenges. In contrast, at Erasmus MC in the Netherlands, CBL is integrated into medical education to train students in clinical reasoning, ethical judgment, and patient-centred care by engaging with authentic patient cases. These examples (from outside of the TEACH4SD network) illustrate how CBL supports both analytical and practical skill development, tailored to the disciplinary needs of each field.

Example 1: Case-based learning in management at ESCP Business School

ESCP is a leading European business school with campuses in London, Paris, Berlin, Madrid, and more. During class, students analyse real company cases involving leadership dilemmas where decisions must be made under uncertainty. Students take on roles (e.g. CEO, CFO), debate possible strategies, support their choices with evidence, and defend their positions in front of peers and instructors. After discussions, the instructor and classmates provide feedback, prompting students to reflect on which information was most relevant and why.

ESCP's case-based learning lets students actively step into decision-making roles, debate real business issues, receive feedback, and practice strategic reasoning. It fosters critical thinking, communication, and leadership skills.

Sources:

- World Case Teaching Day: ESCP's Commitment to Excellence in Case-Based Learning | ESCP Business School
- ESCP ranked amongst top 20 business schools worldwide for Customised Executive Education | ESCP Business School)

Example 2: Case-based education in medical education at Erasmus MC

This educational model consists of three components: a pitch to introduce the subject and motivate students, guided self-study in which students acquire the necessary knowledge, and case discussions in which students apply the knowledge gained to realistic situations.

Source: Erasmus MC

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Although limited meta-analyses have been conducted by European institutions, there are international meta-analyses published in European journals and European studies that examine the effectiveness of case-based learning. These studies confirm the value of CBL in improving academic performance and developing practical skills in students. As such, we can state that this method is highly useful in teaching sustainability.

2.4.4 Embedding sustainability in practice-oriented education through CBL

This section is inspired by:

Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007). Developing key competences for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, *8*(4), 416–430. https://doi.org/10.1108/14676370710823582

Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D., & Lambrechts, W. (2013). Declarations for sustainability in higher education: Becoming better leaders through addressing the university system. *Journal of Cleaner Production*, *48*, 10–19. https://doi.org/10.1016/j.jclepro.2011.10.006

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures*, *44*(2), 127–135. https://doi.org/10.1016/j.futures.2011.09.005

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, 1(1), 9–20. https://doi.org/10.7771/1541-5015.1002

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. In *Sustainability Science* (Vol. 6, Number 2, pp. 203–218). https://doi.org/10.1007/s11625-011-0132-6

The academic literature increasingly supports the use of Case-Based Learning (CBL) as an effective pedagogical tool for embedding sustainability into education, particularly in practice-oriented environments such as vocational education, higher education, and professional training.

2.4.4.1 CBL enhances systems thinking and sustainability competences

CBL enables students to engage with the complex, interconnected nature of sustainability issues—economic, social, and environmental—through realistic, often interdisciplinary cases. According to Barth et al. (2007) and Rieckmann (2012), this approach helps foster key sustainability competences, including:

- Systems thinking / Critical thinking/ Normative competence (evaluating values and ethics)
- Strategic competence (designing interventions)

2.4.4.2 Linking theory to practice

Academic studies (e.g. Lozano et al., 2013) emphasize that sustainability education must go beyond theoretical models. CBL supports this by offering real-life, context-rich scenarios where students must make decisions that mirror the dilemmas faced in sustainable development work. This bridges the knowledge-action gap, a key challenge in sustainability education.

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2.4.4.3 Active, student-centred learning drives engagement

CBL is grounded in constructivist learning theory, where knowledge is constructed through active engagement. When sustainability is embedded into this format, it encourages student ownership, motivation, and deeper reflection. This is especially valuable in preparing learners for real-world decision-making, a core goal of both ESD and vocational excellence initiatives like TEACH4SD.

2.4.5 Case-based pedagogy for sustainability across sectors

Given the advantages of CBL, we want to provide the reader with some example cases that can be integrated into their classes. The TEACH4SD project strategically focuses on five key sectors that are essential to fostering sustainable development within the European labour and education landscape. These sectors include **healthcare, trade, entrepreneurship, clothing and textiles, and construction**.

Each case is accompanied by specific challenges and a set of guiding questions that can stimulate meaningful classroom discussion. The purpose of these cases is to illustrate that sustainability is rarely straightforward. Choosing a sustainable path can sometimes be costly for an organisation, or it may generate unintended consequences for other dimensions of sustainability. By engaging with these cases, students gain insight into the complexity, trade-offs, and sometimes competing priorities that arise when pursuing sustainability goals.

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2.4.5.1 CBL in the healthcare sector

In the healthcare sector, CBL can be an effective pedagogical approach for developing both clinical reasoning and patient-centred decision-making skills. By engaging with authentic, often complex patient scenarios, students are encouraged to apply biomedical knowledge within realistic clinical and ethical contexts. CBL fosters critical thinking, diagnostic accuracy, and interdisciplinary collaboration—competences essential to modern medical practice.

Example 1: Diapers and sustainability

You work at a hospital where diapers are used both for the youngest patients and for incontinent adults. However, the diapers currently in use generate a massive amount of waste. In this context, an opportunity arises to introduce reusable diapers. These reusable diapers can be cleaned and reused, but this solution comes with higher costs—both the initial purchase cost and the ongoing cleaning process. It also creates a more complex supply chain, since the diapers must be transported to a specialised laundry facility capable of washing them at the required quality and hygiene standards.

Problem: The costs of the reusable diapers will likely be passed on to the patient's bill.

Key Challenge: You will need to strike a balance between environmental impact and price.

Guiding questions:

- How can the hospital weigh the advantages of one type of diaper against the other?
- How can the advantages of each type of diaper be evaluated from the patient's perspective?
- Are there alternative solutions or options that combine both types?
- Are there other situations within medical practice where you can identify a risk of excessive waste (for example, needles, sterile materials, anaesthesia, etc.)? Do you currently see a possibility to reduce the waste?

Example 2: Proton therapy versus wastewater management

A hospital has the opportunity to acquire a proton therapy installation to treat cancer. These machines are extremely expensive but may help generate additional revenue and increase the hospital's prestige. Neighbouring hospitals already have such an installation. At the same time, the hospital could instead invest in improving its wastewater treatment system, allowing more water to be recycled. However, there is not enough funding for both investments.

Problem: Since there is no budget for both options, the hospital must choose between growth (resulting in more jobs and revenue) and reducing its environmental impact.

Key Challenge: How should one weigh the importance of positive economic and societal benefits against environmental considerations?

Guiding questions:

- What are the factors for or against each choice?
- Should one try to outperform environmental laws?
- Do you think people in other industries would prefer a water treatment installation over a machine essential for medical operations?
- Is the distance to other hospitals an important factor in your decision?

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2.4.5.2 CBL in the trade sector

Context: In the trade sector, Case-Based Learning (CBL) can be a pedagogical method for developing practical, decision-oriented competences. By engaging students with authentic commercial scenarios—such as supply chain disruptions, ethical sourcing dilemmas, or customer conflict resolution—CBL promotes critical thinking, negotiation skills, and situational adaptability.

In vocational training contexts, particularly within retail, wholesale, and logistics education, CBL supports the integration of economic knowledge, customer interaction strategies, and sustainability concerns in a realistic, problem-driven framework. For instance, learners may analyse a case involving the sustainable packaging transition of a mid-sized retail company or the financial implications of implementing fair-trade product lines. Such cases help bridge theory and practice and foster a mindset of responsible trade.

Example 1: Fast delivery, slow ethics"

You are part of the operations team at QuickCart, a fast-growing online retail platform known for next-day delivery. The company is expanding rapidly across Europe, but many warehouse workers in its supply chain—especially in Eastern Europe—report unsafe conditions and low pay.

Problem:
A journalist is preparing to publish an exposé on working conditions in QuickCart's supply chain.

Key Challenges: 1) Keeping the public trust, upholding employee morale, and investor confidence. 2) Deciding whether to change supplier contracts, improve oversight, or defend current practices based on legal compliance.

Guiding Questions:

- What are the ethical responsibilities of QuickCart as a trade operator?
- How should the company balance cost efficiency with fair labour practices?
- What communication strategy should be used to manage reputational risk?

Example 2: Sustainable packaging, unsustainable margins

GreenBasket, a wholesaler of organic food products, is under pressure to reduce plastic packaging. Several clients—mainly supermarkets—have requested fully compostable packaging within six months.

Problem:

Initial supplier quotes for eco-packaging show a 25% increase in costs, which threatens the company's already tight profit margins.

Key Challenges:
GreenBasket must decide whether to:

1. Absorb the cost (and reduce profits),
2. Pass it on to clients (and risk losing contracts),
3. Delay the change (and risk reputational damage).

Guiding Questions:

- What sustainability values does the company want to uphold?
- How can trade-offs between environmental responsibility and profitability be managed?
- Are there alternative solutions, such as shared costs or phased implementation?

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Example 3: Green smartphone cases

Phonesleeve sells smartphone cases and other smartphone accessories such as screen protectors, phone grips and phone lanyards. Phonesleeve realises that smartphone cases and other smartphone accessories are often used for a limited amount of time, while most of them are made of plastic. This has a great impact on the environment, where plastic does not easily degrade. Meanwhile, Phonesleeve wants to stay attractive to its customers: attention to the environment is becoming necessary to avoid a negative reputation.

Problem:

The most profitable option is not always the most sustainable one, both for nature and for the future of the business.

Key challenges:

Find a balance between the most affordable, fashionable, durable and sustainable option.

Balancing the current financial interests (cheap plastic cases) and the ones of the future (the use of plastic can cause damage to the reputation of the firm later).

Guiding Questions:

How can we combine affordability and sustainability?

How could sustainability be integrated without fundamentally altering the DNA of the firm (providing affordable and fashionable cases)?

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2.4.5.3 CBL in the entrepreneurship sector

Example 1: GreenStart: Urban Vertical Farming for Food Security

A team of student entrepreneurs plans to launch GreenStart, a social enterprise aimed at using vertical farming technology in city environments to produce fresh, affordable produce while reducing food miles and waste. They must develop a viable business model, evaluate funding options (crowdfunding vs grants), and craft a marketing strategy that highlights both environmental and social impact.

Problem:

While the ambition is present to develop a business aimed at sustainability, profitability is not as easy to achieve.

Key challenges:

Balancing social mission with financial sustainability

Navigating regulatory and urban zoning constraints

Communicating the enterprise's value proposition to diverse stakeholders

Guiding questions:

Can you explain the field of tension between gaining money and achieving social goals?

Are there possibilities to scale up such a system?

Who would be interested in investing in such a company?

Example 2: EduApp's Pivot: From Education to Senior Wellbeing

EduApp, initially designed as an educational tool for high school students, struggled to gain traction in a saturated market. Its founders observe that senior citizens, especially those living alone, also need engaging digital tools to support cognitive health.

Problem:

It is unclear to what extent this App is viable when promoted amongst senior citizens.

Key Challenges:

Validating market demand and performing rapid customer discovery among seniors

Redesigning the app interface for accessibility and simplicity

Estimating costs and projecting revenue in a new demographic segment

Guiding questions:

What are the differences in added value for the high school students and the senior citizens?

What are the most important changes the app has to undergo to cater to senior citizens?

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Example 3: The standing Wheelchair
J58's mission is to enhance the lives of wheelchair users through an innovative standing mechanical wheelchair that offers practical and emotional benefits.

Basically, this product already contributes to sustainability in the sense of social justice.
It gives wheelchair users a better quality of life because they can participate more easily in society. They give people back their freedom and independence.

For a start-up, the main starting point is always to develop a good-quality product for which there is a market. So, when designing the wheelchair, the most important requirements are:

- Practical usability; strong and long-lasting materials; user experience
- Producible
- Affordability

Therefore, environmental sustainability is not the focus (yet).

Problem:
Prolonging the lifespan of wheelchairs is a challenge: how
can J58 ensure the longest possible product lifecycle that takes sustainability into account?

Key Challenges:
How can J58 help in the development of a product that is both useful and sustainable?

How can J58 do this in a profitable manner, given the fact that disabled people (or at least part of the disabled people) have less money to spend?

Guiding questions:
Should we sacrifice aspects of sustainability to achieve other sustainable goals or things that are ethically good? What are the most important reasons for this?

Should we be more lenient towards companies that produce products that are very important for (certain groups of) people, but are unsustainable?

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2.4.5.4 CBL in the clothing and textiles sector

Context: CBL in the clothing and textiles sector is very useful for several reasons:

1. Higher engagement and critical thinking

Research at the Amsterdam Fashion Institute (AMFI) shows that students who work with realistic business cases (such as sustainability cases from H&M or Patagonia) are more engaged and learn to reason better about ethical dilemmas in the supply chain.

2. Better preparation for practice

In a study published in the journal Fashion Practice (2019), CBL was used in a module on sustainable fashion. Students worked on real cases of fashion brands with sustainability issues. Result: students felt better prepared for real work situations after CBL compared to traditional teaching.

3. Interdisciplinary learning

In programs where clothing and textile students collaborate with engineering or business students, CBL helps bridge silos. One example is the "Circular Textiles Challenge" in several European colleges, where students collaborate on circular solutions in real-life business assignments (Savery, 2006).

This shows that context-driven learning leads to deeper knowledge building, better problem-solving skills and higher motivation levels, especially in sectors with complex ethical and economic issues such as fashion and textiles.

Example 1: Using child labour

Textileco – a European company- purchases an existing production site in Asia. While the patterns and materials are developed in Europe, the actual fabrics will be produced on the new production site. However, the local labour force includes children. Customers in Europe dislike child labour, and new regulations in Europe increasingly prohibit the use of children as labourers. Meanwhile, firing these children means financial distress for their families, who may depend on their income.

Problem:

In order to adhere to European laws and ethics, child labour should be avoided. However, local families may depend on a child's wage to survive.

Example 2: Throwing away clothes

The fashion industry is dominated by clothes that are thrown away after a few cleanings. The clothes become baggy and lose their colours. You work in a firm where you are remunerated according to the sales of clothes.

Problem:

Your financial incentives lead you to continue with the system of fast fashion.

Key challenge:

Trying to deal with the tension between the financial incentive and the unsustainable practice of fast fashion.

Guiding questions:

Do you think, in all honesty, that it is easy to go for more sustainability if this impacts your own remuneration?

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Key challenges: Trying to balance the European values and views on child labour and the values/harsh reality of the local population Balancing the finances. While one may think of just helping the local population (e.g. paying the children while letting them go to school) is ambitious, this may also impact the profitability of the firm and may make the production site unprofitable. Can we as a company sell -even temporarily- clothes and fabrics made by children? **Guiding questions:** How do we make sure our aim to be sustainable does not cause trouble for our stakeholders? What role does time play in this story? How fast should we act?	How would you discuss this problem within the company? How could a company realistically change its practices without losing too much money?

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2.4.5.5 CBL in the construction sector

Context: In the construction sector, CBL offers a valuable pedagogical method for preparing students to navigate the complexity of real-world projects that involve technical planning, safety regulations, stakeholder negotiation, and sustainability concerns.

By working through realistic construction-related scenarios, students develop both disciplinary knowledge (e.g., materials science, project management) and transversal competences (e.g., problem-solving, ethical reasoning, teamwork). CBL supports the integration of theory with practice in fields such as civil engineering, architecture, site management, and construction logistics—making it highly relevant to vocational education and training (VET) in the context of projects like TEACH4SD.

Example 1: Building stores that are aimed at controlling the employees

Constructco is a company that builds sustainable stores for retailers. The company is highly successful, and its sustainable techniques decrease CO2 emissions in the building process by 35% compared to competitors. Currently, the firm tries to get an order for the building of 50 new stores of a large retailer. However, the retailer asks the construction firm to build these stores in a fashion that avoids theft by employees by building the stores as a panopticon: e.g. by minimising exits and windows and ensuring that there are no dead corners that cannot be surveyed.

Problem:

While the Constructco may achieve its goal of both generating more business and building new buildings with less CO2, the fact that one helps in constructing a building that treats people as if they were criminals poses some ethical questions.

Key challenges:

The key challenge is weighing the two aspects of, on the one hand, saving the planet by building sustainable buildings, while on the other hand, contributing to ethically questionable practices.

Another challenge is to maybe impact the retailer in a positive manner, at the risk of losing the contract.

Example 2: Building the house of the future

Futuroconstruct is building the houses of the future. These houses are environmentally friendly and equipped with the most modern technologies. However, in order to become more profitable, the company can reduce costs by installing less durable solar panels and boilers. Given the large number of houses being built, this would result in substantial savings over time. Generally, buyers are not willing to pay extra for the more durable versions, meaning that any additional cost would directly reduce the company's profit.

Problem:

Limiting costs and increasing profits are normal aspects of running a business. However, in this context, these goals may conflict with the ambition to build green and sustainable homes.

Key Challenges:

As a company, it is difficult to find a balance between profitability and environmental responsibility.

Convincing buyers to invest more in higher-quality, more durable materials.

Guiding questions:

How far should one go in pursuing sustainable solutions in construction?

Should companies accept lower profits for the sake of a better world?

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Guiding questions: How much can one aspect of sustainability prevail over another one? What are the limits for the ethically problematic behaviour of customers? Should we just adhere to the law (which allows this), or should we aim higher?	Do we think enough about the durability of the materials used when building energy-neutral buildings?

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2.4.6 Five sequential steps within Case-Based Learning

This section is inspired by:

Dolmans, D. H. J. M., De Grave, W., Wolfhagen, I. H. A. P., & Van Der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education, 39*(7), 732–741. https://doi.org/10.1111/j.1365-2929.2005.02205.x

Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. *Medical Education, 36*(5), 426–431. https://doi.org/10.1046/j.1365-2923.2002.01205.x

Herreid, C. F. (2011). Case study teaching. *New Directions for Teaching and Learning, 2011*(128), 31–40. https://doi.org/10.1002/tl.466

Bryson, J. M. (2004). What to do when stakeholders matter: Stakeholder identification and analysis techniques. *Public Management Review*, *6*(1), 21–53. schmidthttps://doi.org/10.1080/14719030410001675722

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Kolodner, J. L. (1997). Educational implications of analogy: A view from case-based reasoning. *American Psychologist, 52*(1), 57–66. https://doi.org/10.1037/0003-066X.52.1.57

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning, 1*(1), 9–20. https://doi.org/10.7771/1541-5015.1002

Schmidt, H. G. (1983). Problem-based learning: Rationale and description. *Medical Education, 17*(1), 11–16. https://doi.org/10.1111/j.1365-2923.1983.tb01086.x

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.

Yale University Poorvu Center for Teaching and Learning. (n.d.). *Case-based learning*. https://poorvucenter.yale.edu/strategic-resources-digital-publications/strategies-teaching/case-based-learning

A widely adopted model divides the CBL process into five sequential steps. This is a structured CBL process adapted from constructivist and problem-based learning frameworks. As such, they can be used when presenting the previously discussed cases or when presenting a self-developed case.

These steps could promote a deep engagement with authentic scenarios, fostering critical thinking, collaborative inquiry, and evidence-informed action. The structured process ensures that learners not only apply disciplinary knowledge but also develop transversal skills such as argumentation, ethical reasoning, and reflective judgment—competences that are essential for sustainability-oriented and practice-based learning environments. This phased approach is particularly relevant in multi-sectoral settings (e.g. a company like Siemens that has a presence in the healthcare, industry, energy and infrastructure sectors), where it may not be so straightforward where the problem lies and which solutions are relevant for the whole organisation.

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Overview of the Five-Step CBL Process:

1. **Problem exploration**
   Students engage with a real-world scenario and identify core challenges and stakeholders.
2. **Delineation and analysis**
   Students analyse the problem using theory, data, and stakeholder perspectives.
3. **Exploring scenarios or solution directions**
   Students develop multiple strategies or solutions, comparing implications.
4. **Choice and justification**
   A preferred solution is selected and defended with evidence.
5. **Reflection and evaluation**
   Students reflect on their process, learning outcomes, and broader implications.

2.4.7 Mapping GreenComp onto the five-step CBL model

Integrating the 4 competence areas of the GreenComp (see paragraph 1.5 The GreenComp framework) into the five-step Case-Based Learning (CBL) model is not only feasible but pedagogically powerful. It aligns sustainability education with structured, active learning. For each CBL step, we identify corresponding GreenComp competences and a learning focus.

Road mapping GreenComp Competence Areas onto the CBL Process		
CBL Step	**GreenComp Competence Area(s)**	**Learning Focus**
1. Problem exploration	1. Embodying Sustainability Values	• Ethical awareness • Stakeholder sensitivity • Value clarification
2. Delineation and analysis	2. Embracing Complexity in Sustainability (+ 1. Embodying Sustainability Values)	• Systems thinking • Root cause analysis • Interdependency recognition
3. Exploring scenarios	3. Envisioning Sustainable Futures (+ 1. Embodying Sustainability Values)	• Creativity • Innovation • Evaluating trade-offs
4. Choice and justification	4. Acting for Sustainability (+ 1. Embodying sustainability values)	• Critical decision-making • Ethical justification • Responsible action
5. Reflection and evaluation	1. Embodying sustainability values	• Reflection • Peer-learning

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2.4.7.1 From Case to Competence: how to apply CBL using GreenComp

In the next paragraphs, we will learn how teachers can facilitate sustainability learning by guiding students through the five steps of CBL and embedding the four GreenComp areas. As a teacher, one can take the following actions:

A. Select or adapt a realistic sustainability case relevant to the sector the learners of the class will most likely work in
B. Guide learners through each CBL step using the roadmap above
C. Intentionally integrate GreenComp areas (values, complexity, futures, action) at each step

In the paragraphs below, we will further discuss these actions.

A. Select or adapt a realistic sustainability case relevant to their sector

Select a sustainability case that poses real-world environmental, social, or economic challenges. The case should be relevant, well-documented, and suitable for classroom analysis and discussion, considering the level of the class. It will serve as the foundation for students to explore sustainability concepts, assess impacts, and propose actionable solutions. Ensure the case encourages critical thinking and aligns with learning objectives.

Example: The Belgian print company 3Motion (*3Motion - the Power of Visual Thinking*, n.d.) is one of many SMEs being led by the green sprint that Europe wants to make with its Green Deal (European Council, 2025). At 3Motion, sustainable investments have been factored in since its start in 2010. On the environmental front, that ranges from:

- The choice of a sustainable construction developer
- A roof full of solar panels
- A pilot project with wind turbines and batteries to enable energy storage.
- The use of PVC-free and recycled materials, striving for circular systems. For example, they collect old campaign materials from customers for recycling.

Regarding the social aspect, 3Motion sets clear objectives for itself, such as developing an HR policy with an eye for gender and multiculturalism and opportunities for people with difficulties entering the labour market. It also focuses on a healthy and pleasant workplace for its 47 employees through initiatives on exercise and healthy food.

B. Guide learners through each CBL step using a roadmap for investigating a sustainability problem

The roadmap for investigating a sustainability problem serves as a strategic pedagogical tool to guide educators systematically through the five essential steps of Structured Case-Based Learning (SCBL). By providing a clear sequential framework, the roadmap ensures that educators can effectively scaffold learning experiences, from the initial presentation of a complex real-world case to the final stages of reflection. Moreover, the use of the roadmap enhances instructional planning and supports the integration of critical thinking, collaborative learning, and evidence-based reasoning, which are central to the CBL methodology.

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C. Intentionally integrate GreenComp areas (values, complexity, futures, action) at each step

A last action an educator can take is integrating GreenComp areas at each step that is taken. In this manner, learners understand that GreenComp areas are useful in every phase and that sustainability is a process, rather than only action.

2.4.7.2 Educator's Guide: Integrating GreenComp into the Case-Based Learning (CBL) Process

This guide supports educators in embedding the European GreenComp sustainability competence framework into a six-step Case-Based Learning (CBL) process across sectors such as trade, healthcare, construction, and entrepreneurship.

Overview of the Five-Step CBL Process:

1. **Problem exploration**
   Students engage with a real-world scenario and identify core challenges and stakeholders.
2. **Delineation and analysis**
   Students analyse the problem using, e.g. theory, data, and stakeholder perspectives.
3. **Exploring scenarios or solution directions**
   Students develop multiple strategies or solutions, comparing implications.
4. **Choice and justification**
   A preferred solution is selected and defended with evidence.
5. **Reflection and evaluation**
   Students reflect on their process, learning outcomes, and broader implications.

Implementation Tips

- Introduce GreenComp areas explicitly before or during the CBL process.
- Encourage students to use sustainability lenses (e.g., ecological, social, economic) during group work.
- Use reflection journals, stakeholder role-play, or sustainability rubrics to deepen impact.

Conclusion: Aligning CBL with GreenComp helps students not only to develop vocational and cognitive skills but also the transformative competences needed for a sustainable future.

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Example of a roadmap for investigating a sustainability problem		
GreenComp competence		**Description**
VALUING SUSTAINABILITY	EMBRACING COMPLEXITY	STEP 1: PROBLEM EXPLORATION What is the problem? • What damage is occurring (on social, ecological... level)? • Who are the actors involved: companies, citizens, government, nature?

		STEP 2: DELINEATION AND ANALYSIS
		• What components make the problem complex?
		  ○ Ecological impact (carbon emissions, biodiversity...)
		  ○ Social impact (labour conditions, health...)
		  ○ Economic impact (costs, benefits, conflicts of interest...)
		• What are the root causes and effects (direct and indirect)?

	ENVISIONING SUSTAINABLE FUTURES	STEP 3: EXPLORE SCENARIOS OR POSSIBLE SOLUTIONS • What are the possible solutions? • What are their advantages and disadvantages? • Who wins and who loses in each scenario?
	ACTING FOR SUSTAINABILITY	STEP 4: CHOICE & JUSTIFICATION • Choose one or more solutions and substantiate why this is the best option. Consider feasibility, support, cost, and effectiveness.
		STEP 5: REFLECTION & EVALUATION • What are the potential risks or limitations of your solution? • Which values does the solution consider? • What should you monitor as you put this into practice?

2.4.7.3 The educator's role in guiding the CBL phases and embedding GreenComp

Educators play a crucial role in guiding the students through the CBL phases. Within the different phases, they must guide the students through the case, facilitating the students in discovering how GreenComp competencies can be found back in cases that are presented to them. In the following paragraphs, we will discuss for each of the previously discussed steps how educators can help learners.

2.4.7.3.1 Step 1 SCBL: Problem exploration

To effectively achieve the outcome of Step 1 — Problem Exploration — teachers can focus on fostering ethical awareness, stakeholder sensitivity, and value clarification, thereby enabling learners to critically examine the normative dimensions of sustainability issues (meaning values, norms, ideals, prescriptions, or standards that guide how people ought to behave) and understand diverse perspectives and thereby supporting the development of the **GreenComp competence "*Embracing Complexity in Sustainability Values*".**

One could use two tools for this problem exploration; the first one is mind mapping. **Mind mapping** has been found to be effective in brainstorming sessions and developing new ideas. It helps users see connections that linear notes sometimes miss. Mind mapping can also help improve memory

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and comprehension. The second tool is **stakeholder** analysis. This sort of analysis leads to better communication and risk identification in projects. Organisations that apply this analysis in a structured way make better-informed decisions and build greater support. Demonstrating how stakeholders can be candidly and thoroughly plotted on a power-interest matrix may impact the future behaviour of learners.

2.4.7.3.2 Step 2 SCBL: Delineation and analysis

To effectively achieve the outcome of Step 2 — Delineation and analysis — teachers can emphasize the development of systems thinking, the application of root cause analysis (see below), and the recognition of interdependencies, thereby enabling learners to understand the structural complexity and dynamic relationships inherent in sustainability challenges (e.g. competing stakeholders: when a factory has to close to protect the environment, employees will lose their job) and thereby supporting the development of the **GreenComp competence Embracing Complexity in Sustainability.**

Tools for Root Cause Analysis

1. **5 Why's Technique**
   - A simple, iterative method where learners ask "Why?" five times (or more) to drill down to the underlying cause of a problem.
   - *Use:* Works well in group discussions or reflection activities.
2. **Fishbone Diagram (Ishikawa Diagram)**
   - Visually maps categories of potential causes contributing to a specific problem.
   - *Use:* Helps structure analysis in complex scenarios (e.g., environmental degradation).
3. **Problem Tree Analysis**
   - Distinguishes between root causes, core problems, and effects, often used in development studies and sustainability planning.
   - *Use:* Encourages holistic understanding and narrative building.
4. **Pareto Analysis (80/20 Rule)**
   - Identifies key causes that account for most of the problem's effects.
   - *Use:* Useful when data is available to prioritise actions.

2.4.7.3.3 Step 3 SCBL: Exploring sustainable scenarios

To effectively achieve the outcome of Step 4 — Exploring scenarios or solution directions — teachers can foster creativity and innovation while guiding learners in evaluating trade-offs, thereby supporting the development of the GreenComp competences ***envisioning sustainable futures and embracing complexity in sustainability*** through critical exploration of alternative pathways and their systemic implications.

Tools for critical exploration of alternative pathways and their systemic implications

1. **SWOT analysis**
   - Analyse Strengths, Weaknesses, Opportunities, Threats (hence SWOT)
   - Useful for assessing solution scenarios within a sustainability context.
   - Use: Encourages balanced, strategic thinking.

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2. **What-if scenarios**
   - Structured collaborative discussions where groups explore future situations based on different decisions.
   - Use: Stimulates long-term thinking and risk analysis.
3. **Backcasting & roadmapping**
   - Learners start from a desired sustainable future and explore multiple solution routes backwards to the present.
   - Use: Helps generate, compare, and refine solution pathways.

2.4.7.3.4 Step 4 SCBL: Choice and justification

To effectively achieve the outcome of Step 5 — Choice and justification — teachers can foster critical decision-making, ethical justification, and responsible action, thereby supporting the development of the GreenComp competences ***Acting for sustainability*** **and** ***embodying sustainability values*** by encouraging learners to make well-reasoned, value-driven choices aligned with sustainability principles.

Tools for critical decision-making, ethical justification, and responsible action

1. **Pros and cons grid**
   - Learners assess the advantages and disadvantages of each option from multiple stakeholder perspectives (with Stakeholder Lens).
   - Use: Supports inclusive and empathetic decision-making.
2. **Values clarification exercises**
   - Learners identify and rank personal, social, and environmental values influencing their choices.
   - Use: Builds self-awareness and moral grounding.
3. **Dilemma discussions or socratic seminars**
   - Structured dialogues around ethically complex sustainability scenarios (e.g., equity vs efficiency).
   - Use: Enhances ethical literacy and dialogue skills.
4. **Action planning templates**
   - Guides learners to justify their chosen solution and outline concrete, responsible steps to implement it.
   - Use: Supports goal alignment with sustainable outcomes.
5. **Sustainability impact assessment (Mini version)**
   - A simplified evaluation of potential environmental, social, and economic consequences of the chosen action.
   - Use: Promotes systems awareness and responsibility.
6. **Justification posters or presentations**
   - Learners publicly present and defend their chosen solution using evidence, ethical principles, and system impacts.
   - Use: Encourages accountability and persuasive communication.

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2.4.7.3.5 Step 5 SCBL: Reflection & Evaluation

To effectively achieve the outcome of Step 5 - Reflection and Evaluation - educators can focus on cultivating metacognition, personal and social responsibility, and a lifelong learning mindset, thereby supporting the holistic development of ***all GreenComp*** competences by enabling learners to critically assess their thinking, actions, and growth within the context of sustainability learning. In this manner, learners will be able to advocate for sustainability after their courses.

Tools for reflection on the case

1. **Sustainability footprint reflection**
   - Learners reflect on how their choices or project outcomes impact ecological, social, and economic systems.
   - Use: Links personal action to systemic impact.

Tools for reflection on the learning process

2. **Reflective journals or learning logs**
   - Learners regularly write about what they learned, how they learned it, and how their thinking evolved.
   - Use: Supports awareness of learning processes and conceptual shifts.
3. **Thinking routines (e.g., "I used to think... Now I think...")**
   - Promotes comparison of pre- and post-learning understanding.
   - Use: Encourages cognitive flexibility and growth recognition.
4. **Self-assessment rubrics (Aligned to GreenComp)**
   - Learners assess their progress across specific competences, e.g., systems thinking, stakeholder awareness.
   - Use: Fosters ownership of learning.
5. **Peer review and feedback sessions**
   - Structured peer feedback on contribution, teamwork, and sustainability reasoning.
   - Use: Encourages accountability and collaborative reflection.
6. **Learning portfolio or sustainability passport**
   - A collection of artefacts, reflections, and competences developed over time.
   - Use: Reinforces continuity and depth in learning.
7. **Goal setting for future action**
   - Learners identify how they will apply their insights beyond the classroom.
   - Use: Bridges school learning with real-world commitment.

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Example: Roadmap applied to phone cases, inspired by PELA (www.pelacase.com)

Step 1: Problem exploration

A **mind map** focusing on "what is the problem?" could include the following aspects:
Most phone cases are made of plastic, often based on fossil fuels, which contributes to environmental pollution (especially plastic waste in oceans), resource depletion, and carbon emissions during production and transport. Thus, organisations are encouraged to choose more sustainable options. Meanwhile, plastic is not always easy to replace with an alternative, as it has certain qualities (lightweight, impact-resistant, inexpensive, water-resistant, no interference with wireless charging or signal reception…) that other materials lack. On top of that, many consumers choose the cheapest option rather than the most sustainable one. This is not an exhaustive list: try to find as many aspects of the problem as are relevant.

A **stakeholder analysis** could result in an overview of stakeholders, such as:
Consumers, competitors, phone manufacturers, environmental NGOs, plastic industry, governments, suppliers, neighbours of the phone case company... All stakeholders should be considered when looking for solutions: how are they impacted by changes?

Step 2: Delineation and analysis

Applying the 5 Whys technique, this exercise could look like the following:

Plastic phone cases are not sustainable.
Why? Because they pollute the environment.
Why? Because they create microplastics, which are ingested accidentally by animals.
Why? Because they end up in nature, where they are exposed to the elements.
Why? Because they are thrown away rather than collected for reuse or recycling.
Why? Because plastic phone cases are seen as cheap, discardable products by many people.

Step 3: Scenarios or possible solutions

An example of some "what if" scenarios:

- What if the phone case manufacturer collected phone cases for recycling after use? Although it takes a lot of effort and investments (where/how will the cases be collected, how can the cases be recycled), a smaller number of phone cases could end up in landfill, and used phone cases could be reused or recycled.
- What if the manufacturer chose a more sustainable alternative rather than plastic, for example, plant-based materials? This could increase the price, but also the reputation of the brand. Maybe there are financial rewards for manufacturers who choose sustainable materials?
- What if governments raised taxes on plastic? Then many products would suddenly become more expensive, but this would encourage consumers and manufacturers to look for more sustainable options.

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- What if the phone case company offered phone cases as a service rather than selling the product? Then consumers could rent a phone case, swap it for a new one when it is out of fashion, after which the phone case can be rented by someone else. As customers must always return the product to the company, this could lead to more control over what happens to discarded products.

Step 4: Choose and justify

PELA chose to use plant-based materials (https://pelacase.com/pages/our-materials), creating a biodegradable product. Their strategy combines product innovation (sustainable materials) with storytelling and marketing aimed at raising awareness to increase consumers' willingness to choose the sustainable option.

Step 5: Reflection and evaluation

- **Environmental impact**: By using renewable plant-based materials rather than plastic, the environmental impact will be lower than when using plastic. Pela communicates on their website about their carbon emissions, water usage and waste production (https://pelacase.com/pages/our-footprint). In their story, they also spread awareness on sustainability and the environment, encouraging the wider public to choose sustainability.
- **Social impact**: Part of their manufacturing takes place in China, although more than 80% of their cases are manufactured in Canada (https://pelacase.com/pages/our-manufacturing).
- **Economic impact**: while their product might not be the cheapest, they communicate clearly about the value of *sustainable* phone cases.

Things to keep in mind:

- **Limitations**: Larger-scale production may be more expensive.
- **Risks**: Other brands claiming to be sustainable without proof.
- **Monitoring needed**: Consumer behaviour, degradability in real conditions, origin of materials.

These steps could be incorporated into an individual or group assignment. One could ask students to analyse a similar case or have them come up with a sustainable alternative to an everyday product/service/process using this roadmap, followed by reflection on the learning process.

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ASSIGNMENT SHEET

Below, one can find an example of an assignment sheet that is useful in guiding the process. Obviously, one must adapt this to the chosen case.

Learning objectives:

- You will learn how to analyse a sustainability problem.
- You will discover how companies develop sustainable solutions.
- You will practice applying systemic thinking to a real case.

1. Problem exploration (10 min)

a. What is the sustainability problem that the organisation wants to address?

b. Name at least 3 stakeholders affected by this. What are their interests?

2. Impact analysis (15 min): Examine various aspects of the problem.

Ecological	
Social	
Economic	

3. Possible solutions (10 min): compare three possible solutions: what would happen?

Scenario	Advantages	Disadvantages

4. Advice & Reflection (10 min)

a. Which solution(s) would you advise? Why?

b. Do you think this model could be applied to other products? Give an example.

c. As a consumer, what could you do to improve the situation?

Sources & further reading

- https://sdgs.un.org/goals
- Documentary tip: Plastic Planet or The Story of Stuff

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Assessment (suggestion for teachers)

Component	Grade (0-5)
Understanding the problem	
Quality of analysis	
Creativity of the solution(s)	
Reflection & engagement	
Presentation	

Case-Based Learning Evaluation Rubric (GreenComp Framework) suggestion for teachers

A **rubric** is an assessment tool used to evaluate the quality of a student's performance, product, or task. It outlines specific criteria and describes different performance levels, so both teachers and learners understand what is expected. This rubric is designed to help evaluate student performance during a Case-Based Learning activity using selected competencies from the GreenComp sustainability framework. It can be used by the teacher or for self/peer assessment.

Evaluation Rubric:

GreenComp Competence	1 - Basic	2 - Emerging	3 - Proficient	4 - Advanced
Systems Thinking	Identifies isolated parts without seeing interconnections.	Recognises some relationships between parts of a system.	Describes how components interact and affect outcomes.	Analyse system feedback loops and long-term consequences.
Exploratory Thinking	Struggles to suggest new ideas.	Proposes basic or conventional ideas.	Suggests creative and plausible alternatives.	Proposes innovative, bold, and well-justified ideas.
Responsibility	Limited awareness of consequences or ethical aspects.	Recognises some environmental or social impacts.	Balances outcomes with ethical and environmental concerns.	Advocates and justifies ethically grounded, sustainable choices.
Collective Action	Limited participation in team tasks.	Contributes occasionally but with limited collaboration.	Actively collaborates and supports team outcomes.	Demonstrates leadership and promotes inclusive participation.

Teacher Comments

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2.5 Integrating Life Cycle Thinking into Case-Based Pedagogy for Sustainability Education

Summary: A Life Cycle Analysis (LCA) looks at the environmental impact of a product or service during its entire life cycle, from raw material extraction to disposal or recycling. It helps learners understand that sustainability is about long-term effects, not only what happens during use. Combining LCA with Case-Based Learning (CBL) supports systems thinking and evidence-based decision-making. In CBL, students work on real-world cases that show environmental, social, and economic trade-offs. Using LCA in cases makes sustainability data practical and meaningful for students.

An LCA usually has four main steps: defining the goal and scope, collecting data on inputs and outputs, assessing environmental impacts, and interpreting the results. Through clear examples, such as plastic water bottles, students can analyse energy use, emissions, waste, and health effects. LCA often shows that the biggest impact happens during raw material extraction and production. Recycling reduces impacts, but reducing disposable products has an even bigger effect. Teaching LCA helps students make informed and responsible choices in their daily and professional lives.

This section is inspired by:

Baumann, H., & Tillman, A. (2004). *The hitch hiker's guide to LCA: An orientation in life cycle assessment methodology and application*. Studentlitteratur.

Horne, R., Grant, T., & Verghese, K. (2009). *Life cycle assessment: Principles, practice, and prospects*. CSIRO Publishing.

2.5.1 What is a Life Cycle Analysis?

Sustainability is not only about how a product or service performs here and now, but also about its full journey. In its essence, sustainability is about the long term. Life cycle assessment (LCA) is a methodology that analyses the environmental impact of a product, service or process over its entire life cycle. This means from the extraction of raw materials to the end of the product's life (and sometimes beyond, to reuse or recycling).

As such, the integration of Life Cycle Analysis (LCA) into Case-Based Learning (CBL) offers a pedagogical strategy for developing systems thinking and evidence-based decision-making in sustainability education. Moreover, it is essential for learners to understand the complex nature of sustainability education.

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When embedded within a case-based learning context, LCA serves not only as a technical tool but could also be a foundational point for critical inquiry and applied problem-solving. CBL provides learners with real-world, often multidisciplinary scenarios that mirror the complexity of professional practice. These scenarios encourage students to explore the environmental, social, and economic trade-offs revealed by LCA, fostering a holistic understanding of sustainability challenges. By requiring learners to interpret quantitative data and apply it to practical decisions, CBL reinforces the analytical rigour of LCA while making its relevance tangible. For example, in cases such as the circular school "De Verwondering," students can assess the environmental performance of biobased materials versus conventional alternatives, analyse life cycle carbon footprints, and reflect on long-term impacts of design choices that were made. Thus, the use of LCA within CBL contexts enhances students' ability to make informed, responsible, and context-sensitive decisions in different fields.

This analysis is based on general principles of life cycle assessment and case-based learning, combined with sustainability objectives as outlined by.

2.5.2 Main steps of LCA

2.5.2.1 Step 1: Goal and Scope Definition

- What do you want to achieve with the LCA? Which processes, product phases and environmental impacts will be analysed?
- Defining the system boundaries: from raw material extraction to product use and disposal.

2.5.2.2 Step 2: Inventory analysis (Life Cycle Inventory, LCI)

- In this step, data is collected on all inputs (raw materials, energy) and outputs (emissions, waste) of each stage in the product life cycle.
- This can cover, for example, the use of energy in the production, transport, use and disposal of the product.

2.5.2.3 Step 3: Life cycle impact assessment (LCIA)

- In this step, the data collected are analysed to understand what environmental impacts they cause (such as climate change, resource depletion, air or water pollution).
- Different impact categories are assessed, such as greenhouse effect, ozone depletion, toxicity and so on.

2.5.2.4 Step 4: Interpretation

- This final step analyses the results, draws conclusions, and identifies possible areas for improvement. This can lead to recommendations for improving the product's environmental performance.

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2.5.3 Example: Life Cycle Analysis (LCA) applied to plastic water bottles

2.5.3.1 Step 1: Define the Purpose and Scope of the LCA

- Purpose: To understand the environmental impact of a plastic water bottle to make better-informed choices about consumption and recycling.
- Scope: We will examine the plastic water bottle from production to disposal (e.g. discarding or recycling the bottle).

2.5.3.2 Step 2: Plastic water bottle life cycle stages

A plastic water bottle has several stages in its life cycle:

- **Raw material extraction:** Plastic is usually made from petroleum or natural gas. The extraction of these raw materials has environmental impacts such as greenhouse gas emissions and energy consumption.
- **Manufacturing:** The plastic is processed into a water bottle. This process requires energy, water and auxiliary materials. CO2 emissions are also emitted during production.
- **Transport:** After the bottles are produced, they must be transported to shops or distribution centres. This process consumes fuel (usually via trucks) and produces greenhouse gas emissions.
- **Use: T**he water bottle is bought and used by consumers. This is the shortest phase, but it is also important as it usually requires energy or water to fill or store the product.
- **End of Life:** The bottle is discarded after use. This can be done in several ways:
  - Recycling: The bottle is collected and reused, which has less impact than incineration or landfill.
  - Incineration or landfill: The bottle may also end up in the trash and end up in a landfill or be incinerated, resulting in emissions and waste.

2.5.3.3 Step 3: Inventory analysis (Life Cycle Inventory)

We collect the inputs (raw materials, energy, water) and outputs (emissions, waste)

- **Raw materials:** 1 plastic water bottle (500 ml) consists mainly of polyethene terephthalate (PET), a type of plastic made from oil or natural gas. Extraction of oil or gas is energy-intensive and causes CO2 emissions.
- **Manufacturing**: The manufacturing process of plastic bottles requires electricity (for example, to melt the plastic granules and mould them into bottle shapes). Emissions of carbon dioxide (CO2) and wastewater occur during this process.
- **Transport**: The bottles must be transported from the factory to the shops. This can be done via trucks or ships, which involves fuel and thus CO2 emissions.
- **Use**: Water is usually chilled in the fridge or stored in other ways, which consumes energy.
- End-of-life:
  - Recycling: If the bottle is recycled, the material is reused, requiring fewer resources, but there are still energy and costs involved.
  - Landfill or incineration: When landfilled, plastic can end up in a landfill, where it slowly degrades and potentially releases pollutants into the soil or air. Incineration releases CO2 into the atmosphere.

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2.5.3.4 Step 4: Impact assessment (Life Cycle Impact Assessment)

We analyse the environmental impact of the plastic water bottle in different categories.

- **Climate change**: The production of oil, the manufacture of the bottle, transport and landfill or incineration all contribute to the emission of CO2 and other greenhouse gases. This affects global warming.
- **Water consumption**: A lot of water is needed to produce and process the plastic
- **Waste**: If the bottle is not recycled, it contributes to plastic pollution in nature or landfills. This can cause damage to ecosystems.
- **Health**: Burning plastic can release toxic substances, such as dioxins, which are harmful to humans and animals.

2.5.3.5 Step 5: Interpreting the results

The LCA often shows that the biggest impact occurs during raw material extraction and bottle production. Recycling can make an important contribution to reducing environmental impact, but even better would be to reduce the use of disposable bottles by using reusable bottles. Some conclusions that students could draw:

- Plastic water bottles have a significant environmental impact in terms of CO2 emissions, water consumption and waste generation.
- Recycling helps, but it would be best to use reusable bottles to minimise environmental impact.
- Sustainability awareness plays a big role: by making small choices, such as avoiding disposable plastic, we can significantly reduce the environmental impact of our daily lives

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2.6 Integrating material flow thinking into case-based pedagogy for sustainability education

Summary: MFA is a powerful method to analyse the flow of materials within a system, from the extraction of raw materials to the end of a product's life cycle. It helps identify inefficiencies and provides opportunities for sustainable materials management, recycling and reducing the environmental impact of products. For example, it can be applied to analyse the life cycle of products such as plastic bottles and find ways to minimise their environmental impact.

This section is inspired by:

Brunner, P. H., & Rechberger, H. (2016). *Handbook of material flow analysis: For environmental, resource, and waste engineers* (2nd ed.). CRC Press.

2.6.1 What is a Material Flow Analysis?

While LCA is excellent for looking at the time aspect of sustainability, Material flow analysis (MFA) looks at the width of sustainability. MFA is a systematic assessment tool used to quantify the flows and stocks of materials within a defined system—be it a city, industry, product system, or national economy. It helps identify inefficiencies, waste streams, and opportunities for resource optimisation. **Case-based learning (CBL)**, on the other hand, is a pedagogical method that uses real-world cases to stimulate critical thinking, collaborative problem-solving, and interdisciplinary learning.

The link between MFA and CBL lies in their shared emphasis on **systems thinking** and **evidence-based analysis**. When students engage with a case involving material use (such as urban resource management, construction waste, or product life cycles), MFA provides the **quantitative backbone** for analysing how materials move through the system. Integrating MFA into a CBL context allows students to not only understand the technical aspects of resource flows but also apply that knowledge in realistic, context-sensitive decisions.

For example, a case about circular building design might involve using MFA to assess how materials enter, are stored, and exit the construction process. Through this, students learn to identify potential points for intervention—such as reuse, recycling, or substitution. CBL makes the analysis **practical and situational**, turning MFA from an abstract tool into a driver of innovation and sustainability-oriented decision-making.

In sum, combining MFA with CBL enhances students' ability to connect data with design, diagnose systemic problems, and develop actionable, sustainable solutions across disciplines such as urban planning, engineering, and environmental management.

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2.6.2 Example: Material Flow Analysis applied to plastic water bottles

1. **Purpose:** The goal is to analyse the materials flow of a plastic water bottle from the production of the plastic to the end of its life cycle.
2. **Raw materials**: The bottle is made of a certain amount of PET (polyethylene terephthalate). PET is produced from petroleum.
3. **Production**: In factories, the plastic is converted into bottles. This conversion requires energy (electricity), and there is waste that is not used in the bottle form.
4. **Transportation:** The bottles are transported from the factory to the stores by truck or ship. During the transport, CO2 is released from fuel combustion.
5. **Usage**: Consumers fill the bottles with water and use them. There is no loss of material in this phase, but there may be water consumption in rinsing it before reuse.
6. **End of life**: When the bottle is no longer needed, it can end up in the trash. If it is recycled, the PET material can be reused to make new bottles or products. However, if it is not recycled, it may end up in a landfill or be incinerated, causing pollution (microplastics or air pollution).

MFA analysis would quantify how much PET is used to produce the bottle, how much of it is lost as production waste, how much CO2 is released by transportation and how much of the material is eventually recycled, or how much plastic waste ends up in a landfill.

2.6.3 Case: Reducing Medical Waste in a Hospital Setting

This section was inspired by:

Ivanović, T., Meisel, H.-J., Som, C., & Nowack, B. (2022). Material flow analysis of single-use plastics in healthcare: A case study of a surgical hospital in Germany. *Resources, Conservation and Recycling*, *185*, 106425. https://doi.org/10.1016/j.resconrec.2022.106425

Students are presented with a case in which a mid-sized hospital is facing increasing waste disposal costs and environmental criticism due to high levels of single-use plastics, pharmaceuticals, and packaging waste. Hospital administrators are seeking a sustainability strategy that balances environmental impact, safety regulations, and operational efficiency.

Case Question: How can the hospital reduce its environmental footprint while maintaining high-quality patient care and complying with hygiene standards?

As part of the case, students are asked to **conduct or interpret a simplified MFA** of material flows within the hospital system. For example:

- Inputs: gloves, syringes, IV bags, medications, PPE, cleaning agents
- Stocks: inventory storage, on-site pharmacy, medical supply rooms
- Outputs: hazardous waste, plastic packaging, pharmaceutical residues, general waste

Using this data, students analyse:

- Where the most material is used (e.g., surgical departments, emergency room)
- Where the most waste is generated (e.g., single-use items in intensive care units)
- Opportunities for substitution, reuse, or better segregation (e.g., reusable gowns, closed-loop recycling of PPE)

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By combining MFA with the case study, students learn to:

- Apply systems thinking to complex healthcare environments
- Quantify and interpret material flows in a real-world context
- Evaluate trade-offs between sustainability, cost, and patient safety
- Develop data-informed, realistic interventions (e.g., switching to reusable sterilisation trays or improving waste separation protocols)
- MFA provides the analytical structure, helping students understand the scale and distribution of resource use. CBL provides the human and institutional context, challenging them to navigate ethical, regulatory, and practical constraints. The integration empowers students to create feasible, systems-based solutions in a critical real-world sector.

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2.7 Whole-institution approach

Summary: Real change towards sustainability needs a whole-institution approach, not only individual tools like LCA or MFA. A Whole Institution Approach means integrating sustainability into all parts of the organisation, such as teaching, campus operations, management, and community partnerships. When sustainability is visible everywhere in the institution, students are more likely to develop a sustainable mindset and use it in their future jobs. This approach can also be used for other themes, like digitalisation or internationalisation, but it is especially effective for sustainability education. Sustainability should be included in all subjects and developed by teams of teachers, using collaboration and small, practical steps. The campus itself can act as a "living lab", where students work on real sustainability projects. Leadership support, clear strategies, and active engagement of students and staff are essential for success.

This section was inspired by:

Duurzaam Educatiepunt. (n.d.). Whole Institution Approach: de hogeschool als 'change agent'. https://rise.articulate.com/share/9r3e93vjA5jvv2CIOv_U8LCttlTSYII4

D'Andrea, V., & Gosling, D. (2005). *Improving teaching and learning in higher education: A whole institute approach*. McGraw-Hill Education.

Rieckmann et al. (2017). *Education for sustainable development goals: Learning objectives*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000247444

Wals, A. E. J., Bjønness, B., Sinnes, A., & Eikeland, I. (Eds.). (2024). *Whole school approaches to sustainability: Education renewal in times of distress*. Springer. https://doi.org/10.1007/978-3-031-56172-6

2.7.1 What is a whole-institution approach?

Not only are time (LCA) and width (MFA) important, but real change also requires a **broad, integrated and holistic approach**. This is exactly what the **Whole-institution approach** stands for: embedding sustainability in all aspects of the organisation, including infrastructure, energy, social services, catering, material use, transport, participation, diversity, education, and research**.** When sustainability is embedded in the entire college experience, students are more likely to adopt and apply these principles in their own careers.

The whole institution's approach is not limited to the topic of sustainability; it can also focus on areas like digitalisation, internationalisation, multilingualism, or industry collaboration. However, when sustainability is the central theme, it ensures a ***consistent and coherent sustainability narrative*** throughout the institution.

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A **whole institution approach (WIA)** is, like LCA and MFA, highly useful for effective sustainability education**.** While individual educators can promote sustainability, their impact is limited if the broader institution does not reinforce these principles. A fragmented approach makes it difficult for students to fully embrace sustainability in their future roles. A Whole Institution Approach ensures that sustainability is not just addressed in isolated courses or projects but becomes a core principle throughout the institution.

When sustainability is embedded in all aspects of the institution, students gain not only knowledge but also a **sustainable mindset and skill set**. They see sustainability in action and experience how it is an integral part of professional and societal responsibility. This increases the likelihood that they will apply these principles in their own future careers.

> "**ESD is not only about teaching** sustainable development and adding new content to courses. Schools and universities should [...] orient all their processes towards principles of sustainability. For ESD to be more effective, the **educational institution as a whole has to be transformed**. Such a whole-institution approach [...] involves rethinking the curriculum, campus operations, organisational culture, student participation, leadership and management, community relationships and research. In this way, the **institution itself functions as a role model** for the learners."
>
> (Rieckmann et al., 2017, p. 53)

2.7.2 How can the whole institution approach be implemented?

A **whole-institution approach (WIA)** integrates sustainability into all aspects of an educational institution, ensuring it is not just taught in classrooms but also reflected in campus operations, governance, community engagement, and institutional culture. This holistic approach helps students and staff develop sustainability competences in a way that extends beyond theory and into practice.

2.7.2.1 Step 1: Teaching and learning

The first step, maybe the most obvious one, is to embed sustainability into teaching and learning. Rather than limiting sustainability education to environmental science courses, institutions should integrate it across all disciplines/vocations, ensuring that students in all fields develop sustainability-related skills and knowledge. Using frameworks like GreenComp, educators can together design curricula that foster systems thinking, collaboration, and problem-solving in various courses. Real-world learning opportunities, such as project-based learning and interdisciplinary collaborations, can help students engage actively with sustainability challenges. If one is looking for examples of how one can (re-)design one's curriculum to include the transversal GreenComp competences, please have a look at the GreenComp modules in the Digital Hub. Moreover, if one needs more help with this, have a look at Pedagogical approaches.

It is important to mention that such a curriculum should be developed by a team of educators. This may not be easy, given the fact that some colleagues will see little benefit in incorporating this topic. Moreover, some educators may state that their course or field leaves little opportunity to add GreenComp competences to their courses. To include these educators, it may be recommended to convince them with one of the following methods:

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1. **A Collaborative Vision Session**

Invite teachers from different subjects to a short workshop where they will explore:

- What does *sustainability* mean for your school, program or field of profession?
- Which values and competences should students develop?
- What sustainability issues feel most relevant (local environment, waste, energy, justice, food systems…)?

This helps to create a shared language, a joint purpose and a sense of collective ownership

2. **Form a Cross-Disciplinary Working Group**

Instead of one teacher doing everything, create a small team with representatives from the different subjects (e.g. science, languages, economics, technology, crafts, etc.). Each subject brings a unique lens, which makes the curriculum richer and avoids "sustainability = only science or technology".

3. **Host Co-Creation Workshops**

Co-creation workshops are useful in the sense that they involve multiple parties in the curriculum design process. In these processes, one can use simple collaborative methods like brainwriting (teachers write ideas silently, then share), Design thinking sessions, Curriculum mapping (identify overlaps and gaps across subjects) and Project-based learning planning. These sessions make development more democratic and fun.

4. **Integrate Sustainability into existing classes**

Another way to improve the participation of educators is to look for quick wins that are easily implemented. This is a good strategy, as a lot of educators can feel discouraged from participating due to the prospect of additional work. Therefore, one can ask each educator:

- *"What part of your course already touches sustainability?"*
- *"Where could you naturally add a small sustainability element without extra workload?"*

Examples:

- A math teacher uses real energy or water data in exercises.
- A language teacher analyses speeches about climate.
- A physical education teacher teaches outdoor ethics and nature-friendly outdoor activities.

This shows sustainability is **not necessarily extra work**, but a dimension that enriches what already exists.

5. **Offer Peer Learning & Professional Development**

Another way to respond to the fear of too much workload is to help them. Teachers are more willing to join if they feel supported. One can, for example, provide: Guest speakers or short training, examples of good practice, opportunities to visit other schools or join networks, and shared resource banks. People collaborate more when they feel skilled and confident.

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2.7.2.2 Step 2: The campus as a living lab

Beyond the classroom, campus operations play a vital role in demonstrating sustainability in action. Institutions can reduce their environmental footprint by improving energy efficiency, managing waste more effectively, and adopting sustainable procurement practices. A “living lab” approach can further enhance learning, allowing students to work on practical sustainability projects within their own campus—such as developing green spaces, monitoring energy use, or designing innovative waste reduction strategies.

2.7.2.3 Step 3: Sustainable strategic plans

Sustainability also needs to be supported at the governance and leadership level. Institutional leaders should integrate sustainability into strategic plans, ensuring it is a core priority rather than an add-on initiative. Appointing sustainability coordinators or committees can help oversee and drive these efforts. Setting measurable goals and regularly tracking progress ensures accountability and long-term commitment.

2.7.2.4 Step 4: Student and staff engagement

Student and staff engagement is essential for creating a culture of sustainability. Encouraging student-led initiatives, such as environmental clubs and sustainability campaigns, empowers students to take an active role. Staff training and professional development opportunities -such as our Digital Hub- can help teachers integrate sustainability into their teaching, ensuring that they feel confident and equipped to engage with these topics. Events, challenges, and incentives can also reinforce a sustainability mindset throughout the institution.

2.7.2.5 Step 5: Community partnerships

Finally, a Whole Institution Approach extends beyond the campus by fostering community partnerships. Collaborations with local businesses, NGOs, public institutions, and policymakers allow institutions to work on real-world sustainability challenges and contribute to broader societal change. Service-learning opportunities, where students apply their skills to sustainability projects in their communities, strengthen the connection between education and action.

By embedding sustainability across teaching, operations, governance, and engagement, students not only learn about sustainability, but they can also see how it should be done in real-life situations. This helps them understand the interconnectedness of various aspects of sustainability and how it can be integrated into everyday practices. They experience sustainability first-hand and are empowered to make a meaningful impact in their future careers and communities.

The teacher may wonder how one can advocate for such an approach within their institution. One way is to push for a whole-institution approach, which integrates sustainability into all aspects of the school's operations, governance, and curriculum. This can be a challenging process, but it is crucial for creating a sustainable learning environment. A good first step is to discuss this vision with your school's leadership and gather support for embedding sustainability more deeply into your teaching and institutional practices. Starting these conversations with school leaders can lead to a broader, more cohesive effort, aligning your teaching with the school's sustainability goals.

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3 How to evaluate sustainability competences

Summary: Evaluating sustainability competences is different from traditional assessment because there is often no single correct answer. Assessment should focus not only on the result but also on the learning process, such as collaboration, reflection, and problem-solving. Teachers should choose evaluation methods that support key sustainability competences like systems thinking, valuing nature, and teamwork. Tools such as portfolios, self-reflections, and peer assessments help students show their learning over time. Rubrics are useful to make expectations clear, give structured feedback, and assess competencies in a fair way. Involving students in assessment increases their responsibility and engagement with sustainability topics.

Both formative and summative evaluation methods are important in sustainability education. Formative assessments support learning during the process through feedback, reflection, and discussion. Summative assessments measure learning outcomes at the end of a course or project. Process evaluation helps teachers understand how learning happens and how teaching can be improved.

This section was inspired by:

Caeiro, S., Leal Filho, W., Jabbour, C., & Azeiteiro, U. M. (Eds.). (2013). *Sustainability assessment tools in higher education institutions: Mapping trends and good practices around the world*. Springer International Publishing. https://doi.org/10.1007/978-3-319-02375-5

KU Leuven Learning Lab. (2024). *Procesevaluatie*. KU Leuven. https://www.kuleuven.be/onderwijs/learninglab/ondersteuning/evaluatie-feedback/evaluatie/procesevaluatie

White, R. M., Kemp, S., Price, E. A. C., & Longhurst, J. W. S. (Eds.). (2025). *Perspectives and practices of education for sustainable development: A critical guide for higher education*. Routledge. https://doi.org/10.4324/9781003451563

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3.1 Rethinking assessment for sustainability learning

Teachers may wonder how these competences can be evaluated. It is important to remember that evaluating sustainability competences is different from traditional assessments. Sustainability challenges **do not have one "correct" answer as the focus is not merely knowledge, but also values, attitudes and behaviour.** That is why, instead of focusing only on the outcome, the assessment should also **focus on the process:** how students approach problems, collaborate, and reflect on their learning.

To guide your evaluation process, it is essential to think about how the assessment can foster not just knowledge, but also the **development of key competences for sustainability,** like valuing nature, systems thinking, and collaboration. The challenge lies in choosing evaluation methods that align with these broader goals. Instead of simply focusing on a final product or answer, consider how the steps students take along the way might be assessed: how they interact with others, how they reflect on their learning, and how they apply their knowledge to real-world situations.

While there are specific methods to **track progress**—such as portfolios, peer assessments, or self-reflections—the key is selecting the right approach based on the competences one aims to develop, while also considering the specific skill level of the students. For example, **portfolios** can serve as a comprehensive tool, where students track their own progress through reflections, project reports, or examples of problem-solving. When selecting an evaluation tool, it is helpful to clarify the key competences you are targeting and choose methods that allow for the most meaningful assessment of these competences.

Rubrics are a powerful tool to make feedback clear and objective. They allow for outlining specific levels of achievement for key competences, helping educators to assess the development of skills. Additionally, rubrics can be developed collaboratively with students, which fosters a sense of ownership over the learning process.

Involving students in the evaluation process can also be transformative. Through **peer assessment, self-assessment, or feedback from external professionals**, students can gain insights into their own learning. The act of reflecting on their own progress or receiving feedback from others not only reinforces the learning process but also strengthens their sense of responsibility and engagement with sustainability issues.

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3.2 Formative and summative evaluation methods

Understanding summative vs formative evaluation methods is essential for any teacher and educator, especially in a field like sustainability, where reflection and adaptation are key to long-term impact.

Formative evaluation methods monitor student learning and provide ongoing feedback that can be used to **improve teaching and learning throughout the process**. It is flexible and informal, and for this reason, the evaluation results are hard to express in a numerical grade. As formative assessments help students identify strengths and areas for improvement, they encourage a growth mindset aimed at the development of the learner and student engagement. For teachers or educators, it provides feedback on how to improve or adjust instructions as needed. Some examples of formative evaluation methods are:

- Reflection journals
- Peer reviews during a project
- In-class (group) discussions
- Informal quizzes in class introducing a new topic (not to grade)
- Concept maps

Summative evaluation methods aim to **evaluate student learning at the end of a certain course** or unit by comparing the learning progress of the learner against a standard or benchmark. These are structured and formal evaluation methods where students receive a grade indicating how well they scored. They provide accountability and measure learning outcomes. Some examples of summative evaluation methods are:

- Written tests or exams
- Group presentation at the end of a project
- Quizzes to measure how much students have learned after finishing the course.

Effective sustainability education combines both evaluation methods. On one hand, educators can use formative assessments to evaluate critical thinking, collaborative learning, and systems thinking as students explore complex sustainability challenges. On the other hand, summative assessments can be used to validate that students can synthesise and apply what they have learned in real-world contexts. And as a bonus, since sustainability is about long-term thinking and impact, integrating reflective formative assessments (e.g., self-assessments or learning diaries) helps students become more mindful of their own ecological and social choices, aligning well with the goals of transformative education.

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3.3 Process evaluation

Process evaluation helps assess how effectively sustainability education is being implemented and whether it is fostering the intended competencies in students. Unlike outcome evaluations that focus on the end results (product evaluation), a process evaluation examines how the learning experience unfolds. This allows educators to identify strengths, challenges, and opportunities for improvement in their learners.

The first step is to **define the purpose and scope** of the evaluation. As a teacher, one should determine **which aspects of sustainability competences they want to assess**, such as students' understanding of sustainability concepts, their ability to apply systems thinking, or their engagement in interdisciplinary collaboration...

The second step is to choose an evaluation method, depending on the learning process chosen by the educator. For this, educators can use a combination of qualitative and quantitative methods. Some examples:

e) **Surveys and questionnaires** can be used to measure students' perceptions of their learning experience, their level of engagement, and their confidence in applying sustainability concepts.
e) **Classroom observations, teacher reflections and peer reviews** provide insights into student participation and interactions.
e) **Student portfolios and self-assessments** allow learners to track their own progress over time.
e) **Focus groups and interviews** with students and teachers can reveal deeper insights into the effectiveness of sustainability education and any obstacles that may be hindering its success.
e) **Case studies and project reviews** help assess how well students apply their competences in real-world problem-solving situations.

Once data is collected, the next step is to **analyse the learning process and identify challenges faced by the educator**. This involves examining whether sustainability education is being implemented as planned, assessing the level of student engagement, and determining if interdisciplinary connections are being effectively made. Barriers (external to the student) to learning, such as lack of institutional support, limited resources, or resistance to change, should also be identified and kept in mind for future improvements.

The findings from a process evaluation should be used to **enhance sustainability education continuously**. For example, if students struggle with interdisciplinary teamwork, structured group work strategies could be introduced to improve collaboration. If real-world case studies prove more effective than traditional lectures, teachers could integrate more practical, hands-on learning experiences. Sharing findings with school leadership can also help strengthen institutional support for sustainability initiatives.

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To illustrate how this works in practice…

Consider a sustainability project-based learning course. If surveys reveal that students find the course engaging but struggle with teamwork, and teacher observations show that students grasp theoretical concepts but struggle with practical applications, the teacher can adjust their teaching method. Focus group discussions might highlight that real-world case studies improve understanding, while project reviews could indicate that students need more guidance in developing concrete sustainability solutions. In response, teachers could refine the curriculum by incorporating structured group work activities, increasing the use of case studies, and providing targeted coaching on sustainability problem-solving.

By conducting regular process evaluations, teachers can ensure that sustainability education is **not just delivered but also effective**. A well-structured evaluation process allows for continuous refinement of teaching methods, improving student engagement and deeper learning, in which students understand the problems thoroughly. Ultimately, this helps institutions cultivate sustainability-minded graduates who are equipped to address the complex challenges of both today and those in the future.

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3.4 Evaluation criteria

To help students understand what is expected of them, it is essential to **clearly communicate the evaluation criteria used during process assessments**. Given that process elements can be challenging to articulate and understand, it is important to offer opportunities for feedback. This includes discussing the student's current standing in their learning journey (feedback) and suggesting actions to further enhance their progress (feedforward).

Using clear evaluation criteria helps ensure reliable assessments, especially when students or external parties are involved in the evaluation. Various sources, such as guidance discussions, portfolios, reports, and self-evaluations, can provide a comprehensive view of the student's learning process.

Time investment involves tracking students' progress and mapping out their learning journey. Sharing some responsibility with students by requiring self-evaluations or evidence submissions can help one manage this time investment.

→ Curious for more? Discover the Evaluation tool on the TEACH4SD ESD Academy.

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4 Conclusion

Education for Sustainable Development plays a crucial role in preparing individuals to face the environmental, social, and economic challenges of the modern world. By integrating sustainability into education, learners develop not only knowledge but also the values, skills, and attitudes needed to make responsible decisions for the future. ESD encourages critical thinking, collaboration, and active citizenship, empowering people to contribute to a more just and sustainable society. Moreover, it highlights the interconnectedness of global issues and stresses the importance of long-term thinking. In conclusion, Education for Sustainable Development is essential for creating awareness, fostering responsibility, and inspiring action. Investing in ESD today is an investment in a healthier planet and a better quality of life for future generations. We hope that this handbook has provided the necessary tools to implement sustainability in your own education and to develop the sustainability competences of your learners.

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