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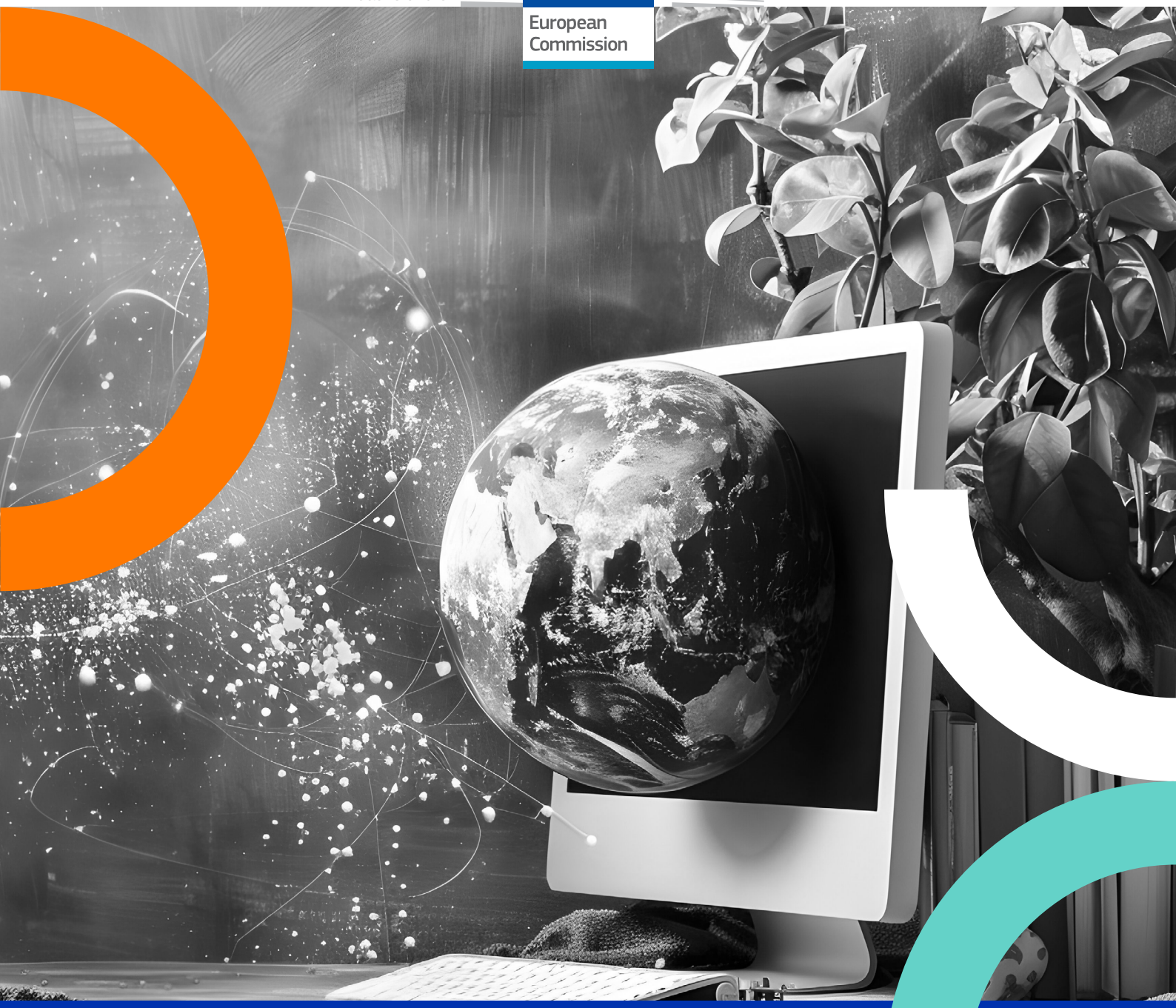

Sustainability in Online Education

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The European Digital Education Hub (EDEH) is an online community for practitioners from all sectors of education and training aiming to contribute to improving digital education in Europe. To achieve this goal, EDEH is not only a place for exchange and discussions but also offers a variety of different events and activities. These activities include the squads that are online working groups where community members can collaborate on a specific topic of digital education. This document is the result of the work of the EDEH squad on diversity, equity and inclusion.

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Introduction

Purpose and scope of the report

The purpose of this investigation is to explore sustainability within digitalisation through a multifaceted lens focusing on two main perspectives in education.

Firstly, this report will provide insights into how the topic of sustainability is incorporated into the curriculum at educational institutions and how it is taught through a broad spectrum of digital education modes, highlighting also good practice examples. From this point of view, the investigation will focus primarily on the pedagogies related to curriculum design and development of learning experiences that engage students in sustainability issues and in a sustainable way. In this framework, incorporation of digital technologies and their sustainability within international education, within blended mobilities (higher education) will also be addressed. Secondly, the report will focus on the administrative aspects of education and the greening of these through the digitisation of key processes. This will include the digitisation of the general administration operations as well as processes related to the internationalisation of higher education.

The report will also address the sustainability impact of using digital technologies to deliver education as well as digitising administrative practices. From this point of view, the focus is primarily on the environmental footprint of using digital technologies, platforms and channels, as well as effective solutions to mitigate it. Practical examples of how to drive sustainability in digital education across both perspectives which can be utilised and adapted by educators across educational institutions, will be highlighted in the annexes of the report.

As a final contribution, the report will provide a "Checklist" that can be used by educators, administrators and other key stakeholders within education to reflect on and incorporate sustainability as a topic in digital education, adopting digital tools and platforms to engage students in sustainability issues, and identifying the environmental impact of digital education channels, platforms and tools.

The need to explore sustainability within digitalisation

In the evolving landscape of education, the intersection of digital education and sustainability represents a critical area of focus. Digital education, characterised by the use of technology to enhance learning, has become indispensable in modern academic environments. The internationalisation of (higher) education further amplifies this, as institutions embrace "blended mobilities" learning environments. These environments integrate physical and digital interactions, fostering international collaboration while adhering to sustainable practices.

Sustainability in this context refers to the responsible use of digital resources in a way that minimises environmental impact whilst maximising educational effectiveness. The need to explore this intersection stems from the growing ecological footprint of digital technologies and the increasing recognition of education's role in fostering a sustainable future. This is particularly evident in the administration of international programmes such as Erasmus+, where initiatives like Erasmus Without Paper showcase the digitisation of higher education administration, reducing paper use and streamlining processes in line with environmental sustainability.

Integrating sustainability into digital education not only aligns with global environmental goals but also prepares students to become conscientious digital citizens. In the context of internationalisation, this preparation is crucial. Blended mobility models and digital administration systems ensure that students can engage in international learning experiences without the associated environmental costs of traditional exchange programmes.

The drive towards sustainable digital practices in education is not just an environmental concern but a comprehensive approach to responsible teaching and learning. As digital platforms become more prevalent in educational settings, their impact on energy consumption and e-waste becomes a pressing issue. The digitisation of HE administration, including the management of international exchange programmes, plays a vital role in addressing these concerns by adopting energy-efficient practices and reducing physical resource dependency. It is imperative that educational institutions adopt strategies that balance technological advancement with ecological prudence. This includes the exploration of energy-efficient digital technologies, the promotion of digital literacy that encompasses sustainability, and the development of digital pedagogies that reflect environmental consciousness. By doing so, education can model sustainable practices for students, who will carry these values into their future professional and personal lives.

Sustainability in digital curriculum design goes beyond the mere inclusion of environmental topics in course content. It involves rethinking how digital tools and resources are utilised to create educational experiences that are both environmentally and socially responsible. This entails leveraging technology to reduce the need for physical resources, adopting virtual platforms that minimise carbon footprints, and fostering a curriculum that encourages critical thinking about the global impact of digital technology. Embedding sustainability into digital education thus serves a dual purpose: it reduces the environmental impact of education itself and equips students with the awareness and skills to address sustainability challenges in a digital age. This rethinking is crucial as we develop curricula for a digitised and internationalised educational landscape, ensuring that students are prepared for a globalised world where sustainability is a key challenge.

The exploration of sustainability within digitalisation in education has broader implications for society as a whole. By championing sustainable digital practices, educational institutions set a precedent for other sectors to follow. This approach encourages a shift in societal attitudes towards technology usage, promoting a more responsible and conscious engagement with digital tools. Furthermore, it contributes to the development of a workforce that is not only technologically adept but also environmentally aware, capable of leading sustainable initiatives in various fields. This is particularly significant in the administration and delivery of international programmes, where sustainability and efficiency are paramount. Thus, the pursuit of sustainability within digital education resonates far beyond the confines of academic institutions, influencing broader societal and environmental well-being.

Sustainability – the case of Higher Education Institutions

Higher Education Institutions are well-placed in most societies to become significant catalysts for change in citizens' behaviors and mindset related to the adoption of more sustainable practices. Increasingly, universities have embraced this opportunity to share knowledge and educate students on key issues related to sustainability and in alignment with the United Nations Sustainable Development Goals and following the Council Recommendation on learning for environmental sustainability, which suggests to "further embed environmental sustainability into programmes, syllabuses and modules, across a range of disciplines, such as business studies, social sciences, architecture and engineering, land use planning and management".

Some universities have set up specific initiatives such as Sustainability Labs, Green Campus Initiatives, Maker Spaces, Research Working Groups, Innovation Accelerators, and funding streams to support "green" start-ups. These are all indications of how themes including "sustainability", "the green transition" and "societal impact" are influencing the design, development and execution of university education and further cementing universities' responsibility to drive equity, positive change and transformation through education, innovation, and the development of new technology.

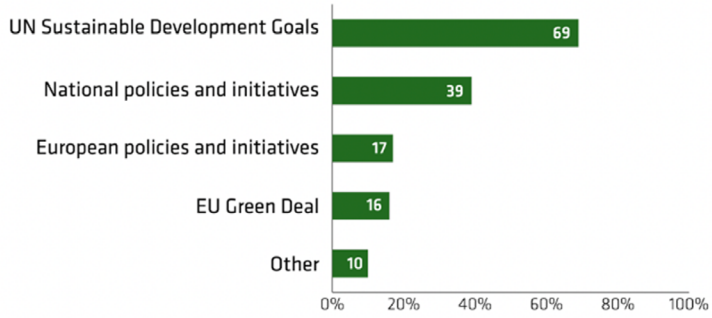
A recent study by the European University Association (2021) entitled "Greening in European higher education institutions", which was open to EHEA and EU partner countries during the period 15th March to 9th April 2021, gathered the views of 305 Higher Education Institutions about their greening measures and initiatives. The majority of feedback was gathered from respondents at comprehensive, multidisciplinary universities (57%), followed by universities of applied sciences and university colleges (16%), and technical universities (13%).

From the study it became evident that 61% of Higher Education Institutions address greening through their overall strategy or through a dedicated strategy and 25% of institutions were at the time planning for the development of an institution's strategy on greening (Figure 1).

N=305. Q8: Are you part of any networks or working groups on greening? Please select all that apply.

Figure 1: Addressing greening within the university
Source: Greening in European higher education institutions, EUA (2021)

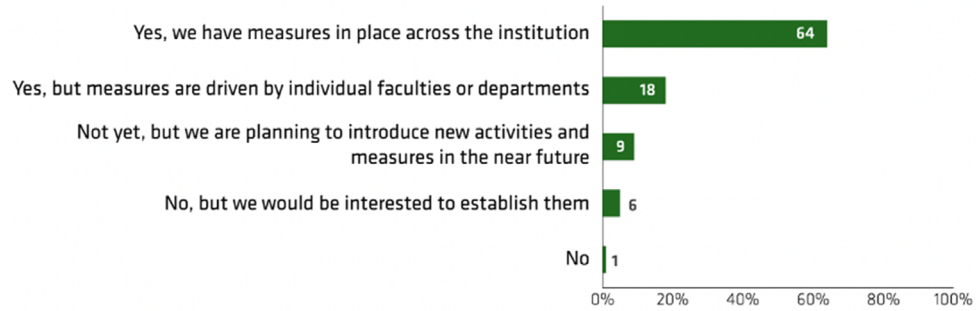
Further to this, the majority of Higher Education Institutions (Figure 2) in the survey seem to align their strategies with the SDGs, and about a third also do so with national policies and initiatives.



N=185. Q9.1: If yes, does your strategy explicitly relate to any of the following? Please select all that apply.

Figure 2: Relation of university strategy to policies
Source: Greening in European higher education institutions, EUA (2021)

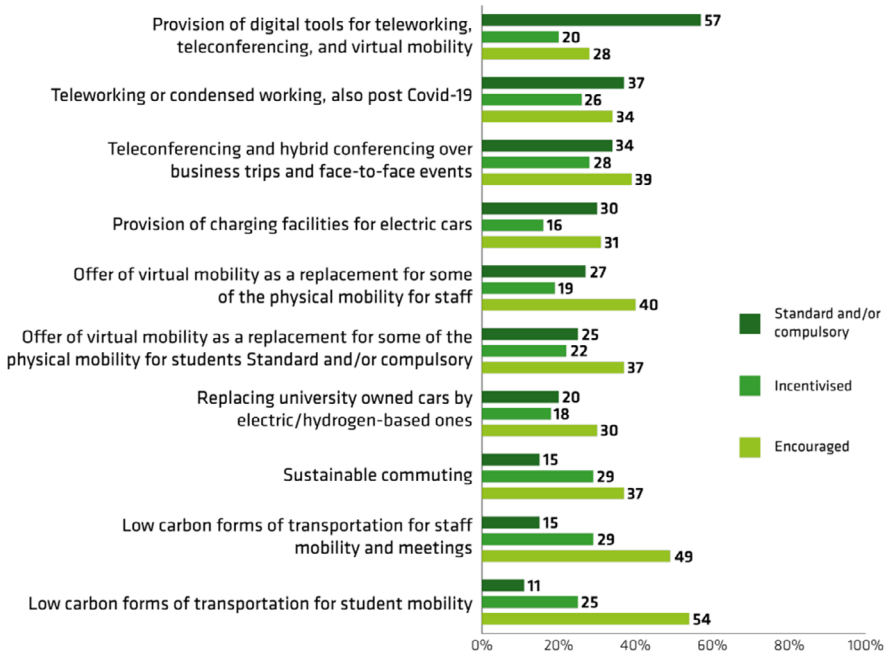
When it comes to measuring greening efforts, 64% of Higher Education Institutions have measures in place and 18% have measures in place driven by specific faculties or departments. Only 6% of respondent institutions have no greening measures in place (Figure 3).



N=372. Q5: Does your institution have any greening measures in place? Please select one option.

Figure 3: Measuring greening efforts
Source: Greening in European higher education institutions, EUA (2021)

Furthermore, the same survey results indicated that nearly all institutions have implemented various initiatives for mobility and commuting, with 80-90% of them introducing specific measures (Figure 4). These institutions often make digital tools and virtual alternatives for learning, working, and exchange, standard or compulsory, a trend accelerated by the pandemic. Digital tools have therefore become integral in this shift, offering and supporting said virtual alternatives.



N=305. Q6: Which of the following activities and measures take place at your institution? Please select all that apply in the following categories.

Figure 4: Greening and mobility
Source: Greening in European higher education institutions, EUA (2021)

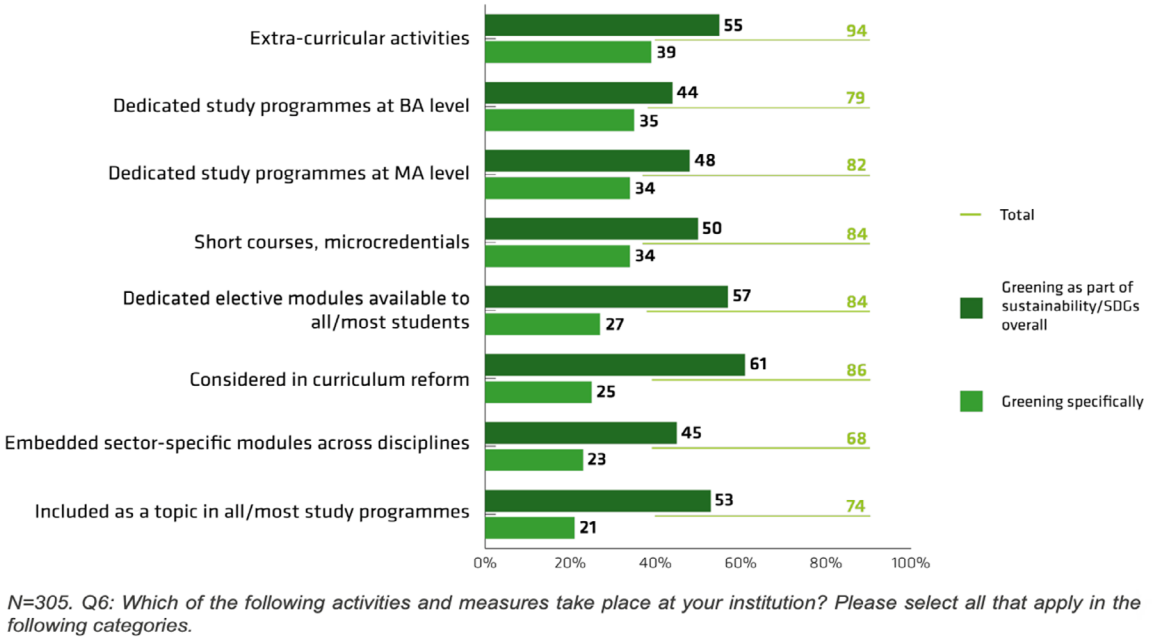


Figure 5: Greening in teaching and learning
Source: Greening in European higher education institutions, EUA (2021)

It is clear from the data above that universities not only have the willingness to incorporate the greening within their everyday practices but also in their teaching and learning activities.

It is undeniable that there are many opportunities for universities and educators to proactively embed the topic of sustainability into the curriculum and using digital tools and platforms to enhance the learning experience, but there is also a necessity to encouraging students to reflect and self-reflect on the "darker" sides of learning and working through digital tools, platforms and channels. Hence, investigating sustainability in digital education is a multifaceted exploration that has implications for curriculum design, educational approach, and the wider role of Higher Education Institutions within society.

The pedagogical dimension

In the age where digital technology pervades every facet of learning, the quest for sustainable education has taken center stage. Digital education has emerged as a pivotal arena for instilling sustainable practices and mindsets. This evolution presents an unprecedented opportunity to embed sustainability deeply within the educational fabric, transforming how we teach, learn, and interact with our environment. As we navigate through this digital era, it is important that we harness the power of technology not just to broaden access to education, but to cultivate a culture of sustainability that is woven through the very thread of learning experiences.

This chapter, titled “The pedagogical dimension”, explores the intersection of sustainability and digital education, emphasising the pedagogical strategies that can foster a more sustainable future. Delving into the pedagogical dimension of such a transformation, we will explore the nuanced paradigms of sustainable and sustainability pedagogies within the digital education landscape.

While looking at this, we will discuss various digital education modalities—synchronous, asynchronous, and those supporting on-campus education—and their roles in advocating for sustainable development. We will also address the practical integration of sustainability topics into digital courses, highlight the development of green competencies (GreenComp), and examine the reconstruction of courses with a sustainability lens.

This chapter will provide educators with a roadmap to navigate the complexities of integrating sustainability into digital education. Through a blend of theoretical insights and practical strategies, we will explore the essence of teaching about, for, and as sustainable development in a digital context. By the end of this, the reader will be equipped with the knowledge and tools necessary to craft educational experiences that are not only digitally innovative but also sustainably transformative.

Sustainable vs sustainability pedagogies

Sustainable pedagogies and sustainability pedagogies are terms that refer to different approaches to teaching and learning about sustainability in education (Pavlou and Castro-Varela, 2024). According to Burns, Kelley and Spalding (2019) and Seatter and Ceulemans (2017) sustainable pedagogies are those that aim to foster a holistic understanding of sustainability, integrating environmental, social, economic, and ethical dimensions, and engaging students in critical thinking, problem-solving, and action-oriented learning. They are pedagogies that are designed to be environmentally, socially and economically sustainable. Sustainable pedagogies include methods and practices employed in education that aim at minimising negative impacts on the environment and promoting social equity and inclusion.

In practice, sustainable pedagogies involve creating learning experiences that encourage students to analyse and reflect upon the ecological footprints of their actions, the social equity implications of policies, the economic sustainability of practices, and the ethical dimensions of decisions. The goal is to prepare learners to make informed, responsible choices that contribute to the long-term well-being of our planet and its inhabitants. These pedagogies are about fostering a culture of sustainability that transcends the classroom, equipping students with the skills and mindset necessary for lifelong sustainable living and leadership.

Sustainability pedagogies, on the other hand, as seen in *Sustainability education at higher education institutions: pedagogies and students' competences* (Wang, Sommier and Vasques, 2022) are those that focus on specific aspects of sustainability, such as environmental education or social justice, and emphasize the development of either mindset/framework or action-oriented competences. They focus on sustainability issues, emphasise the importance of educating learners about sustainability-related topics and fostering a sense of environmental responsibility.

For instance, a sustainability pedagogy might involve immersing students in projects that address local environmental issues, thereby promoting action-oriented competencies. Alternatively, it might focus on cultivating a deep understanding of social justice issues related to sustainability, such as equity in resource distribution or access to clean water. The specificity of sustainability pedagogies allows for a concentrated impact on particular areas of sustainability.

While sustainable and sustainability pedagogies have distinct characteristics, they are not mutually exclusive. There is significant overlap in their aims and methods, and they can be integrated to create a comprehensive approach to sustainability education. For example, a course designed with sustainable pedagogy in mind might include modules that use sustainability pedagogy to delve deeply into topics like renewable energy, waste management, or ethical consumption.

The integration of these pedagogical approaches can enrich the learning experience, providing both a broad understanding of sustainability and the specialised knowledge necessary to address specific issues. Educators can use sustainable pedagogies to lay the foundation for holistic sustainability education and then employ sustainability pedagogies to focus on distinct competencies and issues. The synergy between these approaches can produce well-rounded learners who are not only aware of the broad challenges of sustainability but also equipped with the skills to take targeted actions.

This dual approach also prepares students to adapt to and address the evolving landscape of sustainability challenges. By understanding the broader context and possessing specialised competencies, learners can apply their knowledge and skills to emerging issues, making them more effective agents of change.

Digital education defined

Digital education refers to incorporating technology (computers, interactive displays, internet, software applications, online resources, communication platforms) to design and facilitate learning and teaching in a variety of forms, each with unique characteristics and applications.

Definitions required for each mode

- **Synchronous digital education:** This form takes place in real-time, allowing immediate interaction between instructors and students. It includes live online classes, webinars, and video conferences, where participants can engage in instant dialogue, feedback, and collaboration, mirroring traditional classroom dynamics in a virtual space.
- **Asynchronous digital education:** Asynchronous learning does not require simultaneous participation. Instead, it provides flexibility, allowing learners to access course materials, participate in discussions, and complete assignments on their own schedules. Tools commonly used include learning management systems, recorded lectures, discussion boards, and email.
- **Digital support for on-campus education (blended learning):** Digital tools can also enhance on-campus education by offering supplementary resources, extending learning beyond the classroom. Digital support might include online quizzes, interactive simulations, digital libraries, and virtual labs that students can access at any time. While there is no unified definition of blended learning, its essence is the integration of offline and online learning resources, spaces, and materials. This “new normal” (Dziuban, Graham, Moskal, Norberg and Sicilia, 2018) in educational design takes advantage of the strengths of both traditional and digital settings to provide a holistic learning experience. It is a pedagogical innovation that converges online and traditional instruction, integrating digital technologies with conventional teaching methods to develop effective, efficient, and flexible learning outcomes.

Digital education, in all its forms, holds the potential to make learning more accessible and tailored to individual needs, thereby supporting the principles of sustainability by reducing physical resource demands and enabling education to reach a broader audience.

Teaching about, for, and as Sustainable Development

In this framework, we look at sustainability as the responsible use of digital resources minimising environmental impact and maximising educational effectiveness, so we can talk about education about (or of), education for and education as sustainable development. Thinking of the pedagogical approaches to be used when dealing with these different aspects, it seems that they fall under the umbrella of both sustainable and sustainability pedagogies.

The pedagogical approaches of teaching about, for, and as sustainable development integrate seamlessly with the varied forms of digital education:

- **Teaching About Sustainable Development:** This approach imparts knowledge about sustainability concepts, challenges, and solutions. In digital education, this can be achieved through curated online content, virtual tours, and interactive modules that explain the principles of sustainability.
- **Teaching For Sustainable Development:** This method aims to install skills and values that encourage sustainable living. Digital education facilitates this through participatory activities such as online workshops, collaborative projects, and simulations that allow learners to practice and apply sustainability competencies in virtual environments.
- **Teaching As Sustainable Development:** Here, the focus is on modelling sustainability through the educational process itself. Digital education embodies this by utilising energy-efficient technologies, promoting paperless learning materials, and supporting digital literacy as a means to enable learners to make sustainable choices in their personal and professional lives.

Education about/for/as sustainable development can be combined to develop green competencies. As illustrated in the table below, when planning for a course, depending on each type of digital education, we can look at specific content delivery methods, assessing the sustainability of the method and its environmental and social risks:

Table 1: Type of digital education – assessing sustainability

Educational Type	Sustainability Content Delivery	Sustainability of the Method	Environmental and Social Risks
Digital Synchronous Education	• Facilitates live discussions on sustainability. • Real-time understanding of environmental issues.	• Highly sustainable: Reduces physical resource needs and travel. • Energy-intensive due to continuous digital connectivity.	• Increases energy consumption and electronic waste. • Potential social isolation due to lack of physical interaction.

Digital Asynchronous Education	• Provides resources like recorded lectures on sustainability, accessible anytime.	• Highly sustainable: Minimizes physical resources and optimises energy use. • Reduces carbon footprint by eliminating commuting.	• Challenges in managing electronic waste and energy use. • Risk of diminished community engagement and student collaboration.
Digital Support for On-Campus Education (blended learning)	• Combines traditional and digital methods. • Uses tools like simulations to enhance sustainability knowledge.	• Moderately sustainable: Balances digital resources with physical campus presence. • Can optimise campus resource usage digitally.	• Higher resource consumption due to campus operations. • Digital divide issues impacting equitable access.

Each form of digital education can be tailored to address these aspects of sustainability. Synchronous learning environments can foster real-time discussions on sustainable practices, asynchronous platforms allow learners to explore sustainability topics in-depth at their own pace, and on-campus digital support tools can enrich traditional sustainability education with innovative resources.

These approaches underscore the multiplicity of ways digital education can promote sustainability. They offer a lens through which educators can view and design their digital courses, ensuring that the content, competencies, and the educational process itself are aligned with the goals of sustainable development.

When teaching about sustainability in digital education and having the focus on embedding it as a topic addressed into courses that are designed and delivered online/digitally we might also consider:

- How to bring in the topic of sustainability into courses that are designed and delivered online/digitally
- How to use digital tools and platforms to teach about sustainability (across any of the digital education modes)
- How digital learning can be an educational opportunity for sustainable development, by enhancing access, equity, quality, and relevance of education, and by fostering digital literacy, critical thinking, collaboration, and creativity skills (Sousa, Marôco, Gonçalves and de Bem Machado, 2022).

In digital education though, sustainability is not only taught as a subject but is also embedded in the methods and mediums of instruction, reflecting a commitment to educate responsibly and with foresight for the future. The subsequent sections will delve into the specifics of how these pedagogical approaches can be operationalised in digital education to effectively engage learners in the pursuit of a sustainable tomorrow.

Teaching sustainability competences online

Sustainability education involves also developing competences and agency that enable action for sustainable development. The GreenComp framework, developed by the European Commission's Joint Research Centre, provides a reference for sustainability competences. It aims to advance a consensual definition of what sustainability as a competence entails and responds to the growing need for individuals to improve and develop the knowledge, skills, and attitudes to live, work, and act in a sustainable manner. The framework is designed to support education and training programs for lifelong learning, and it is intended for all learners, irrespective of their age and education level, and in any learning setting – formal, non-formal, and informal. The GreenComp framework can help educational institutions to become more sustainable through digitalisation by providing a common ground and guidance to educators, learners, and all education providers, and by advancing a consensual definition of what sustainability as a competence entails. It can also help in the development of sustainability competencies using digital transformation tools at the professor and student levels. The framework can be used to integrate sustainability principles into teaching and learning, and to support the development of knowledge, skills, and attitudes that promote sustainability and sustainable lives. On the other side, the Key Sustainability Competences as outlined by UNESCO in 2017 are a set of competencies that individuals need to possess in order to engage in responsible and effective actions that contribute to sustainable development. How students' GreenComps or Key Sustainability Competences (UNESCO, 2017) develop during online courses depends on the pedagogical approaches and tools which the teachers use.

Here the question is how to foster collaboration, students' initiative taking, futures thinking, systems thinking, value clarification, dealing with complexity, connection to nature or empathy (just to name some) in online environments. In GreenComps this is called Learning for Sustainability (LfS). Designing and carrying out this kind of learning processes online demands quite a lot of careful preparation and strong engagement of students. They must understand that they have responsibility not only for their individual learning but also on the learning process of the whole group or learning community.

One interesting example of a community that is developing collaborative learning is Open Networked Learning community (ONL), which organises online courses on collaborative learning. The ONL does not specifically focus on learning for sustainability, but helps teachers apply pedagogies and tools that facilitate learning for sustainability online.

In order to be able to teach sustainability competences online in an effective way, we need to rethink our courses. We propose below a set of steps to be followed when planning for such a course.

Planning steps

Step 1: Reflect on your courses / deconstruct your courses.

- Assess how relevant each of your courses are to each of the 17 SDGs
- Assess how confident you feel about integrating each of the 17 SDGs in your courses
- Evaluate how often you effectively integrate each of the SDGs in your courses
- Evaluate how often youyou actually relate the content of the course to real-life issues
- Evaluate how motivated you are to connect your courses to the SDGs
- Consider your perceptions on the importance (or not) to connect your courses to SDGS
- Examine your needs related to

  a) writing appropriate learning outcomes for the SDGS in your courses,

  b) developing/ locating appropriate resources to integrate the SDGs in your courses,

  c) evaluating the outcomes of the SDGs' integration in your courses.
- Document all the digital materials/resources/ activities that you are using so far and assess their sustainability.

Step 2: Reflect on your students

- What are their literacy practices/ habits in relation to technology?
- Do they "embody" technology? (for example with smart watches)
- Are they "comfortable" with screens?

Step 3: Reconstruct your courses to introduce or strengthen learning on sustainability issues/ SDGs through digital education.

- What is the main focus of your courses?
- What are the main aims/learning outcomes?
- What are the main learning activities and resources?
- How can the above relate to real life and sustainability issues/ 17 SDGs?
- Can the content of your courses and especially the learning activities be connected to the GreenComp? How?
- Can the learning activities of your courses utilise digital means/resources, etc. in class and out of class? How?

There are different ways to use digital technologies to teach about sustainability. Annex 1 illustrates a few world-wide examples, and the following chapter brings some new insights from educators across Europe.

Reflecting and redesigning of courses

Educational institutions aim to place sustainability and SDGs as a focus for their institutional activities, curricula, and student learning. However, the complexity of addressing SDGs in curriculum, teaching methodology and pedagogy has been recognised, and a diversity of approaches is emerging. Aligning teaching and learning capacities with sustainability objectives increases universities' relevance and responsiveness to societal needs.

Digital education can facilitate change towards the professionalisation of academic teaching to address sustainability issues/SDGs in multiple academic disciplines, especially given the experiences gained because of the lockdowns due to the COVID-19 pandemic.

The alignment of curriculum content with suitable teaching and learning processes and practices is underpinned by the nexus of transmissive-constructive-transformative modes with a clear aim towards transformative teaching/learning and participatory curriculum development. Next the DeCoRe plus (Deconstruction-Construction-Reconstruction) methodology (Vouzaxakis et al. 2023) is proposed to academics who wish to reflect on their courses and re-design them. This methodology offers a framework enabled by a blended learning approach, which can easily be adapted to a distance learning approach and comprises six processes as shown in the following figure.

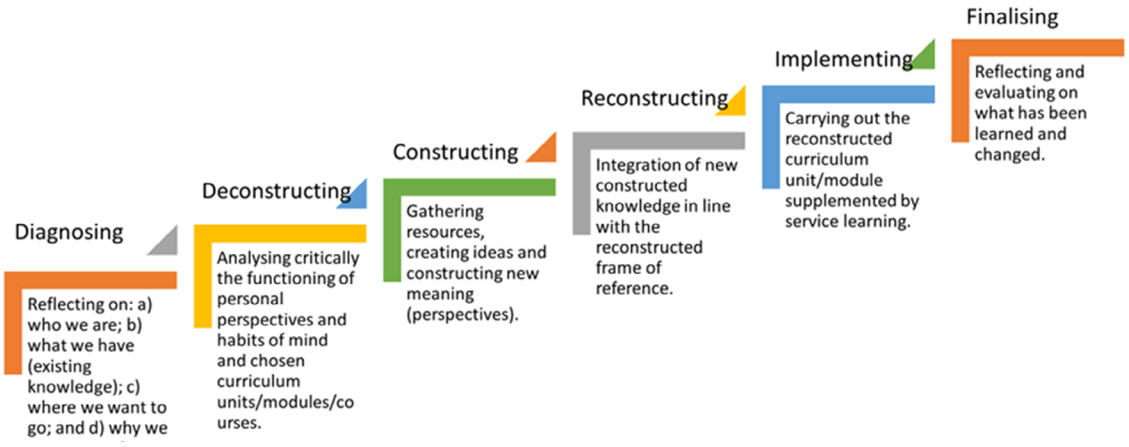


Figure 6: The DeCoRe plus methodology.
Source: Vouzaxakis et.al. (2023)

Next, three templates are described to facilitate step 2, the deconstruction process, step 3 the construction process and step 4, the reconstruction process. The three templates provided are based on the work of the following EU-funded projects:

1. "ICT-enabled In-service Training of Teachers to address Education for Sustainability". The ICTeEfS project focused on seven universities in Indonesia, Malaysia and Vietnam. It was a European Commission Erasmus+ Capacity Building in Higher Education (CBHE) funded project (Reference Number: 598623-EPP-1-2018-1-CY-EPPKA2-CBHE-JP) (2019-2022).
2. "Professionalisation of Undergraduate Academic Teaching in Multiple Disciplines to Address SDGs". The PUAT was a European Commission Erasmus+ Capacity Building in Higher Education (CBHE) funded project (2019-2022) that focused on four universities in Africa.

Template for the Deconstruction process (step 2)

The deconstructing process is a demanding process where one needs to reflect not only on the course's goal, aims, content, activities, methodologies, and assessment but also on any hidden curriculum, gaps and omissions, assumptions, values and ideologies. Digital education is not directly assessed at this step, but if it is already adopted, this will be made visible through the tutor's answers to the different points. Digital education is directly included in the next steps.

Table 2: The Deconstruction process template

1. Unit / Module content	Provide detailed and critical answer
1.1 Title, Subject, and Audience: *What is the name, subject, and who is the target audience of the unit/module/course?*	
1.2 Main Idea: *What is the central concept or unit/module/course?*	
1.3 Objectives: *What are the goals and specific objectives? Are they clear?*	
1.4 Suitability of Content: *Does the content match the goals with clear and understandable concepts?*	
1.5 Activation Elements: *Does the course include engaging elements to stimulate student interest?*	
1.6 Learning Activities: *Are there activities for recalling previous knowledge and building new understanding?*	
1.7 Connection with Objectives: *Do activities align with the learning objectives?*	
1.8 Cross-subject Connections: *Do activities relate to other subjects? If yes, how?*	
1.9 Real-life Relevance: *Are topics and activities related to real life and sustainable development?*	
1.10 Sustainable Development and Learning Pillars: *How does content align with the UNESCO learning pillars (learning to know, learning to be, learning to live together, learning to do) and sustainability competences (critical thinking, creativity, ...)?*	

1.11 Problem-Based Learning: *Are learning activities integrated with problem-based learning strategies?*	
1.12 Implicit Values: *Are there values in the content that are not explicitly taught?*	
1.13 Reproduction of Ideology: *Does it reinforce the dominant ideology and non-sustainable economic growth?*	
1.14 Types of Knowledge: *What type of knowledge is promoted: technical, practical, or emancipatory?*	
1.15 Hidden Curriculum: *Is there an unofficial curriculum? If yes, explain.*	
1.16 Zero Curriculum: *Are there missing elements that could be useful? If yes, why?*	
2. Method of assesment	**Provide detailed and critical answers**
2.1 Assessment Methods: *How are learners evaluated?*	
2.2 Engagement Impact: *Do assessment methods hinder active learner engagement?*	
2.3 Concept Assessment: *Are concepts from the unit/module assessed?*	
2.4 Non-Unit Concepts: *Are concepts not in the unit/module assessed?*	
2.5 Authentic Assessment: *Is the assessment realistic and diverse?*	
3. Gaps, purposeful omissions, and assmuptions:	**Provide detailed and critical answers**
3.1 Missing Content: *What is absent, and why? Explain.*	
3.2 Purposeful Omissions: *Who or what is intentionally left out, and why?*	
3.3 Unasked Questions: *What questions are not addressed, and why?*	
3.4 Underlying Assumptions: *What assumptions underlie the unit/module?*	

4. Power and interests:	Provide detailed and critical answer
4.1 Raised Interests: *What interests/views are presented, and why?*	
4.2 Hidden Views: *What views are concealed, and why?*	
4.3 Objectivity: *Are presented views fair and objective?*	
5. Projected image and reality:	**Provide detailed and critical answers**
5.1 World Image: *What worldview does the unit/module convey?*	
5.2 Social Reality: *Which aspect of social reality is portrayed?*	
5.3 Real vs. Imaginary: *Distinguish between real and imaginary aspects.*	
5.4 Comparisons: *Are there similar subjects in other contexts?*	
6. Author's image:	**Provide detailed and critical answers**
6.1 Tutor's Image: *What image of the tutor is perceived?*	
6.2 Tutor's Values/Ideas: *What values or ideas do the tutor endorse?*	

Template for the Constructing Process (Step 3)

This step primarily centres on building new components or elements for the curriculum. It often begins with a blank slate or a fresh perspective, where educators and curriculum developers create new content, methodologies, or approaches, which should aim to the sustainability of digital education. The main goal is to introduce novel ideas, subjects, or teaching methods into the curriculum, addressing gaps, updates, or advancements in education. In summary, while the construction process focuses on building new components, the reconstruction process involves a more extensive and fundamental overhaul of the entire curriculum, often starting with an existing framework.

Table 3: The Construction process template

Construction process Based on the detailed and critical answers to the deconstruction process, start the construction process by recording the main points that need changes and describing your proposals, which will be used in the reconstruction process.	
Critical reflection Reflect on what is needed to support the following four domains.	
Interactive Teaching and Learning *Provide a brief overview of how to promote engaging teaching and learning by using digital tools, multimodal texts, adapting to various learning styles, utilizing repositories of learning materials, and organising the classroom. Think of the sustainability of digital tools/ texts/ repositories.*	**Learning pillars and Sustainability Competences** *Explain briefly how you plan to incorporate the UNESCO learning pillars and Sustainability competencies in an interactive teaching and learning process, addressing real-world problems.*
Interactive Teaching and Learning *Provide a brief overview of how to promote engaging teaching and learning by using digital tools, multimodal texts, adapting to various learning styles, utilizing repositories of learning materials, and organising the classroom. Think of the sustainability of digital tools/ texts/ repositories.*	**Authenticity** *Outline briefly how the key concepts and learning activities connect to real-life situations, especially of sustainability issues in digital education. Consider emphasising experiential and social learning and promoting active citizenship.*

Report the key points that need to be deconstructed in each of the following domains and present your suggestions	**Elaborate your key points and suggestions based on the following table organiser of critical reflection**
Content	
Evaluation Methodology	
Gaps, purposeful omissions & underlying assumptions	
Power and interests	
Alleged perspective/reality	

Template for the Reconstructing Process (Step 4)

This step involves a more comprehensive transformation that goes beyond just introducing new elements. It revisits and reshapes the entire curriculum structure. It begins with the existing curriculum that needs substantial changes, modifications, or reorganisation (step 2). The primary goal is to overhaul the curriculum, addressing fundamental issues, outdated content, or pedagogical approaches. It should involve aligning the curriculum with evolving educational philosophies or societal needs and specifically dealing with sustainability in digital education.

Table 4: The Reconstructing process template

Basic information about the course: Title, ECTS, Programme of Study, etc.	
Context / activation:	
Write the general goals of the unit/module:	**Describe what kind of previous knowledge you will use in teaching the reconstructed unit/module:**
Describe the characteristics of learners (e.g., skills, values, knowledge, attitudes, competencies) that will contribute to the learning outcomes:	**Describe what kind of teaching/ learning activities you will do to activate your learners and how you will investigate a) what learners know on the subject, b) what they want/ need to learn, c) how they want/need to learn, and d) how you will approach the issue of sustainability in digital education.**

Specific objectives:

Write down what learners should be able to do after the end of the lesson unit/module.

1.
2.
3.
4.
5.
6.
7.
8.
9.

[The learning outcomes should be learner-centred or learner-driven and include all categories of learning processes and cognitive skills. It is important that learning outcomes can arise from both the activation process and the learning activities across all lesson phases. The co-formulation of the specific objectives of the course is a prerequisite for a learner/learning-centered teaching approach. This means that the specific objectives can be partially modified and/or supplemented during the implementation phase of the reconstructed unit/module.]

Connectivity

Interdisciplinarity:

Try to connect your unit/module with at least two different subjects of the curriculum by identifying intersections in curriculum areas, objectives, and content. The interdisciplinary approach leverages a holistic perspective in knowledge construction.

Sustainability in digital education:

Describe the connection between the unit/module and learning outcomes with reference to:
- the learning pillars: learning to know to be, to live together sustainably, to do, to transform myself and society, and to give/share.
- environmental sustainability in digital education, as evidenced by the deconstruction and construction process.
- sustainability competencies, taking into account the deconstruction and construction process.

Learning material and resources

Describe what is needed in terms of learning materials, digital sources, web-based tools, and other ICT tools:

Cite the references of all your sources:

Organising your class

Explain how you are going to organise your class to carry out the reconstructed learning unit/module successfully with the support of digital education.

Blended/ fully online / synchronous / asynchronous / individual work / collaborative work / etc.

Describe the strategies and activities that will be used to implement the reconstructed unit/module, categorising the process by phase and time duration.
- Consider the sustainability of digital education in each phase.
- Consider that assessment should be incorporated in phases and that there must be consistency with the table below. It should also be consistent in phases, starting from how to recall and use learners' prior knowledge (activation).
Particular attention should be paid to the interconnectivity strategies and learning activities along the authentic assessment chart and the linkages to the interdisciplinary approach, the learning pillars, digital education and sustainability competencies.

Plan of authentic assessment

Objective	Authentic assessment*	Cognitive skill **	Learning activities***

** An authentic assessment focuses on the evaluation of the learner's capacity: 1) to apply knowledge and skills in situations - problems of the "real world" and 2) to generate ideas, construct new knowledge, use multiple ways of knowing holistically, consolidate knowledge, cooperate, and investigate. Therefore, it may include multiple modes and tools such as: conceptual maps, interactive learning activities, learning logs, autobiographies, tests, etc. Also, authentic assessment is integrated into all teaching/learning phases at the diagnostic, formative and summative level.*
*** Indicate the category of skills.*
**** Indicate the learning activity and the phase in which each specific objective (learning outcome) is connected.*

Examples of courses that were reconstructed based on the procedures (steps) mentioned above can be found here in the reports of the "ICT-enabled In-service Training of Teachers to address Education for Sustainability" project. The document contains 72 revised undergraduate courses, the majority of which fall within the Faculties of Education representing different subjects and the rest from other academic disciplines such as applied sciences, social sciences, engineering and humanities.

Digital Futures Taskforce: Assessment design that blends digital tech and UN SDGs

Practice Developer
Dr Rikke Duus
(EDEH Squad: Sustainability in digital education member)

Type of Practice
Dr Rikke Duus
(EDEH Squad: Sustainability in digital education member)

Host Organisation
University College London (UCL) School of Management, United Kingdom

Rational for Practice
The main purpose of this assessment is to create an opportunity for students to learn at the intersection of digital technologies and UN Sustainable Development Goals (SDGs); two of the dominant pillars of societal transformation. The assessment design requires students to utilise digital technologies and tools, whilst also enhancing their understanding of UN SDGs, including those focused on sustainability challenges.

Description of Practice
Students undertake this assessment individually and are provided with the following scenario as part of the assessment brief:

"You have been invited by the Chief Digital Officer from [your chosen] organisation to join the Digital Futures Taskforce. As a member of the Digital Futures Taskforce, you are required to offer your research skills and expertise for how the organisation can use digital technologies to create and launch a new initiative. You have been told the new initiative must deliver on specific UN Sustainable Development Goals (UN SDGs), in addition to creating value for the organisation and key stakeholders.
You have been given a few weeks to prepare a video-based presentation of the new initiative that you will be proposing. As the members of the Digital Futures Taskforce are located all over the world, you have been asked to video record your presentation so that it can be shared asynchronously with the Taskforce members. As a junior employee in the organisation, you are excited about this opportunity to present a new initiative to senior members of the Taskforce."

Students are tasked with proposing a new digital initiative for their chosen organisation, which clearly contributes positively to specific UN SDG targets and indicators. Whilst students have a choice in which UN SDGs to focus on, many align their proposed digital initiative to deliver sustainability targets for the organisation. As part of their investigation, students undertake research and analyse data, apply frameworks (introduce during the module), and utilise analytical tools, investigate UN SDGs, and enhance their digital skills. Importantly, students also practice presenting to the camera which is critical in a business environment where much communication now takes place via video conferencing platforms such as Zoom and Teams, rather than in person.

In addition to the video-based output, students also complete a 1,000 word learning reflection on the following questions

1. What did you learn from undertaking the research and investigation for this submission (e.g. from the research about UN SDGs and innovation, your chosen company and partners, customer and industry trends, how companies use digital tech to meet SDG targets, etc.)
2. How, specifically, did you learn it? What information and resources did you use as part of your research? How did you acquire the new knowledge that you needed?
3. As a student, why is it important/significant to learn about how organisations can use digital technology to create new solutions and meet UN SDG targets? How will this be relevant for you in your future career/profession?
4. What new digital skills and competences have you gained from doing this work? How might these be useful in future, for example when employed with an organisation?
5. What did you find challenging about doing this work? Why do you think you found it challenging?

Use of Digital Technologies

The assessed output students design and develop is a 15-minute asynchronous video presentation for the "Digital Futures Taskforce". Students are required to use multiple digital tools to present their new initiative within the video they create (e.g. process mapping and interactive prototypes), their research and investigation (e.g. data visuals), analysis of new opportunities and expected impact upon implementation and the impact the initiative is expected to have. Students are encouraged to use digital platforms, including Canva, Flourish, Lucidchart and Lumen5, for recording the video content and making edits, embedding visual material and blending in third-party content (e.g. news clips and news articles).

Insights from practices and approaches of educators across Europe

In order to understand how sustainability in digital education is perceived by educators we decided to carry out exploratory research within the hub. We first listed the interesting areas that we were interested in finding out more details on and created corresponding questions (Table 5).

Table 5: Areas and questions to gather insights on sustainability in digital education

Defining Sustainability	• What does sustainability mean to you in the context of digital education?
Integration in Curriculum	• How have you integrated sustainability into your digital education or teaching practices? • From your experience, are there specific subjects or projects that you find particularly interesting to address in this area?
Challenges	• What challenges have you encountered when trying to incorporate sustainability into digital education? • How have you addressed them?
Pedagogical Approaches	• Can you share effective teaching methods/ strategies you have used to engage students in sustainability topics within a digital learning environment?
Assessment and Evaluation	• How do you evaluate students' understanding of sustainability concepts in your digital education initiatives? • Are there specific assessment methods that you find most effective?
Resources and Materials	• What digital tools, resources, or materials do you rely on to teach sustainability in digital education? • How do you select or create them?
Student Engagement	• How do you foster student engagement when teaching? • Can you share examples of successful activities when teaching sustainability topics?
Interdisciplinary Collaboration	• Have you collaborated with colleagues from different subject areas to incorporate sustainability into your teaching? • How?
Professional Development	• How would you like to learn about sustainability in digital education? • Do you feel you need formal training related to sustainability in digital education? • Did you already finish a training on this topic?
Recommendations	• If you could make recommendations to educational institutions, policymakers, or stakeholders to better support sustainability in digital education, what would they be?

Then we agreed on a set of 10 open-ended questions and tested them within the squad. Based on the answers and comments we created a questionnaire with 6 multiple-choice questions and 5 open-ended questions. We chose the following areas to focus on:

- What is sustainability in digital education associated with, whether sustainability is included in participants' activities and how;
- Which challenges do participants encounter in relation to sustainability in digital education;
- Which are the top three competences of the EU GreenComp Framework most interesting; more information on the framework
- What practices and tools do respondents recommend for addressing sustainability in digital education;
- How do participants want to be trained on this topic;
- What recommendations do they have for educational institutions, policymakers, or other stakeholders to better support sustainability in digital education.

The survey was uploaded on the EU survey website and distributed in the EDEH channels and in the networks of the squad members. The survey was open between end of December 2023 and beginning of January 2024. At the end of the 4 weeks there were 37 responses. The results are not intended to be completely representative for all of Europe, but they provide starting insights into how sustainability in digital education is perceived.

The respondents come from a diverse range of countries, with a total of 15 being mentioned. Among these, educators from Romania, Germany, Greece, Italy, Portugal, and Spain were the most prominent in the sample. This diverse geographical representation is valuable as it allows for a more comprehensive exploration of how educators from different cultural and educational contexts perceive sustainability in digital education.

In terms of level of education, the respondents are involved with, higher education emerges as the most common setting, with 65% of educators working in this sector. 24% work in adult education, 19%, in middle school, 16%, in high school and 14%, in Vocational Education and Training (VET). Additionally, smaller percentages of respondents work in preschool (3%) and elementary school (8%). This skewed distribution represents a limitation in terms of range of opinions.

Overall, most of the respondents have a considerable background in digital education, providing a rich pool of insights for further analysis on their perceptions of sustainability in this context. 40% have been involved

in digital education for 11 to 19 years, while 26% have 6 to 10 years of experience and 14% have more than 20; only 20% have less than 5 years of experience in digital education. This distribution is the result of a self-qualifying process, as in the introduction of the survey it was mentioned: “If you have experience with digital education, please answer the following questions”.

In terms of integrating technology into educational activities, there are varied approaches, from enhancing traditional classes to fully online programs. The majority of educators (76%) enhance their presentations with technology or incorporate interactive digital tools within traditional learning setups, which indicates a widespread use of technology as a supplementary tool to enrich in-person teaching. Additionally, 57% of respondents employ a blended learning approach, combining in-class instruction with online components, while 38% of educators reported being involved in hybrid education - using synchronous instruction with a mix of in-class and online participants. A notable percentage (62%) utilises online platforms for fully online educational experiences.

Coming to the first focus area of the survey, how is sustainability in digital education perceived, the key concepts frequently cited are ”environment”, ”society”, ”accessibility”, ”paper” and ”energy”. Additionally, ”SDG” or ”ESG”, ”transportation emissions”, ”e-waste”, ”data security”, ”cost”, ”time” and ”digital fatigue” are other concepts with less mentions. The responses highlight multifaceted understandings among educators, ranging from positive impact (handprint) to negative impact (footprint) and from an environmental perspective to a social and economic perspective.

Sustainability is somewhat integrated into digital education activities by 62% of the respondents, which would be a reason to celebrate if the research were representative. Nonetheless, we can say that most of our respondents recognise the importance of sustainability and sustainable practices and also understands the potential for further incorporation. 19% explicitly state that sustainability is integrated into their digital education activities, and we would definitely like to know more about their practices. On the other hand, 11% state that sustainability is not a significant consideration in their digital activities and here there is need for further exploration on the reasons and barriers. Lastly, 8% expressed uncertainty or ambiguity about the integration of sustainability in digital activities. This group might benefit from additional clarifications on the concept of sustainability in the context of digital education and on related practices.

Digging deeper into how sustainability is incorporated into digital education, the most prevalent approach, mentioned by 86% of respondents, involves addressing the topic - that is either by (1) talking about sustainability

in technologically enhanced courses that are focused on sustainability or (2) talking about various aspects of sustainability in technologically enhanced courses that are not linked directly to sustainability, for example teaching French with a topic on circular economy or (3) talking about the sustainability of digital activities, for e.g. of the energy consumption of sending an email or the carbon footprint of a website that is visited. Approximately 46% of respondents indicate collaboration with colleagues to develop cross-disciplinary projects related to sustainability, while 40% introduce sustainability in the requirements or topics related to assessments, and 31% implement sustainable practices related to digital activities, such as encouraging participants to turn off cameras when not speaking.

The second area of the study shows that the most prominent challenge, as reported by 47% of educators, is the lack of time. This suggests that educators perceive time constraints as a significant barrier to effectively incorporating sustainability considerations into their digital teaching practices. Student engagement and integration of sustainability into curriculum, each mentioned by 29% of respondents, as well as access to digital tools and lack of support (mentioned by 26%) are other notable challenges. Additionally, a few participants mention also issues such as a lack of recommendations for self-learning resources, outdated equipment, and slow internet speed. Surprisingly, creating or selecting materials was not identified as a significant challenge, suggesting that educators may not perceive content development as a major hurdle in incorporating sustainability into their digital teaching.

The third area of the research looks at the top 3 most interesting competences to develop of the EU GreenComp Framework. Out of 12 competences grouped into 4 categories, "critical thinking" (59%), "valuing sustainability" (38%), and "futures literacy" (35%) stand out. The prominence of critical thinking, seen as "assessing information and arguments, identifying assumptions, challenging the status quo and reflecting on how personal, social and cultural backgrounds influence thinking and conclusions", suggests a recognition of its paramount importance in navigating the complexities of sustainability. Valuing sustainability, seen as "reflecting on personal values, identifying and explaining how values vary among people and over time, while critically evaluating how they align with sustainability values", is also high on the list, indicating a shared emphasis on fostering a deep appreciation for sustainable practices. Futures literacy, which entails "envisioning alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future", underscores educators' awareness of the dynamic and evolving nature of sustainability challenges and a forward-looking perspective.

However, none of the competences associated with "acting for sustainability" area made it to the top: political agency (5%), collective action (24%), individual initiative (8%). This could suggest that educators are currently placing a greater emphasis on understanding and envisioning sustainability rather than immediate practical actions. It may reflect a sequential approach in which foundational competences take precedence before moving to more direct implementation and action for sustainability.

The fourth area of the study aims to collect practices and tools that worked well for integrating sustainability in digital education. 62% of respondents contributed 30 resources, which were structured into content-related and tools. These can be accessed by the whole EDEH community here.

In terms of best practices, there are no surprises - presentations, discussions, case studies, real-life examples, projects and impact assessments are recommended to be used, in an international, cross-disciplinary, collaborative, gamified, opened for learning context, given that there is access to proper equipment, digital tools and platforms, open educational resources and training paths.

Next, it is interesting to notice the order of preferences the respondents express in relation to preparing for sustainability in digital education:

- 76% want to engage in hands-on projects with colleagues or students - a hands-on approach that suggests a desire for practical, experiential learning. Collaborative projects allow educators to apply sustainability principles directly within the digital education context, fostering a deeper understanding through active participation.
- 70% would choose in-person workshops or training sessions - a preference that highlights the value educators place on direct interaction and real-time engagement with sustainability concepts and peers. In-person sessions provide opportunities for immediate feedback, networking, and a more socially connected learning experience.
- 59% are interested in participating in online courses or webinars on sustainability - a choice that recognises the convenience and accessibility offered by online learning platforms. Educators may find value in self-paced online courses and webinars that allow them to acquire knowledge and skills at their own convenience.
- Other options for training that amounted less interest were: collaborating with peers on forums and in communities, reading articles and other materials on the topic, attending events focused on sustainability in education, blogging and publishing articles.
- Lastly, 54% of respondents made recommendations to (a) educational institutions, (b) policymakers, or (c) other stakeholders to better support sustainability in digital education (Table 6).

Table 6: Recommendations to support sustainability in digital education

Educational institutions	• Develop a sustainability policy • Adopt the whole school approach • Integrate sustainability across disciplines • Collaborate with local communities • Invest in professional development • Encourage cross-disciplinary collaboration • Implement sustainable technology practices • Empower teachers be more flexible • Provide a toolkit to help including sustainability • Promote responsible e-waste disposal
Policymakers	• Integrate sustainability in national standards • Develop clear strategies and action plans • Provide fundings for different initiatives • Promote sustainable digital education • Support innovations in sustainable technologies for education • Promote Open Educational Resources (OERs) • Support research in digital education tools that effectively teach sustainability • Set framework for integrate sustainability in ALL courses • Make it compulsory
Other stakeholders	• Raise awareness for sustainability in digital education • Promote, support and take part in different initiatives • Integrate sustainability in digital education in extra-curricular activities • Ensure that digital sustainability education is inclusive and accessible to all students • Involve parents, alumni, workers, representatives from labour market • Be part of community initiatives (knowledge transfer, financial support, idea generation, networking etc.)

This study aimed to investigate educators' perceptions of sustainability in digital education across various levels and geographical locations. Due to sample size and demographics of the respondents, the study presents only a tiny glimpse into six interest areas: most common concepts associated with sustainability in digital education, the degree to which sustainability is integrated in every-day educational activities, challenges encountered, best practices & tools, most interesting competences in this domain, preferences in terms of training on this topic and recommendations for different stakeholders to support sustainability in digital education. The research manages to shed some light on the complexities and opportunities associated with embedding sustainability principles in digital education.

Further to this, we conducted semi-formal interviews in December 2023 with professors and educational leaders in Romania regarding integrating sustainability into digital and face-to-face higher education programs. The following key strategies, challenges, and future directions were identified based on the provided answers.

Integration of Sustainability in Curricula and Digital Education

The curriculum has been thoughtfully adapted to integrate sustainability following consultations with the business community. This approach ensures that the content remains relevant to industry standards and practices. By including digital education as a subject area that addresses sustainability, there is an acknowledgment of the evolving educational landscape and the need to prepare students for a digital future. This integration signifies a proactive stance towards embedding sustainability across all disciplines, although it presents unique challenges in ensuring that digital education methodologies also adhere to sustainability principles.

Remarkably, no significant challenges were reported in integrating sustainability into digital education. This lack of obstacles could suggest a seamless integration process, a proactive stance by the institution, a favourable context (due to the emergence of hybrid learning after the COVID-19 pandemic and the EU focus on sustainability) or a need for deeper evaluation to uncover subtle barriers.

> *Digital education is ancillary to face-to-face programs and more often than not perceived as just a supplement and not the norm, therefore it shall follow the face-to-face curricula, without any other specific additions. This aspect shall also refer to factors related to sustainability. For instance, courses such as "Sustainable Development" have been introduced as mandatory or elective in face-to-face and digital programs.*

Sustainability Assessment and Impact Measurement

The existence of a sustainability assessment framework within general departments such as the International Relations Department (as is the case for the Bucharest University of Economic Studies) indicates an institutional commitment to sustainability. However, not all organisations have such a framework.

The respondents rely on international evaluation indicators to measure the impact of sustainability initiatives in digital education when such a framework exists in a "best practice" approach. These indicators likely

encompass various environmental, social, and economic dimensions, and metrics are perceived as essential for evidence-based decision-making and continuous improvement.

However, the approach to measuring the specific effect of these initiatives within digital education remains broad and could benefit from more detailed methodologies. Nonetheless, data-driven decision-making is often the exception, not the norm, particularly regarding non-mandatory reporting.

> *Sustainability is in the early stages of being considered in higher education strategies, being perceived in most cases as more about compliance than a definite goal of educational development. The organisational approach is to think of sustainability as either a cost-reducer, a compliance requirement, or a potential market need (regarding topics to cover in educational programs). It is not seen as a competitive driver or part of the academic values.*

Addressing the Sustainability of Digital Technologies

The institutions still need to explicitly address the sustainability of digital education technologies and platforms regarding energy consumption and e-waste management. This acknowledgment highlights an essential gap in the sustainability discourse within digital education and presents an opportunity for educating the higher education leadership on the topic.

There are also concerns regarding the social sustainability of digital technologies, student (and teacher) alienation, or reduction in foundational skills related to collaboration (such as team exercises). These concerns must be addressed alongside the environmental impact of digital platforms and cloud services. However, these elements are not part of the current organisational discourse.

Collaboration and Success Stories

Collaborations with NGOs and other institutions, including partnerships with entities such as The Employment and Social Innovation (EaSI) (the circular loops have been explicitly mentioned), exemplified successful strategies for enhancing the sustainability of digital education programs. These collaborations broaden the impact of sustainability initiatives and provide valuable learning and networking opportunities for students and faculty. Usually, they appear in study programs related to sustainability (such as Environmental Economics).

Future Goals and Development

The focus on developing learning platforms and business simulations as future goals underscores a commitment to innovative and interactive digital education methods. These tools can offer practical experiences and insights into sustainable practices within various industries. Achieving these goals will likely require continued collaboration with external partners, advancements in sustainable digital technology, and an ongoing commitment to integrating sustainability into all aspects of digital education.

Recommendations for Further Development

The recommendations may follow the Bain&Company 2022 Three-part Game Plan:

Focus 1: The Creative Offense: renew, innovate, collaborate

- **Expand Partnerships:** Broaden collaborations with industry and other educational institutions to share best practices and resources in sustainable digital education.
- **Continuous Curriculum Evaluation:** Regularly review and update the curriculum to incorporate the latest sustainability and digital education research and practices. This direction should embed sustainability literacy throughout the curriculum, which fosters responsible graduates and equips them with the critical thinking and problem-solving skills needed to address complex sustainability challenges in their future careers.
- **Collaborate on Open Educational Resources (OER):** Encourage the creation and use of OER to reduce the carbon footprint associated with producing and distributing traditional educational materials. Collaborating across institutions to share resources fosters sustainability and promotes inclusivity and access to education.

Focus 2: The midfield: measure, optimise, reduce, augment

- **Develop Specific and Detailed Metrics:** Establish clear, specific metrics for measuring the impact of sustainability initiatives within digital education. University decision-makers should know, understand, and use these metrics (which should involve content and infrastructure) as fundamental KPIs for digital education. Organisations should regularly assess the impact of sustainability initiatives in digital education and use the data to inform future improvements and strategic decisions, in line with the evidence-based decision-making identified as a current vulnerability. They should publicly share sustainability goals, progress reports, and best practices.
- **Address Technology Sustainability and Develop Sustainable Digital Learning Environments:** Initiate projects aimed at reducing the energy consumption of digital platforms and managing

e-waste effectively. For instance, projects may be developed to promote circular economy approaches in technology management. Before these projects, properly acknowledge that digital platforms have environmental and social sustainability concerns.

- **Develop Sustainable Digital Content:** Shift towards creating digital content that is sustainably designed and hosted. This includes optimising digital resources for energy-efficient storage and access, using easily updated formats to extend their lifecycle, and adopting practices that reduce digital redundancy and waste.

Focus 3: The defence: reskill, protect, secure

- **Student and Faculty Engagement:** Engage students and faculty in discussions and projects focused on sustainability in digital education to foster a culture of innovation and responsibility. This may be done through Gamification and experiential learning, collaborative research and peer learning (see also the previous recommendations) and/or recognition and incentives.

Nonetheless, it is highlighted that for proper deployment of sustainability in digital education as a relevant topic, organisations should consider all three aspects as a holistic approach.

Digital technologies and sustainability in international education

As we have explored in the preceding chapters, the pedagogical dimension of sustainability in digital education is multifaceted, with various practices across European educators enriching our understanding. Continuing on this topic, this chapter looks at the specific role of digital technologies in bolstering sustainability within international education, with a particular spotlight on the Erasmus+ Programme. This exploration is crucial in understanding how digital platforms can also be used as educational tools that are instruments of environmental responsibility in the framework of internationalisation of higher education.

Building upon the pedagogical dimension previously discussed, we can recognise that the use of digital technologies in education serves a dual purpose. It facilitates the dissemination of sustainability concepts within the curriculum and promotes environmentally conscious learning modalities. The integration of digital technologies has led to the emergence of virtual and blended courses as a normative practice, which adeptly combines face-to-face interactions with digital engagements. This blend optimises resource usage and exemplifies the commitment to sustainability, marrying educational quality with ecological mindfulness.

The Erasmus+ Programme has been particularly progressive in this regard. It champions a greener form of exchange by incentivising virtual and blended formats of mobility. These innovative educational

frameworks not only conserve but enhance the international learning experience while adhering to the principles of sustainable practice. In the case of higher education, virtual exchanges offer a viable solution to environmental concerns, enabling students to engage in international collaboration without the carbon costs of travel. Blended mobilities, with their strategic mix of physical and online education, strike a balance that respects the pedagogical need for physical interaction while maintaining a commitment to environmental sustainability by minimizing the overall travel requirements and associated carbon emissions. Blended mobility programmes typically involve condensed in-person engagements complemented by substantial virtual learning components, which significantly reduce the duration and frequency of travel compared to traditional semester-long exchanges. The approach is designed to maximise the efficiency of resource use during the physical stay, with a packed schedule that ensures the environmental cost per educational outcome is minimised.

Moreover, the Erasmus+ Programme's support for blended mobilities reflects an understanding that environmental sustainability can be integrated into the fabric of international education. By facilitating access to these programs for a broader demographic, the program indirectly promotes sustainability by offering alternatives to long-term travel, which can be both financially and ecologically taxing. The emphasis on virtual collaboration and local immersion during the physical stay not only enriches the learning experience but also instils a culture of environmental consciousness among participants. This is pivotal in cultivating a future workforce that is not only internationally educated but also environmentally responsible. The Erasmus+ Programme, through these initiatives, illustrates a commitment to reducing the ecological impact of international education, paving the way for a more sustainable future in global student mobility.

Nonetheless, the environmental impact of the digital technologies that underpin these education methods is significant, an issue we will examine in greater detail in subsequent chapters. The energy consumption of data centres, cloud computing, and online platforms contributes to the ecological footprint of digital education. Thus, sustainability in digital education must consider not only travel-related emissions but also the energy efficiency of the digital tools and platforms employed.

As we advance towards a digital future in education, the strategic implementation of technologies that support sustainable education is imperative. The pedagogical benefits of digital learning—its flexibility, accessibility, and inclusivity—must be balanced with a conscious approach to its environmental impact. This requires an ongoing evaluation of digital practices, ensuring they align with the broader sustainability goals of reducing energy consumption and carbon emissions. In the context of international education, such as

the Erasmus+ Programme, the integration of digital and sustainable practices is a multifaceted process. It requires the engagement of all stakeholders—from policymakers to educators, administrators to students—to cultivate an ecosystem that values and implements eco-friendly educational practices. The Programme's initiatives can guide the sector towards adopting such practices universally.

Therefore, as we integrate sustainability into the fabric of digital education, it is not enough to focus on content and pedagogy. We must also consider the operational aspects—how we power our digital tools, the life cycle of our devices, and the overall digital infrastructure. These considerations are very important to the understanding of sustainability in international education. The journey towards a more sustainable digital education landscape is complex, but with the collective efforts of the global education community, it is within our reach.

Sustainability within administration of education

Greening of key processes

In recent years, the administrative sector of higher education institutions has witnessed a significant shift towards “greening” their processes. This shift is a reflection of a broader commitment to environmental sustainability, answering the global call for action on climate change. Greening administrative processes involves a comprehensive re-evaluation and restructuring of traditional practices to reduce environmental impact, increase efficiency, and promote a culture of sustainability among staff and students. It is a transformative approach that goes beyond mere paperless initiatives, encompassing energy management, waste reduction, sustainable procurement policies, and eco-friendly campus operations.

At the heart of this green transformation lies the digitisation of administrative functionalities. Educational institutions are adopting digital workflows and cloud-based infrastructures, which not only streamline operations but also significantly curtail the consumption of tangible resources. This digitisation spans a range of practices, from electronic document management systems and virtual conferencing tools to digital student services. Such advancements lead to a marked reduction in the carbon footprint of the institutions. In conjunction with sustainable procurement that prioritises environmentally responsible sourcing, these measures are crucial. Moreover, the concept of green campuses — which includes the integration of sustainable design principles, biodiversity conservation, and the use of renewable energy sources — further embodies the ethos of environmental stewardship in higher education. Together, these initiatives place higher educational institutions at the forefront of sustainable operations, aligning their daily practices with the urgent demands for ecological prudence.

Focusing on the digitalisation of administrative processes and how it presents a significant opportunity not just for efficiency but also for contributing to sustainability initiatives, we can note it as an initiative as well within the Erasmus+ Programme. Evaluating and optimising these processes involves a critical analysis of necessary steps, leading to a reduction in paperwork and mindful management of digital files to mitigate digital waste as well, which is a central goal of the programme and specifically the European Student Card Initiative / Erasmus Without Paper initiatives (central to higher education).

But before we look at these two initiatives, first we need to define what do we consider paperless administration? Before we can elaborate on that, it is sensible to define which stages of digitalisation are out there:

In the model below, 3 stages of digitalising administration are presented. Looking at the differences in educational institutions, every institution will find themselves in a different phase.

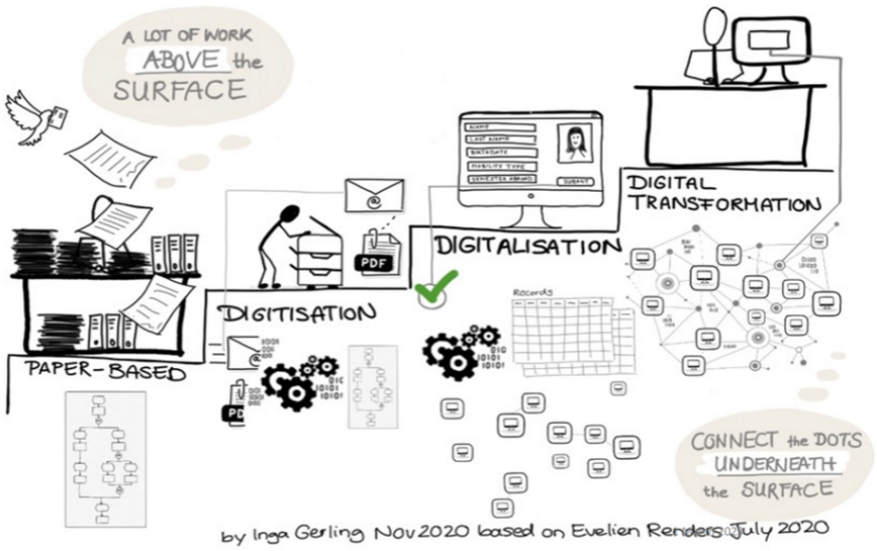


Figure 7: Illustration of the different stages of digitisation - digitalisation - digital transformation. Created by Inga Gerling (University of Hohenheim) and Evelien Renders (SURF) (2020). Presented in the ACA conference in Prague: Digitalisation in Higher Education: forward looking perspectives. 2020

Initially a HEI will start out with paper-based administration, application for admittance, Erasmus documents and whatever is documented on paper.

In the first phase of digitalisation of an institution it started with **DIGITISATION**. Digitisation can be defined the conversion of text, pictures, or sound into a digital form that can be processed by a computer. For example: making a PDF of your files or sending your application by e-mail.

The second is **DIGITALISATION**, which can be defined as adaptation of a system, process, etc., to be operated with the use of computers and the internet. For example: your outgoing exchange process is completely online. The students enter their details through an online application form, the selection and further procedure of the exchange will be executed completely online.

The final stage is **DIGITAL TRANSFORMATION**, this is the process of using digital technologies to create new — or modify existing — business processes, culture, and customer experiences to meet changing business and market requirements.

Each of these phases have their own underlying surfaces or what we call digital infrastructure.

From paper to pixel: the EU approach in higher education

The digitalisation of education systems across Europe has seen a significant leap forward with the introduction of the European Student Card Initiative (ESCI), a key project of the European Commission aimed at revolutionising student mobility. The ESCI is set to enhance the Erasmus+ Program's administration, making it more sustainable, inclusive, and streamlined, while fostering a strong European student identity.

This Initiative aims to facilitate student movement within Europe through digitalisation. It comprises three key components: the European Student Card (ESC) to replace existing student cards, the Erasmus+ App for managing practical aspects of student mobility, and the Erasmus Without Paper (EWP) for online mobility management. The European Commission advocates for these elements to help transition from paper-heavy processes to efficient digital systems, reducing the workload for students and staff. The Erasmus+ App serves as a social and informational hub for students, while the integration with the ESC simplifies access to services, negating the need for multiple cards. Additionally, ESCI promises to enhance sustainability, aligning with modern environmental goals.

The objectives of the ESCI are:

- A sustainable Erasmus+ Programme administration through paperless workflows – from application to transcript of records
- A more inclusive Erasmus+ programme through ready-made solutions, targeting communication with students
- A streamlined mobility experience for participants
- Boosting the sense of a European student identity

Switching to paperless systems, the Erasmus+ Program greatly cuts down on the use of paper and waste. Moving away from old systems that rely a lot on paper to digital ones helps the environment by reducing the need for paper and the pollution from moving documents around. Reported anecdotal experiences from the past reflect the inefficiency of old systems, with document loss during postal transfers leading to repeat shippings.

Digitalisation, particularly through energy-smart storage and cloud services, diminishes ecological footprints, embodying technology's potential for environmental stewardship. The ESCI champions the "once-only principle," where students submit their information a single time, securely shared among relevant parties, thereby cutting down on redundancy and resource use.

This approach encourages a sustainable mindset within academic institutions, where managing digital documents is more straightforward, leading to better efficiency for staff, students, and the planet. Though it is primarily aimed at higher education, the principles of switching from paper to digital are just as applicable in other educational sectors. With an increasing focus on environmentally aware learning and lifestyles, the Erasmus+ Programme supports sustainable habits across all areas of education and training, from the syllabus to building management, in harmony with the European Commission's wider objectives for eco-friendly education.

Although the initial intention was to adopt a bottom-up approach by giving higher education institutions the liberty to choose in which way they wish to connect, the realisation of the goal has proven to be challenging.

A number of stakeholders (Higher Education Institutions, National Agencies, system administrators) have expressed their concerns regarding the increasing gap between policy and implementation.

This call has been partially answered by the launch of the so-called Erasmus Without Paper Champions. In order to achieve a mainstreamed manner in which data can be exchanged safely, timely, and effortlessly there is an urgent need for case studies and experience from the field.

Table 7: Role of EWP Champions

The role of the EWP Champions contains but is not limited to:	• **Promote digital transformation through their case studies** • **Disseminate best practices and lessons learned with the community** • **Assist in testing new features and digital workflows** • **Contribute to optimising Erasmus+ student mobility workflows**

Practical examples

The efforts to enhance the mandate of the end-users (i.e. higher education institutions) has been reinforced by the European Commission which has approached and a number ofNational Agencies (Germany, the Netherlands, Italy, France, and Spain) in order to organise EWP Days in 2024. These days aim to address country-specific issues and offer customised solutions depending on the situation per country.

In addition, the German National Agency (DAAD) and Dutch National Agency (Nuffic) are organising a Training and Cooperation Activity (TCA) in collaboration with the Academic Cooperation Association (ACA) in 2025, in order to explore in which way digital transformation complements sustainability, inclusion, and participation.

Recommendations

Digital transformation plays a very important role for all horizontal priorities of the Erasmus+ Programme (digitalisation, civic engagement, inclusion, sustainability). Addressing how digital education can benefit from sustainable practices and how sustainability can influence the digital transformation are ongoing subjects that need to be explored on regional, national, and transnational levels.

We recommend:

- Engage all relevant stakeholders in discussions regarding potential challenges and possibilities;
- Adopt a pragmatic approach by setting feasible targets;
- Invest in resources (personnel, time, funding, expertise);
- Stay committed to the long-term vision;
- Promote all "quick wins";

A practical approach

The transition from paperwork to online documents does not inherently leads to increased sustainability; in fact, it can inadvertently lead to digital waste. Therefore, optimising work processes requires a critical examination of workflows, aiming to reduce both workflow and paperwork. Utilizing methodologies like LEAN (de Souza Lima, Rébula de Oliveira, de Carvalho Costa, Aprigliano Fernandes and Teodoro, 2023) offers a globally recognised approach for sustainable process improvement.

This critical assessment involves identifying essential stages and eliminating redundant ones, thereby streamlining workflows and enhancing efficiency. Following the LEAN approach, the determination of which steps should be retained or eliminated is structured within the PLAN-DO-CHECK-ACT stages. The initial PLAN phase entails evaluating the current state of processes and assessing their relevance in the digital transition. This assessment involves considering various types of "waste," such as:

Table 8: PLAN-DO-CHECK-ACT stages

Extra-processing	This is doing more work than required or necessary to complete a task. Examples include double-entering data and unnecessary steps in a process.
Non-utilised talent	This refers to the waste of human potential and skill. The main cause is when management is set apart from employees; when this occurs, employees are not given the opportunity to provide feedback and recommendations to managers in order to improve the process flow. Examples include lack of incentives for employees and placing employees in jobs or positions that do not use all of their knowledge or skill.

Waiting	This involves the process to be temporarily on hold to wait for an action to be done by a stakeholder in the process. Examples include waiting for authorisation from a superior or waiting for an email response.
Defect	A defect in a process should be declared unfit for use, as it means that this step would be done again (rework). Example includes a system does not automatically send out the e-mail, so a separate e-mail is sent.

Note: These are not all types of waste under the LEAN approach, but the types referred to, are most applicable to workflow assessment

After the current state, the future state is defined through collaborative discussions among stakeholders to determine necessary steps and identify areas for reduction or elimination.

The DO phase involves implementing the agreed-upon **future state**, followed by the CHECK phase, where stakeholders evaluate the effectiveness of the new process. Adjustments are made as necessary in the ACT phase, ensuring continual improvement and sustainability.

A practical example of a Higher Education Institution using the describe LEAN approach including the PLAN-DO-CHECK-ACT phases can be read in this case study from the European Association for International Education (EAIE).

Concluding, it is an important fact that the digitalisation of administrative processes is not just about technological advancement; it's a crucial component in fostering sustainability. Through a meticulous evaluation of process steps and digital files, organisations can significantly reduce paperwork and mitigate the environmental impact.

Environmental challenges and impact of digital approaches in education

The environmental challenges for digital education

There are many benefits of digital education with the ability to bring together learners across cultural and geographical boundaries using synchronous and asynchronous modes of delivery and innovative pedagogical designs; and by reducing on-campus resource requirements and the environmental impact of students, faculty and staff travelling to and from the university premises. However, at the same time, the continued acceleration of the adoption of digital technologies within the (higher) education sector, is a cause for some concern from a sustainability and environmental perspective (Selwyn, 2022). It is necessary that educational institutions understand the role they play in the usage of scarce resources required to manufacture, use, and dispose of digital hardware and in the enormous amounts of energy required to facilitate the underlying technology infrastructure that facilitates digital education.

Much of the concern about the continued adoption of digital technology in education (and this of course reached beyond the domain of education) is predicated on the need for raw materials (e.g. minerals and metals) used to design, develop and manufacture the technology hardware (e.g. batteries) and the manufacturing required to develop the digital hardware (e.g. significant energy usage) (Selwyn, 2024). Belkhir and Elmeligi (2018) also highlight that digital education is using hardware and software provided by a technology industry that has a significant environmental footprint in terms of global greenhouse gas emissions.

To address these sustainability challenges, the role of digital technologies is twofold. On one hand, they are part of the problem, but on the other hand, they can be instrumental in crafting solutions. Digital tools and platforms can be harnessed by educators to inform and engage students about vital sustainability issues. For instance, by integrating simulations and digital models, educators can offer students hands-on experience in managing virtual ecosystems, conducting energy audits, or exploring the impact of human activities on climate change, all within a digital environment. Such educational experiences are crucial for fostering an understanding of sustainability practices and encouraging responsible stewardship of resources.

One route to potentially reducing the environmental impact of education technologies and digital education is green tech, i.e. digital technologies that can help with mitigating negative impact on the environment. In practice this might mean technology that is based on more “ecologically friendly means of energy consumption, cleaner training of AI models, decarbonised software, sustainable device production and data

storage" (Selwyn, 2024, p. 265). There are doubts, however, whether the design and development of green education technologies can generate enough positive impact quickly enough, especially as core issues related to the "material extraction, excessive water consumption and e-waste would remain" (Fox, 2023).

Moreover, educational institutions can lead by example in the management of e-waste, which is a growing concern associated with the disposal of obsolete digital hardware. Developing robust recycling programs, advocating for extended producer responsibility, and promoting the purchase of environmentally friendly and easily recyclable devices are essential steps. Institutions can also partake in or initiate take-back programs, ensuring that electronic waste is responsibly recycled, thereby reducing the leakage of hazardous substances into the environment and recovering valuable materials for reuse.

In essence, while the transition to digital education poses environmental challenges, it also offers educational institutions a unique platform to demonstrate and teach sustainable practices. By adopting a proactive approach to managing the environmental impact of their technological resources and by integrating sustainability into the curriculum, universities can play an important role in shaping a more sustainable future.

EdTech within limits

The field of education is, however, in a good place to explore, challenge, critically review, and innovate to meet the current and future digital needs of learners, whilst at the same time seeking ways of lowering the environmental footprint and adopting greener IT and digital solutions and alternatives where possible (Greenwood and Houston, 2015). This may require a different way of thinking about digital education and EdTech where access to and usage of digital technologies are not considered as infinite (e.g. unlimited cloud storage, always-on, continuously faster internet connectivity). Instead, educational institutions may wish to explore other approaches to reduce EdTech's environmental impact. Several of these approaches (e.g. Computing within Limits, Permacomputing) can be grouped under the theme of "radically sustainable computing" (Heikkilä, 2021). The underlying belief is that digital technology is not infinite and limitless due to the huge amount of natural and other resources required to produce, manufacture, transport and use the hardware and software. In this way, a different world view presents itself where the development and usage of digital technologies in education may need to be constrained, limited and "radically leaner" (Pargman and Wallsten, 2017; Selwyn, 2022).

In the aftermath of the pandemic, new initiatives arose focused on how to offset the environmental impact of increased use of digital tools and platforms, such as video conferencing platforms, which many educators use to deliver sessions, workshops, and lectures. An example of such an initiative is the partnership between Brynk and Norwegian video conferencing app Whereby which plant trees in an effort to offset the carbon dioxide that is emitted into the atmosphere from video conference calling.

In practice this approach for educational institutions may include:

- Reduction of resource usage and breaking the continual churn cycle of upgrading hardware and software.
- Using technology hard that can be disassembled and repaired.
- Choosing to procure refurbished and reconditioned hardware and develop the in-house capability to repair and refurbish technology.
- Using community-based internet networks, long-range Wi-Fi, and other low-tech connectivity.
- Connecting to alt-energy grids such as community power banks (Bhowmik, 2019).

Initiatives have also been launched in recent years to enable universities to assess and evaluate their environmental footprint. One such initiative is EUSTEPs, which is a project launched under the leadership of Aristotle University of Thessaloniki and is a strategic partnership between four European universities and non-governmental organisation Global Footprint Network. Following this concept this paper also includes a checklist for universities to assess and self-reflect on the sustainable practices within their pedagogical and administrative activities in the following chapter.

Environmental Cost of Connectivity and Computing

A 50-inch LED television consumes much more electricity than a smartphone (100 times) or laptop (5 times). Because phones are extremely energy efficient, data transmission accounts for more than 80% of the electricity consumption when streaming.
Source: https://www.iea.org/commentaries/the-carbon-footprint-of-streaming-video-fact-checking-the-headlines

A recent study explored the potential energy and emission reductions of shifting YouTube music videos to audio only when playing in the background.
Source: https://www.iea.org/commentaries/the-carbon-footprint-of-streaming-video-fact-checking-the-headlines

According to a test, a genuine Apple iPhone charger uses in the region of 135W of power a month, which equates to just over 1.5KW h a year, which means that if you lived in Hawaii, that charger would cost $0.46 a year it I left it plugged in doing nothing. If you decided this was too much and moved to Louisiana, you would save a quarter.

Source: https://www.zdnet.com/article/how-much-electricity-do-all-your-smartphone-chargers-waste-when-not-in-use/

Apparently, training a large deep learning model uses roughly the amount of energy used by a human brain over its entire lifetime (about 78 years). And that is not factoring in the huge amounts of energy then used to process all of the queries sent to the AI after it has been trained.

Source: https://www.wholegraindigital.com/blog/will-ai-be-good-for-the-environment/

Researchers at the University of California, Riverside and the University of Texas, Arlington recently crunched the numbers to figure out how much water a data center operating ChatGPT would consume. They based this on reported water consumption by Microsoft's data centers while training OpenAI's GPT-3, which clocked at about 185,000 gallons. For reference, that is enough to make 320 Tesla vehicles. Using this metric, the researchers were able to calculate that ChatGPT "drinks" roughly 500 ml of fresh water for every 20 to 50 questions that it answers. That's the same as a 16.9 oz water bottle.

Source: https://www.govtech.com/question-of-the-day/how-much-water-does-chatgpt-drink-for-every-20-questions-it-answers

The paper explores how neuropsychology, social signaling and norms have been exploited to drive human behaviors which grow the economy, from consuming goods to having large families. The authors suggest that ancient drives to belong in a tribe, signal one's status, or attract a mate have been co-opted by marketing strategies to create behaviors incompatible with a sustainable world. "We're talking about replacing what people are trying to signal, what they're trying to say about themselves. Right now, our signals have a really high material footprint –our clothes are linked to status and wealth, their materials sourced from all over the world, shipped to south-east Asia most often and then shipped here, only to be replaced by next season's trends. The things that humans can attach status to are so fluid, we could be replacing all of it with things that essentially have no material footprint – or even better, have an ecologically positive one."

Source: https://www.theguardian.com/environment/2024/jan/13/human-behavioural-crisis-at-root-of-climate-breakdown-say-scientists

Checklist for educational institutions – sustainable digital approaches

As a concluding element of this report, we present a "checklist" that serves as a practical resource for educators, administrators, and others within the educational sector. This guide is dedicated to the critical examination of digital education's role in addressing sustainability. It aims to aid stakeholders in the thoughtful integration of sustainability topics within digital learning environments, the adoption of digital tools to engage students with sustainability concerns, and the assessment of the environmental impact of various digital educational platforms and tools. The checklist is not just a tool, but a stepping stone towards a more informed and sustainable approach to digital education, enabling stakeholders to make decisions that align with ecological considerations and educational excellence.

Sustainability in the university

Sustainable behaviour in campus
☐ **Use green transportation to arrive in campus: walk, bike, carpool**
☐ **Reduce water consumption** • Turn off faucets when not needed • Have automatic faucets
☐ **Reduce energy consumption** • Turn off lights and electronics when not in use; • Use energy-efficient devices; • Unplug chargers and adapters when not charging; • Use natural light
☐ **Minimise physical waste from packaging** • Use reusable cups, water bottles, lunch containers, bags • Opt for products with minimal or eco-friendly packaging (recyclable, biodegradable, made from sustainable materials); • When possible, invest in products that are designed for longevity; • Look for sustainability certifications and eco-labels on products;
☐ **Reuse, recycle**
☐ **Set goals, monitor and track progress**

Sustainable behaviour in the digital space
Hardware
☐ Minimise electronic waste: Develop and implement a lifecycle management plan for electronic equipment.
☐ Extend the lifespan of devices by scheduling regular maintenance checks for all electronic equipment to ensure optimal performance.
☐ Buying refurbished or second-hand devices instead of always purchasing new ones.
☐ Properly disposing of and recycling outdated or non-functional equipment following environmental guidelines.
☐ Adjust screen brightness to conserve energy.
☐ Implement power management settings on devices to reduce energy consumption during idle periods.
☐ Provide training programs for staff on energy-efficient equipment usage and maintenance.
☐ Add to your list of criteria for choosing suppliers: low energy/ low carbon.
Software
☐ Lower resolution when streaming videos to reduce data and energy consumption.
☐ Reduce video quality during online classes.
☐ Download content for offline use when possible, to avoid streaming repeatedly.
☐ Download and upload files during green energy windows or off-peak.
☐ Turn off cameras in online events when not needed.
☐ Close unnecessary tabs in browsers and applications to conserve energy.
☐ Declutter the digital space - email, photos and other files.

- [ ] Optimise file sizes for sharing and storage, avoiding unnecessary attachments and compressing files.
- [ ] Optimise length of videos in content development.
- [ ] Use video conferencing platforms with lower bandwidth requirements.
- [ ] Use tools for collaboration that reduce the need for excessive printing and paper usage.

Sustainability in curriculum integration

Sustainable topics and activities in general
☐ Infuse sustainability topics into any discipline curriculum - consumption, waste, lifecycle, safety, inclusion, wellbeing, platforms algorithms, disinformation etc.
☐ Share relevant news, resources and tools.
☐ Create assignments that focus on green topics.
☐ Include assessment criteria that are related to sustainability.
☐ Incorporate outdoor activities or experiments into lesson plans.
☐ Monitor student engagement and participation in green initiatives.
☐ Collect feedback from students and peers on effectiveness.
☐ Incorporate sustainability explicitly in the learning objectives, for example specify the knowledge, skills, and attitudes you aim for students to develop regarding sustainability.

Sustainable topics and activities related to digital space
☐ Opt for digital textbooks, resources, and materials to minimise the use of paper.
☐ Organise virtual clean-up activities - declutter email and files.
☐ Mix in-person and online teaching and meetings when possible, reducing the need for commuting.
☐ Encourage participation in collaborative online projects that address real-world sustainability challenges.
☐ Record and share lectures online to minimise travel for both teachers and students.
☐ Encourage practices such as minimalism, efficient coding, and accessibility of the digital creations.
☐ Use open educational resources, which are freely accessible, openly licensed materials that can be shared and reused.
☐ Use video conferencing platforms with lower bandwidth requirements.
☐ Use tools for collaboration that reduce the need for excessive printing and paper usage.
☐ Optimise size and mix of files shared to reduce energy use.
☐ Create a lifecycle system to keep track, reuse and archive digital content.

Conclusion

This report has undertaken a thorough investigation into the relation between sustainability and digital education, focusing on essential aspects, such as the perceptions of educators, challenges encountered, good practice cases, and the necessary competencies for embedding sustainability within digital educational. Our analysis has revealed a complex understanding among educators regarding the impact of digital education on sustainability. Importantly, the findings indicate a strong inclination and preparedness among educators to incorporate sustainability into digital education, albeit challenges like time constraints, limited resources, and inadequate support persist. There is a clear preference for practical, experiential learning approaches to sustainability, as evidenced by the enthusiasm for participating in projects, workshops, and collaborative efforts.

The abundance of exemplary practices and tools shared by participants of the survey and the squad on sustainability in digital education of the European Digital Education Hub suggests a collective drive within the digital education community towards enhancing the integration of sustainability. The recommendations for educational institutions, policy makers, and other stakeholders present a comprehensive strategy for supporting this endeavour, advocating for policy evolution, interdisciplinary collaboration, practices in sustainable technology, and augmented support for educators.

Incorporating the checklist for educational institutions as a practical resource for stakeholders in education, this report champions a systematic approach for educators, administrators, and educational leaders. This tool not only provides a practical resource for the thoughtful incorporation of sustainability in digital learning environments but also marks a stepping stone towards a more informed and sustainable approach to digital education, aligning ecological considerations with educational excellence.

Looking ahead, it is crucial for the educational sector, policy makers, and the broader society to acknowledge and act upon the critical role digital education plays in achieving sustainability objectives. By leveraging digital education as a strategic instrument for sustainability, we align with global educational and environmental goals, while preparing learners to contribute meaningfully to a sustainable future.

In closing, this report sets the stage for ongoing discourse and initiatives aimed at merging sustainability with digital education. It calls for a united effort among all stakeholders to embrace innovation, foster collaborative ventures, and advance a sustainability agenda that is comprehensive, effective, and transformative. As we progress, it becomes a collective duty to ensure digital education not only facilitates knowledge sharing but also acts as a driving force for sustainable development.

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Appendices

Annex 1. Teaching about sustainability world-wide examples

Digital simulations and games https://dl.acm.org/doi/fullHt	Teaching about sustainability.	• Jeux sur le recyclage et tri des déchets - Le site de Tom (syctom-paris.fr) • U-M Environmental and Sustainability Online Games | University of Michigan School for Environment and Sustainability (umich.edu) • Tri des déchets, jeu en ligne - Jeux éducatifs gratuits en ligne (educatifenfants.com) • Games4Sustainability - Sustainability through serious games • Sustainability Management Simulation: Net Zero | Harvard Business Publishing Education • https://erpsim.hec.ca/en/node/771
	VR games that promote sustainability.	• 5 Eco-Friendly Virtual Reality Games (ecofriend.org)
	Malaysia – VR recycling game.	• Malaysia's First Fully Immersive Recycling VR Game | Sustainability, Sunway University
	Romania – VR game that allows municipalities to distinguish between actions and situations that either support or hinder sustainability, ethical manners, race and gender diversity, etc.	• Promoting sustainability with Virtual Reality gaming (centric.eu)
	Austria – VR game through which players learn about the value of aluminum as a raw material and gain knowledge about proper waste recycling disposal systems used at music festivals, sports events, and roadshows.	• Recycling VR Game: Every Can Counts | vrisch
	UN Environment Programme - VR game to experience your carbon footprint in VR.	• Recycling VR Game: Every Can Counts | vrisch
	Trash rage – a post-apocalyptic VR adventure to learn about ecology.	• Trash Rage VR - First ecologically themed VR game (giantlazer.com)
	North Carlina Uni, USA; Sustainability- Gamified.	• Gamified: students can learn about sustainability, researched child development.

Virtual field trips	Virtual field trips can be used to take students to places they might not otherwise be able to visit and can also spark discussions about sustainability. Example: Google Earth, Google Maps Street View, Google Earth VR, etc.	• Top 10 Virtual Reality (VR) Field Trips for Students - Nearpod Blog • Virtual Field Trip Apps and Websites | Common Sense Education • The Best Virtual Field Trips for the Classroom (weareteachers.com)
	Teaching about sustainability. Virtual XR, XR application can be used to foster knowledge on environmental sustainability and biodiversity while also increasing students' interest and possibly leading to a more positive attitude towards the environment and sustainable behavior.	• Developed by Greenpeace, it allows students to visit places like the Great Barrier Reef or the Amazon rainforest
Courses and webinars	Online or hybrid courses and webinars can be used to teach students about sustainability from anywhere in the world. Online MOOC on sustainability	• Article: Massive Open Online Courses as a Digital Learning Strategy of Education for Sustainable Development
	Hybrid university immersive course on "Sustainability Transition in international business" at Grenoble Ecole de Management, France. Chapter 4 of this paper presents 8 good practice examples of digital sustainability education.	• Dispositif ST101 : GEM lance un cours hybride et immersif pour former aux enjeux de l'innovation durable et de la transition écologique | Actualités | Grenoble Ecole de Management (grenoble-em.com) • WPS_03-2021.pdf (uni-giessen.de)
Badges and challenges	Virtual or physical badges can be used to motivate learners and involve them in sustainability projects both in formal and informal education.	• Environment and Sustainability | World Scouting
	Scouts platform with online challenges that aim at acting for the environment in real life:	• Students earn digital badge for sustainability-focused activities in new program | Penn State Engineering (psu.edu)
Digital storytelling	Digital storytelling can be used to teach students about sustainability in a creative and engaging way. A video story that "exposes the connections between a huge number of environmental and social issues, and calls us together to create a more sustainable and just world".	• The Story of Stuff - Story of Stuff

Digital storytelling AI chat bots	An interesting way to approach sustainability topic in any subject could be to include in the course inquiry activities in which students are supposed to interact with an AI chatbot to find answers and get ideas. This requires nevertheless a plus account on ChatGPT.	• https://chat.openai.com/g/g-AamgQLJ2x-luna-the-sdg-bot
Data, analytics and visualisation tools	These tools can be used to visualise and analyse data related to different sustainability topics.	• MyOceanLearn • European Air Quality Index • Googles Environmental Insights Explorer
Digital storytelling AI chat bots	These tools can be used to can be used with students to collaborate and generate discussions on sustainability topics.	• Mural Social Business Model Canvas • Miro Sustainable UX Design Toolkit

Annex 2. Digital Resources for Teaching Sustainability: A Comprehensive Framework

Other educators may use this set of digital resources to teach sustainability in both digital and hybrid settings. These resources aim to engage students, foster critical thinking, and promote sustainable practices. The resources are suitable for students at various levels of study and may be used as part of courses or as a stand-alone course.

Unless otherwise mentioned, the resources are results of Erasmus+ projects; therefore, ***they are open-source, available digitally free of charge for teachers and students.***

1. Introduction to Sustainability

Objective: Establish a foundational understanding of sustainability principles.

Resources:

- **Video Lectures:** Short videos explaining the three pillars of sustainability (environmental, social, economic).

  What a Wonderful World: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-IT02-KA229-079456

  Sustainability Illustrated: https://www.youtube.com/watch?v=2f5m-jBf81Q

  Sustainable Earth: https://sustainable-earth.org/videos/

  TED Talks: https://www.ted.com/topics/sustainability

- **Interactive Infographics:** Visual representations of sustainability concepts.

  ERASMUS FOR FUTURE - Young Europeans facing climate change as a common challenge - Poster exhibitions and Simulation Game: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-DE03-KA229-077300

  Sustainability Illustrated: https://sustainabilityillustrated.com/en/
- **Readings:** Accessible articles or e-books on sustainability basics.

  Developing Empowered Sustainable Communities: Green LifeStyle, Cultural Heritage & Economy: https://erasmus-plus.ec.europa.eu/projects/search/details/2021-1-LT01-KA220-ADU-000030102

  Highlighted project results for the European Green Deal: https://erasmus-plus.ec.europa.eu/projects/priorities-2019-2024/a-european-green-deal

2. Sustainable Development Goals (SDGs) Exploration

Objective: Connect sustainability to global goals.

Resources:

- **Interactive Websites:** Explore the United Nations' SDGs and their relevance to various sectors.

  UN SDGs website: https://sdgs.un.org/goals

  UNEP – UN Environmental Programme: https://www.unep.org/

  21st Century Skills in the Context of the UN's Social Development Goals for Pupils: https://erasmus-plus.ec.europa.eu/projects/search/details/2019-1-DK01-KA201-060200
- **Case Studies:** Real-world examples of projects aligned with specific SDGs.

  School Food Lab: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-BE02-KA229-074774

3. Life Cycle Assessment (LCA) and Environmental Impact

Objective: Understand the environmental impact of products and processes.

Resources:

- **Simulations:** Interactive LCA tools demonstrating the life cycle of everyday items.

  LifeCycle Initiative: https://www.lifecycleinitiative.org/

  Quantitative Tools for Sustainable Food and Energy in the food chain: https://erasmus-plus.ec.europa.eu/projects/search/details/2014-1-MT01-KA200-000327

  Environmental simulation tool by IRTA: https://www.wur.nl/en/research-results/projects-and-programmes/euphoros/calculation-tools/environmental-simulation-tool.htm
- **Virtual Tours:** Explore eco-friendly factories or sustainable supply chains.

  European Platform on LCA: https://eplca.jrc.ec.europa.eu/

4. Circular Economy and Waste Reduction

Objective: Explore circular economy principles.

Resources:

- **Masterclasses:** courses on sustainability issues

  Circular Economy Lab & Observatory: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-IT02-KA201-079994

  Building bridges for circular economy by fostering youth entrepreneurship: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-3-BE04-KA205-002798

  Care for our planet with Natura 2000 and stand up against climate change!: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-BE01-KA229-074944

- **Webinars:** Live or recorded sessions on circular economy models.

  European Circular Economy Stakeholder Platform: https://circulareconomy.europa.eu/platform/en/event-type/webinar

  The Institution of Environmental Sciences: https://www.the-ies.org/analysis/webinar-introduction-circular

- **Design Challenges:** Encourage students to create sustainable product designs.

  Building green skills for circular economy – Fast fashion: https://erasmus-plus.ec.europa.eu/projects/search/details/2021-1-NL01-KA210-ADU-000033999

- **Documentaries:** Films like "The True Cost" or "The Story of Stuff."

  Films for the Earth: https://filmsfortheearth.org/en/film/the-true-cost/

  PBS's 17 films about sustainability and climate change: https://www.pbs.org/independentlens/blog/earth-day-watch-list-17-new-films-about-sustainability-climate-change/

5. Climate Change and Resilience

Objective: Address climate challenges and adaptation.

Resources:

- **Interactive Maps:** Visualize climate change impacts on specific regions.

  NASA Climate Change: https://climate.nasa.gov/

- **Climate Simulators:** Tools to explore scenarios and mitigation strategies.

  Biosphere VR – Finland: https://erasmus-plus.ec.europa.eu/projects/search/details/2021-2-DK01-KA210-SCH-000050423

  Remote learning and examination by using AR in maritime VET education: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-NL01-KA226-VET-083043

  The World Bank - Climate Change: https://www.worldbank.org/en/topic/climatechange/overview

6. Business and Sustainable Innovation

Objective: Link sustainability to business practices.

Resources:

- **Focus on energy efficiency:**

  Digital Energy Efficiency Designers: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-IT01-KA226-VET-009143
- **Focus on ESGs:**

  From ESG Integration to Impact Investing: https://erasmus-plus.ec.europa.eu/projects/search/details/2019-1-LI01-KA203-000168
- **Online Business Games:** Simulate sustainable business decisions.

  Circular economy from social enterprises to their customers – Circular Loops: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-AT01-KA202-078021
- **Masterclasses:**

  Greening the EntreComp Framework to Reconcile Economic Development and Environmental Security: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-DE02-KA202-007429
- **TED Talks:** Inspirational talks on sustainable entrepreneurship.

  TED Talks: https://www.ted.com/topics/sustainability
- **Case studies:**

  Skoll Foundation: https://skoll.org/

7. Assessment and Reflection

Objective: Evaluate student learning and encourage self-reflection.

Resources:

- **Online Quizzes:** Assess knowledge of sustainability concepts.

  Change Yourself, Help Nature: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-SK01-KA229-078316
- **Blogs or Journals:** Encourage students to reflect on personal sustainability practices.

  TREES: To Reinforce European Environment Sustainability – Creative Storytelling: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-CY01-KA229-065951

8. Hybrid Learning Strategies

Objective: Seamlessly integrate digital and face-to-face components.

Resources:

- **Blended Learning Modules:** Combine online content with in-person discussions.

  Tree of Light: https://erasmus-plus.ec.europa.eu/projects/search/details/2022-1-CY01-KA210-ADU-000083838
- **Virtual Labs:** Conduct experiments remotely.

  REmote labOratories for Practical Experiments on renewable energies at EU uNiversities: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-IT02-KA226-HE-095424
- **Collaborative Projects:** Hybrid teamwork on sustainability initiatives.

  greenYOUthCHANGEMAKERS: https://erasmus-plus.ec.europa.eu/projects/search/details/2022-1-SK02-KA154-YOU-000063103
- **Escape Games:**

  Erasmus + for Environmental Education in Europe: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-FR01-KA201-080647

  ARELL: AR Enhanced Life and Learning: https://erasmus-plus.ec.europa.eu/projects/search/details/2021-1-SI01-KA220-VET-000030513

9. Other resources

- **Lesson Plans:** Download pre-designed lesson plans aligned with various learning objectives and adaptable to different grade levels and subjects.

  Back to the Future – Building with Sustainable Local Traditional Materials - Educational Methodology: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-PT01-KA203-078406

  Learning and Teaching Materials for Greenings at Schools: https://erasmus-plus.ec.europa.eu/projects/search/details/2021-2-AT01-KA210-SCH-000049542
- **Facilitator Guides:** Access detailed guides with teaching tips, discussion prompts, and assessment strategies for each module and activity.

  Green Erasmus Guidelines for Environmental Activities: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-BE01-KA203-074971
- **Curated Resources:** A continuously updated library of reliable articles, documentaries, videos, and online tools related to sustainability.

  GIS4Schools: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-IT02-KA201-079490

Look for more resources in the Erasmus+ project results list (searchable on topics, languages, and types of resources) https://erasmus-plus.ec.europa.eu/projects search/?page=1&sort=&domain=eplus2021&view=grid&map=false&searchType=projects

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