green erasmus

HIGHER EDUCATION
on the journey towards
SUSTAINABLE DEVELOPMENT
in curricula

This educational framework was carried out in the framework of the Erasmus+ Key Action 2 Strategic Partnership project:

Green Erasmus
2020-1-BE01-KA203-074971

Brussels, July 2023

Editors:

Vasiliki Tsaklidou, European Students' Union
Katrīna Sproģe, European Students' Union
Rachel Drayson, Students Organising for Sustainability UK
Swetha Guruprasad, Students Organising for Sustainability UK

Contributors

All project partners

Design:

Melike Semercioglu, Erasmus Student Network
Joana Campinas, Erasmus Student Network

Illustrations:

Storyset

Contact:

www.project.greenerasmus.org

This publication is the outcome of in-depth consultations undertaken by the Green Erasmus consortium:

Erasmus Student Network
European Students' Union
European University Foundation
Students Organising for Sustainability UK
Technische Hochschule Köln
Université Libre de Bruxelles

Co-funded by the Erasmus+ Programme of the European Union

This project has been funded by the support of the European Commission. This document reflects the views of only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

1. Introduction ____ 4
2. Desk research on curricula design for environmental sustainability ____ 5
   2.1. Executive Summary ____ 5
   2.2. Desk Reserach Summary ____ 7
      2.2.1. Curricula design: definitions and guidelines ____ 8
      2.2.2. Pedagogies and methodological approaches in including ESD in curricula ____ 10
      2.2.3. Climate Change Education ____ 13
   2.3. Recommendations ____ 14
3. Case studies of environmental sustainability in curricula ____ 16
   3.1. Introduction ____ 16
   3.2. Methodology ____ 16
   3.3. Results ____ 17
4. Mapping competencies for sustainable development ____ 20
   4.1. Introduction ____ 20
   4.2. Competences Map ____ 21
5. Conclusion ____ 25
6. Bibliography ____ 27
7. Annexes ____ 32
   A. Sustainability in the Curricula Desk Research ____ 32
   B. Case Study Template (Question for the interviews) ____ 107
   C. Mapping of Competence Framework ____ 111

1. Introduction

This report was produced in the scope of the Green Erasmus project, co-funded by the Erasmus+ Programme. It aims to increase awareness on environmental sustainability in higher education by developing tools to incorporate the topic into curricula. By conducting research and looking into case studies, the goal was to map current practices of integrating sustainability into courses and competence frameworks. The outcome aspires to be an innovative guidebook that serves as a guideline for university staff to incorporate sustainability into curricula, increase awareness, and offer solutions for building competence frameworks on sustainability. Moreover, the expected impact is to encourage more sustainable operations in universities, producing more graduates with sustainability competencies, and contributing to the United Nations Sustainable Development Goals

This Educational Framework for Environmental Sustainability in higher education curricula is intended for teaching staff, staff responsible for curricula design, and other relevant personnel in Higher Education Institutions (HEIs) who have the responsibility of following initiatives and activities in order to integrate Education for Sustainable Development (ESD) in their Institutions. The goal of this report is to summarise positive outcomes, opportunities and challenges with regards to the implementation of ESD in the HEIs' curricula, based on extensive research and five case studies. The final part of this framework is dedicated to a mapping of competences that have been marked as the desired outcome of the embedding of Education on Sustainable Development within Higher Education Institutions curricula.

The results of the research are intended for use in policymaking and advocacy for further implementation of sustainable development thinking and education in the curricula of European universities. It is based on evidence of HEI's responses to policy initiatives set by international organisations, for example, the UN Sustainable Development Goals (SDGs) and the European Green Deal, illustrating that HEIs are invested in adapting their processes, policies and strategies to 'greening'. Simultaneously, the case studies have been collected with the intention to provide a hands-on glimpse into the realities of different HEIs implementing ESD in the curricula, with the hope that this will serve as an inspiration for more HEIs to start or continue their journey towards this goal.

2. Desk research on curricula design for environmental sustainability

2.1. Executive Summary

Aim

This desk research was conducted by European Students' Union (ESU) as part of the Green Erasmus project to investigate how Higher Education Institutions (HEIs) have embedded education for environmental sustainability at institutional and departmental levels. Moreover, it focused on identifying which actions HEIs take to support academic staff in embedding sustainability within the course curriculum (including training, learning and teaching methods, curricula strategy, curriculum reviews, etc.). This happened through a careful collection of literature on the subject. You can access the complete report for a more detailed account of the research.

Methodology

The literature review was conducted between November 2021 and March 2022 and resulted in a desk research report covering the following topics:

- definition of Education for Sustainable Development (ESD),
- guidelines and reflections on embedding ESD in the curriculum,
- the role of methodological and pedagogical approaches in embedding sustainability in the curriculum, and
- incorporation of Climate Change Education (CCE) in the curriculum. The review was limited to sources published between 2010 to 2021, mainly focusing on HEIs in Europe.

Core Findings

There is a strong need for a wide consultation with key players on the topic of embedding ESD in the curricula, such as students, employers and enterprises, academics, professional service teams and academic governance. It is beneficial to use a ‘whole institution’ approach that goes beyond the formal education settings and mainstreams sustainability in all aspects of the university, including teaching and learning improvement and creates connections between academic institutions.

Same as with integrating ESD in curricula, CCE seeks cross-sector collaboration, educational assessment, interactive teaching modes and interdisciplinary workshops. Many academics and students still perceive ESD as a somewhat ideological concept that is being forced into a specific area. Thus, ESD-related changes in the curricula need to be clearly linked to core scientific and technical competencies.

Pedagogical approaches in ESD should not be centralised on an institutional, yet alone national level, but should depend on the context in which the curricula is being developed. In other words, the previously conducted desk research suggested that there should not be a "one-size-fits-all" approach to incorporating education on sustainable development in curricula. Rather, the approach should be context-specific and take into consideration the unique characteristics and needs of the local environment, culture, and economy. This entails that the pedagogical approaches used to teach sustainable development should be tailored to the specific context in which the education is being provided. For example, a course on sustainable agriculture in a rural farming community may require a different approach than a course on sustainable urban planning in a city, and both will be very different from a course on Political Economy or Law. By taking a context-specific approach, educators can better engage students and help them to understand how sustainability applies to their specific environment. This can help to increase the relevance and applicability of the education, and make it more likely that students will be able to apply what they learn in their future careers and daily lives. Overall, a context-specific approach can help to ensure that education on sustainable development is more effective and impactful.

HEIs have changed their approach in incorporating sustainability. In the past, their main emphasis was on reducing environmental impacts, but during the last decade, they started to question traditional teaching methods and began using collaborative, community-based, and service-learning approaches. This shift in approach is due to the growing recognition of the importance of sustainable development in addressing global challenges, such as climate change, social justice, and economic inequality. HEIs are now incorporating sustainable development into their curricula through innovative pedagogical approaches that promote critical thinking, problem-solving, and collaboration. These approaches not only prepare students to address global challenges but also help them develop skills that are highly valued by employers. Additionally, HEIs are also using these approaches to engage with their local communities and promote sustainability initiatives beyond their campuses.

Another aspect of the topic are the challenges that prevent or hinder the integration of sustainability in curriculum design. These include lack of funding, lack of staff engagement, insufficient coordination of activities and strategic support. A potential limitation of including ESD in the curricula is the lack of possibility to measure whether the university graduates that had ESD incorporated in their curricula will use the academic knowledge they have obtained in their workplace. These findings have been confirmed by the case studies as well.

2.2. Desk Research Summary

Through this desk research, we identified three main topics relevant to embedding environmental sustainability in the curriculum:

1) Curricula design: definitions and guidelines,
2) Pedagogies and methodological approaches in including ESD in curricula, and
3) Climate Change Education

The main findings of each of the sections and their conclusions are further explained below.

2.2.1. Curricula design: definitions and guidelines

Another aspect of the topic are the challenges that prevent or hinder the integration of sustainability in curriculum design. These include lack of funding, lack of staff engagement, insufficient coordination of activities and strategic support. A potential limitation of including ESD in the curricula is the lack of possibility to measure whether the university graduates that had ESD incorporated in their curricula will use the academic knowledge they have obtained in their workplace. These findings have been confirmed by the case studies as well.

Education for Sustainable Development (ESD)

Introduction

ESD offers an opportunity to frame curricula and harmonise objectives such as internationalisation, decolonising learning, promotion of interdisciplinary and transdisciplinary learning, as well as promotion of employability, civic engagement, equality, diversity and inclusion.

ESD can be embedded in an HEI's curriculum at a micro-level (teaching and learning in courses) and at a macro-level (programs and curricula) but the process of institutionalisation is still unclear. The process can differ from institution to institution because every HEI has its own individual context and history.

Core findings

- **The process of framing ESD is not linear, and therefore, asks for mapping exercises** that could be done in the form of qualitative questioning to the target groups.
- **Starting a discussion with students around the intersection of ESD and Sustainable Development Goals (SDGs) can be highly valuable** to those involved in curriculum design, course management and teaching to recognise ESD as a central part of the curriculum.

- A key methodological approach of positioning ESD within the curricula should require a wide consultation with key players in the topic such as students, employers and enterprises, academics, professional service teams and academic governance and various communities.

- ESD does not seek to be mentioned in every discussion. The course content may mean the term SD is never explicitly mentioned, but explicit issues, such as pollution and proper waste disposal can be.

- The main ways to embed SD in HEIs are through **integrating experimental and interactive approaches,** critical reflection on values and assumptions known as **transformative learning** and the use of **participatory learning approaches,** group works and collaboration outside the lectures.

- Forming a glocal[1] curriculum in HEIs is seen as efficient in ESD. It means **developing a curriculum in a holistic manner that allows transnational collaborations in HEIs for sustainable development** by focusing on real-world case studies, project-based learning and use of the campus as a learning resource.

Almost every course has an opportunity to integrate SD into it. However, there is no unified way to go about it. Overall, the most effective path to follow in this direction is to keep familiarising relevant stakeholders with the concept of ESD and by investing in identifying parts from the particular course that have a connection to it.

Seven different examples of ESD teaching:

1. Tutorials
2. Short courses
3. Key skills and skills for life

➤ *forming and practising critical thinking on how sustainability is relevant to students' chosen career*

4. Projects
5. Community as a learning resource

➤ *the formation of SD in the curriculum is influenced by the local sustainability issues through the use of case studies that are introduced in certain classes.*

[1] 'Glocal': reflecting or characterised by both local and global considerations.

6. The workplace as a learning resource
7. Enriched Curriculum

➤ *an institution can run an Enrichment Programme, which represents a way to help tutors develop better skills in teaching. These Enrichment Programmes would introduce a new ESD short course, show SD-themed films, adapt the existing activity to be connected to SD or run different types of craft activities.*

Challenges

- Difficulties in finding ways to implement and manage a new strategy into curricula.

- **HEIs quality systems work differently in almost every institution** and can cause confusion in the understanding of how the university functions, how to address issues, how Quality Assurance (QA) and Quality Enhancement (QE) aspects connect and how to introduce new themes to existing systems.

- **Lack of access to measure whether the same university graduates will incorporate the SD in their workplace** and implement and use the knowledge and skills they have acquired during their academic life.

2.2.2. Pedagogies and methodological approaches in including ESD in curricula

Introduction

There are three types of learning identified that are relevant to the implementation of ESD in curricula:

- **Conformative learning,** based on the reproduction of knowledge and in 'making things better'.
- **Reformative learning,** involves critical reflection and 'doing better things'.
- **Transformative learning,** includes the external observation of one's own worldview, in order to allow for cognitive and paradigm changes.

In this desk research, **sources related to ESD are mostly focused on transformative learning as a pedagogical approach to include ESD in the curriculum.** In transformative learning applied to ESD, the focus is on the process of **collective awareness which then translates into concrete initiatives.** HEIs should prioritise training for transformative learning in order to embed sustainable education. Implementing transformative and emancipatory pedagogies can be challenging but it is needed to assist sustainability education.

There are a number of identified key conditions to accelerate the progress towards the paradigm **shift to transformative learning** of ESD within higher education (Balsiger et al, 2017):

1. ESD must build on transformative learning and **explicitly integrate critical reflection on goals and values.**
2. Transformative learning has to **encompass critical reflection about the social context,** which includes the educational environment as an institutional setting subject to power relations.
3. **Competences among educators are needed** to recognize and accompany a learning edge, assess the risks of frustration and abandonment, help learners get past the in-between state, and facilitate the reconstruction and assimilation of sustainable meaning perspectives.
4. **Transformative teaching should include an emphasis on personal experience,** inter- and transdisciplinarity, service-learning arrangements, self-organised engagement with knowledge, values, and emotions, and living labs. Teachers should also take on the role of coaches, facilitating learning and co-learning among students but also between students and teachers.

Core findings

- **Integrating transformative learning within ESD requires a paradigm shift in teaching and learning,** based on a process of collective awareness for engagement in concrete initiatives and a participatory, integrative, reflective approach and constant re-negotiations of the practices and values.

- **Integrating different emancipatory and transformative pedagogies can help students,** academics and university personnel in teaching and learning sustainability, thereby emancipating and transforming students into potential social innovators.

- **Contemplative education[2] as a form of transformative education is seen as an efficient pedagogical method for social and individual transformation.**

- **Flipped classroom is a method to incorporate active learning;** students get all the important information for the ongoing lecture before class so that when they come to class they can actively participate in discussions and have more opportunities for high-level learning.

- **Implementing SD in Science, Technology, Engineering and Mathematics (STEM) has a greater possibility of success when their connection can correlate through core scientific and technical competencies** such as critical thinking, and empirical observation and testing, and build on, rather than work against, existing disciplinary, departmental and teaching and learning cultures.

Challenges

- **Change in learning approaches concerning ESD is coming at a slow pace** due to the traditional departmental, compartmentalised structure of universities and its disciplinary boundaries, which reflect the compartmentalisation of learning and research at all levels.

- **Lack of awareness of transformative learning.**

- **Lack of funding,** few financial rewards to educators participating in transformative schemes.

- **Existence of bureaucratic systems** that hinder the flexibility and the undertaking of integration activities.

- **Professional training to develop institutional leadership and competences in ESD for transformative education rarely exists.**

- **The potential clashes between teaching outcomes and sustainability in certain subjects.** In business schools, marketing professors still have the pressure to maintain the current 'profit and consumption approach' even if they identify themselves as sustainability-minded marketing academics. Even in research, environmental concerns in marketing are a niche area, which leads to some researchers focusing on traditional marketing at the beginning of their careers.

[2] Contemplative education is an approach to teaching and learning with the goal of encouraging deep learning through focused attention, reflection, and heightened awareness.

2.2.3. Climate Change Education

Introduction

Climate change education (CCE) aims to address and develop effective responses to climate change. HEIs have the main role in climate change (CC) adaptation by incorporating it into every part of their curricula. **To effectively teach and learn about climate change adaptation, the following methods are mentioned in the sources:**

- New active learning techniques using cross-discipline curricula
- Connecting learning to local problems
- Nourishing problem-solving and critical thinking skills
- Using storytelling teaching techniques and teacher education.

Moreover, **it is important that universities embed climate change into broader curricula and make efforts to increase its visibility.** By implementing CCE, higher education institutions can encourage students to be more active individuals. Furthermore, they can be active participants in facilitating a positive change in the world.

Core findings

- **Universities have to be active promoters of education on climate change** and to do so they have to include cross-sector collaboration, educational assessment and interactive teaching methods such as role-playing games and workshops that meet the interdisciplinary needs and form engaged individuals.

- **Training on CCE can be addressed at the university level** by introducing climate change aspects in the existing courses, designing new interdisciplinary courses, developing a flexible and interdisciplinary curriculum, increasing staff training and capacity, by enhancing partnership and collaboration between universities and by organising events as workshops, seminars and conferences.

- 'Connecting' is considered the most innovative approach in CCE and it means implementing CCE via new cross-disciplinary courses.

Challenges

- **The full integration of CCE into university curricula needs the active and continuous support of many stakeholders** such as management staff, academic staff, green offices in HEIs and external stakeholders such as NGOs and policymakers. **For now, it is reported that many HEIs face lack of funding and lack of staff expertise.**
- There is a big chance that CCE won't be implemented effectively in case there are not enough resources to train teachers or actions that would help the integration process.
- Teaching CCE within the ESD can be at risk because **institutions and academics prefer to focus on other topics in the ESD** framework than climate change.
- **Possibility of cognitive dissonance:** individuals become passive collectors of knowledge and do not act upon the knowledge they have obtained.

2.3. Recommendations

Approach to implement ESD in the curricula by HEIs:

- **Academic staff** should be encouraged to develop formal and extra-curricular resources for sustainability and employability skills relevant to their discipline;
- **Teachers and management staff at HEIs** should continue enterprise work with employers and professional bodies to develop the skills and knowledge needed for business opportunities in an emerging sustainable economy;
- HEIs should conduct further research on the importance of SD skills to graduate employers; further aspects to be researched and deepened are community, student, and academic partnerships for SD, as well as the different definitions and applications of SD being used by students, academics, and policy makers;

- **Students** should be encouraged to raise awareness on the importance of ESD in the formal curriculum through course evaluations, by raising their concerns and ideas through their student representatives and/or student unions, etc.

Approach to implement ESD in curricula by external collaborators:

- **Government and policymakers** should increase the resources and support for HEIs where students have a demand for SD to be embedded in their studies, promote the relevance of SD and support HEIs in the evaluation of SD incorporation;
- **Employers and professional** bodies should form connections with HEIs to identify needed knowledge and skills, work with academics to help incorporate professional sustainability skills and work with student unions to provide relevant experience through work and internships.

For CCE to be successful, universities are encouraged to take a whole-university approach to integrate CCE in every discipline and on every level.

Integrating different emancipatory and transformative pedagogies can help students, academics and university personnel in teaching and learning sustainability, thereby emancipating and transforming students into potential social innovators.

In the context of transformative learning, **students and faculty can strongly benefit from the cooperation with NGOs** in the integration of SD. An open discussion and cooperation between NGOs and universities is thus strongly recommended as it would develop the students' critical thinking, help them make links to the real world and contextualise theory.

Campuses should be 'living laboratories' in which students identify the economic, environmental and social changes that surround them and use the classroom as a space for students to identify barriers and challenges they and local communities can face and how to overcome them.

3. Case studies of environmental sustainability in curricula

3.1. Introduction

In order to connect solid literature research with the reality of universities in Europe, ESU conducted five interviews with staff members responsible for including sustainability in the curricula or representatives of universities. For one of the interviews, we spoke with a representative of a National Union of Students (Norway). The collection of case studies allowed the project to map the different ways currently in use to include sustainability in course schedules. One of the most interesting realisations made during the process of data collection was the challenge to find interviewees. The ensuring of five case studies proved to be much more challenging, as the topic of integration of sustainability in the higher education curricula is still in a phase of rapid evolution.

3.2. Methodology

ESU discussed with all consortium partners the format of the interview and the content of the questions, in order to ensure that the template of the questions will reflect the scope of the interview and efficiently collect HEI and department experiences of embedding sustainability across curricula. The specific questions targeted to highlight not only the barriers and obstacles that the different HEI deal with in relation to embedding ESD, but also the knowledge, good practice and hands-on experience that the HEI and departments have gained during the process, along with the positive outcomes of the endeavour.

The questions of the interview were divided into three categories:

a. Motivations and progress towards embedding sustainability,
b. Approaches to embedding sustainability, and
c. Impact.

3.3. Results

Ghent University

The Rector of the university is keen on embedding ESD in as many faculties and departments as possible, and the Centre for Sustainable Development within the institution has developed an analytical framework to facilitate the process of transition for the different programs. The framework has helped in identifying blind spots in different programs and fostering a good conversation among the different actors within programs. The framework for implementing ESD is anchored in the SDGs, so SD is seen as a broad umbrella term that encompasses the social aspect of sustainable development as well.

As of 2021, six of the university's 11 faculties had integrated sustainability into one or more programs. Some faculties started with a single program and then upscale with more programs. Workshops and community service learning have also been identified as important methods of implementing ESD.

The university is committed to providing resources and support for embedding sustainability in the curricula. However, practical barriers and lack of resources are still significant challenges. Overall, the university is transitioning towards sustainability, with initiatives such as the Think Tank Transition UGent, Sustainability Summer Schools, the Green Office, and surveys to assess the importance of ESD in the curricula.

The university also sees a clear link between ESD and CCE and sees CCE as a good approach to SD which makes ESD tangible.

Katholische Universität Eichstätt-Ingolstadt

The university has a range of initiatives to integrate sustainability into the curricula. The university allows all students to choose classes from other branches like sustainability, and there is an option for students to take an additional trajectory of 20 ECTS in sustainable development. The early attempts at embedding sustainability into the curriculum began in the 90s, and later developed into an institutional approach in the 2010s. Despite the university's efforts to teach sustainability, there are still challenges with integrating it into some of the curricula due to lack of budget and personnel resources.

The university has a coordinator and director of sustainability who focus on implementing sustainability at the university. The institution uses various teaching methods to implement education for sustainable development (ESD), including a seminar course that involves a project of ecological interest, such as biodiversity on campus. This course includes fieldwork and practical implementation of projects. The courses also involve practical implementation of projects such as assistance for refugees and sustainable consumption. The pedagogical approaches that have been emphasised include project seminars, working in groups, working with local stakeholders, and service learning.

The university recommends a whole-institution approach and emphasises the importance of changing the behaviour of institutions to align with sustainable development. The university suggests working with staff to ensure that they understand the role of higher education institutions and to structure sustainability in the university.

The university is in favour of implementing CCE, emphasising intergenerational solidarity, while also discussing the potential impact on research freedom.

Riga Technical University

Riga Technical University has embedded sustainability into its curricula to comply with a national legal requirement to do so, as well as with an aim to become an internationally recognized university (e.g. impact ranking). The university consulted other universities and developed a strategy for sustainability incorporating the SDGs, and now focuses on practical experience and adding value to the curriculum. The legal requirement mandates at least one subject on sustainability in each program, which is already 100% embedded. The university has been mapping out SDGs and is still in the process of it. The timeframe for the project of implementing ESD is 2021- 2025 so there is still a way to go.

CCE is still being developed and discussed, but there is a wish to implement it in the curricula.

University of Bucharest

The University of Bucharest is working towards embedding sustainability in its curriculum through a new strategic plan of the university's current mandate, which aims to promote research and social responsibility towards sustainability.

The University of Bucharest is working towards embedding sustainability in its curriculum through a new strategic plan of the university's current mandate, which aims to promote research and social responsibility towards sustainability. The implementation of environmental sustainability is done on a transversal basis, Mostly though, the university works on sustainability outside the curricula, with additional courses and transnational projects, such as Erasmus+ Strategic Partnerships. Internationalisation plays a big role in how they believe sustainability can be better understood and implemented at the University. The new rector has a visionary strategic plan to further embed ESD in the curricula, but the process, especially in terms of securing funding, can be very long.

Different approaches are being used depending on the course and discipline, and various departments such as Biology and Business Administration have made considerable progress in embedding sustainability.

The university is implementing CCE, and a new master's programme in Climate Change, Sustainability, and Energy is being created.

National Union of Students in Norway (NSO)

The importance of environmental sustainability in the curriculum of Norwegian universities is recognized and discussed, but taking action towards implementing it is still a challenge. Norway has a national law for social, economic, and environmental sustainability, and the government is urging universities to engage in sustainable development in their long-term strategies. In addition, a new generation of students who are more environmentally conscious is emerging, and they demand that their universities incorporate sustainability in their curricula. Students, administration, and management are all involved in implementing sustainability in Norwegian universities. However, there are still institutional differences, and academic freedom is a concern.

The biggest challenge in implementing sustainability is engaging stakeholders, as well as fragmentation of systems and inherent systemic flaws.

4. Mapping competencies for sustainable development

4.1. Introduction

This final element of the framework focuses on competences for sustainability that are the desired outcome of integrating Education for Sustainable Development (ESD) within curricula.

Firstly, it is useful to consider what is meant by a sustainability competence, and the recently published EU GreenComp - the European sustainability competence framework
- (Bianchi, et al., 2022) offers a useful definition:

> *"A sustainability competence empowers learners to embody sustainability values, and embrace complex systems, in order to take or request action that restores and maintains ecosystem health and enhances justice, generating visions for sustainable futures. This definition focuses on developing sustainability knowledge, skills and attitudes for learners so they can think, plan and act with sustainability in mind, to live in tune with the planet."*

With this in mind, a **mapping exercise** has been completed **to develop a comprehensive listing of the range of competences put forward as contributing to the progression and achievement of sustainability.** This map is designed as a resource for educators to gain an overview of a broad range of sustainability competences, drawn out through a literature review. It then goes on to signpost readers to key literature sources and other resources for commonly identified competences. The purpose of the mapping is not to propose a priority set of competences, but to **enable educators to gain a quick understanding of each competence and signposting to a set of references which will enable them to find out more.** The competence map can be found in section 4.1 of this report.

As a final element in this exercise, the same approach was then applied to teaching approaches and methods, recognising that **particular pedagogies have been proposed as being more relevant to supporting the development of sustainability competences.**

4.2. Navigating the competence map

The table, or map, below outlines all competences identified in the literature review. Reflecting the approach adopted by many existing competence frameworks, and to aid usability, the competences identified have been grouped into three categories. The categories defined draw on David Orr's 'head, heart, hands' model (Orr, 1992) of ecological literacy, and include:

- Ways of thinking and planning (head)
- Values and beliefs (heart)
- Ways of acting and doing (hands)

This model was identified as providing a useful framework to organise the competences identified in the literature review due to its holistic nature - it incorporates all three domains of learning identified in Bloom's Taxonomy (Bloom, 1956) which is widely used in educational settings to set learning outcomes and also to assess learning. The three domains of learning are mirrored in the 'head, heart, hands' model as they include:

- Cognitive domain (concerned acquisition and application of knowledge)
- Affective domain (concerned with processing of attitudes and emotions)
- Psychomotor domain (concerned with physical application of skills).

In each case, a short description of the competence is provided along with the sources included in the literature review which propose the competence as contributing to the achievement of sustainable development.

The literature review process highlighted the common proposition of some competences, and in addition, some authors went as far as suggesting competences which should be seen as priorities. These competences have been highlighted using the symbol ** in the map below. Readers are encouraged to **navigate to the section of this report associated with each of these common competences to find a more detailed description of each, along with additional resources beyond those originally included in the literature review.** These resources have been captured as they offer educators an accessible overview of the competence (for example video formats), and therefore the opportunity to rapidly increase understanding of each.

4.3. The Competences Map

Head

Ways of thinking and planning

COMPETENCES	
Exploratory thinking	Drawing on different disciplines, traditions and cultures to develop creative ideas and novel approaches. **Key sources:** *(Bianchi, et al., 2022).*
**Critical thinking	Able to consider information and arguments in a way that assesses assumptions and influences (personal, social, cultural) on thinking and conclusions. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017) (Rieckmann, 2012), (Cebrian, et al., 2020), (UNESCO, 2017).*
**(Integrated) Problem framing/solving	Able to identify the nature and complexity of problems, taking a transdisciplinary, collaborative approach to understand problems from a variety of perspectives and build viable solutions. Described by some authors as a 'meta-competency' that integrates multiple other key competencies for solving problems and fostering sustainable development. **Key sources:** *(Bianchi, et al., 2022), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016)*
**Futures/anticipatory thinking	Able to develop visions of alternative sustainable futures and scenarios and the steps needed to achieve these. Recognises repercussions of choices and actions on communities locally, nationally or internationally both now and in the future. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (University of Leicester Career Development Service, n.d.), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Giangrande, et al., 2019), (Redman & Wiek, 2021), (Demssie, et al., 2019)*
**Inter/transdisciplinary thinking	Uses knowledge and methods from different disciplines, and recognises benefits of gathering perspectives from a range of stakeholders. **Key sources:** *(Lozano, et al., 2017), (Cebrian, et al., 2020), (University of Leicester Career Development Service, n.d.), (Rieckmann, 2012), (Giangrande, et al., 2019), (Demssie, et al., 2019)*
**Values/normative thinking	Able to differentiate, specify, compare, apply, reconcile and negotiate extrinsic and intrinsic values in society, recognising how they are contextually, culturally and historically reinforced with positive and negative outcomes. Able to recognise how they align with sustainability values informed by concepts of justice, equity and responsibility. **Key sources:** *(Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (UNESCO, 2017), (Giangrande, et al., 2019), (Redman & Wiek, 2021)*
** Systems thinking	Approaches problems from all sides, considering time, space and context in order to understand interactions within and between systems. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Redman & Wiek, 2021), (Tejedor, et al., 2019), (Rieckmann, 2012).*
**Strategic thinking/planning	Able to design and implement systemic and transformational interventions, actions and strategies that take into account unintended consequences and spillover effects. **Key sources:** *(Arizona State University, 2018), (Lozano, et al., 2017), (Rieckmann, 2012) (Giangrande, et al., 2019), (Wiek, et al., 2011), (Wiek, et al., 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019) (UNESCO, 2017)*

Heart

Values and beliefs

COMPETENCES	
Commitment to learning	Willingness to learn and innovate, and initiation of own learning. **Key sources:** *(Lozano, et al., 2017), (Demssie, et al., 2019)*
**Self-reflection / awareness	Able to reflect on own values and others, how they might change over time and evaluate how they align with sustainability, and how these might be contradictory. **Key sources:** *(Bianchi, et al., 2022), (UNESCO, 2017), (Brundiers, et al., 2021), (Giangrande, et al., 2019)*
**Commitment to social justice and inclusion	Promotes equity and justice among present and future generations, and also amongst humans, nature and the environment. Includes responsibility for one's own actions. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (Rieckmann, 2012), (Giangrande, et al., 2019) (Demssie, et al., 2019)*
**Affinity for and connection to all life/common good	Recognises that humans are part of nature and showing respect for biological and cultural diversity and all forms of life on earth. **Key sources:** *(Bianchi, et al., 2022), (Cebrian, et al., 2020), (Quendler & Lamb, 2016), (Glasser & Hirsch, 2016)*
Commitment to active participation	Belief in and commitment to active participation across communities in order to reach sustainability solutions. **Key sources:** *(Cebrian, et al., 2020), (Gil-Domenech, et al., 2021)*

Hands

Ways of acting and doing

COMPETENCES	
**Communication	Able to communicate effectively using different methods and tools, adapting to different audiences. Remaining critical and evaluating different media. Listens actively to others' viewpoints and concerns. **Key sources:** *(Lozano, et al., 2017), (University of Leicester Career Development Service, n.d.), (Redman & Wiek, 2021), (Rieckmann, 2012), (Demssie, et al., 2019)*
Planning and implementation	Able to collectively plan and realise a planned solution towards a sustainable vision and to monitor and evaluate this process - recognising that problem solving is a long-term iterative process. **Key sources:** *(Brundiers, et al., 2021), (Redman & Wiek, 2021)*

Resource utilisation	Able to efficiently use material resources, but also in the allocation of 'human' resources and institutional arrangements to tackle sustainability challenges. **Key sources:** *(Demssie, et al., 2019), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*
Discipline specific competences	That complement sustainability and general competences. **Key sources:** *(Redman & Wiek, 2021)*
Maintaining healthy mental and emotional states (intra-personal)	Able to recognise mental and emotional health and take action to maintain healthy mental and emotional states. **Key sources:** *(Giangrande, et al., 2019), (Redman & Wiek, 2021)*
Balancing dimensions of sustainable development	For example able to challenge a focus on economic dimensions at the expense of social and environmental. **Key sources:** *(Demssie, et al., 2019)*
Adaptability	Being able to flex, adapt and adjust opinions and behaviours in relation to complex challenges, and changing contexts. **Key sources:** *(Bianchi, et al., 2022), (Demssie, et al., 2019)*
Individual initiative	Understanding what types of action are possible, as well as the confidence and willingness to act. **Key sources:** *(Bianchi, et al., 2022), (Demssie, et al., 2019)*
**Empathy	Accepting and embracing diverse opinions, experiences and perspectives and acting with compassion and sympathy in relation to the needs and actions of others. **Key sources:** *(Lozano, et al., 2017), (Redman & Wiek, 2021), (Rieckmann, 2012)*
Coping with ambiguity and uncertainty/resilience	Able to manage conflicts and setbacks, competing or contradictory interests and goals. Able to maintain hope. **Key sources:** *(Lozano, et al., 2017), (Rieckmann, 2012), (Giangrande, et al., 2019), (Glasser & Hirsch, 2016)*
**Collaboration and collective action	Ability to coordinate, motivate, negotiate, collaborate and cooperate (mediating and resolving conflicts where needed) to achieve goals and address sustainability problems. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Glasser & Hirsch, 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019)*
Political and community	Positively influences stakeholders at a political level (at local, regional, national or international scales) and demanding accountability for unsustainable action. **Key sources:** *(Bianchi, et al., 2022), (Rieckmann, 2012), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*
Motivate others and self	Able to encourage oneself to take action when required and encourage others to do the same. **Key sources:** *(Cebrian, et al., 2020), (Wiek, et al., 2016), (Hoffmann, et al., 2022)*
Discipline specific competences	That complement sustainability and general competences. **Key sources:** *(Redman & Wiek, 2021)*

Using individual experiences	For example uses local knowledge cultures, languages etc to realise sustainable development goals. **Key sources:** *(Demssie, et al., 2019)*
Understanding and modelling sustainable behaviour	Acts in a way that mirrors the change one wants to see, by acting in ways that are in accordance with sustainability goals. **Key sources:** *(Glasser & Hirsch, 2016), (Quendler & Lamb, 2016), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*

5. Conclusion

Overall, the embedding of environmental sustainability in higher education curricula is a crucial endeavour that has gained recognition and priority within Higher Education Institutions (HEIs). This report has provided a comprehensive framework for educators and university staff to guide the integration of Environmental Sustainability Education (ESE) across disciplines. By synthesising existing research, examining implementation efforts, and exploring perspectives on sustainability competences, this report serves as a valuable resource for HEIs seeking to meet the demands of students, the changing job market, and the pressing environmental challenges of our time.

The research reviewed in this report highlights the significance of embedding ESD in curricula. It demonstrates that incorporating sustainability into educational programs can enhance students' understanding of complex environmental issues and equip them with the necessary skills to address these challenges.
Furthermore, the findings underscore the importance of interdisciplinary and transdisciplinary approaches in fostering a holistic understanding of sustainability and promoting collaboration among diverse stakeholders.
The case studies presented in this report showcase successful implementation strategies employed by HEIs worldwide. These examples demonstrate that embedding ESD is not limited to specific disciplines but can be integrated into a wide range of courses and programs. The challenges identified during the implementation process, such as resistance to change and limited institutional support, highlight the need for institutional commitment, stakeholder engagement, and adequate resources to facilitate effective integration.

Moreover, the identification and exploration of competences for sustainability provide a foundation for curriculum development and assessment. The perspectives of educators, students, and industry professionals highlight the importance of not only knowledge acquisition but also the development of critical thinking, problem-solving, communication, and collaboration skills. Emphasising these competences ensures that graduates are well-prepared to contribute to sustainable development and make informed decisions in their personal and professional lives.

Finally, this report serves as a source of inspiration and methodologies for educators and university staff. It provides practical examples, resources, and tools to support the development and assessment of sustainable curricula. However, it is essential to recognize that embedding ESD is an ongoing process that requires continuous research, evaluation, and adaptation to remain responsive to the evolving needs of students, society, and the planet.

By embracing the principles of environmental sustainability in higher education curricula, HEIs can play a pivotal role in nurturing a new generation of leaders, professionals, and citizens committed to creating a more sustainable and equitable future. The integration of ESD not only meets the expectations of students but also aligns with the global imperatives to address climate change, biodiversity loss, and social injustices. It is through collective efforts and a shared commitment to sustainability that we can strive for a better world.

6. Bibliography

Balsiger, J. (2015). Transdisciplinarity in the classroom? Simulating the co-production of sustainability knowledge. Futures, 65, 185–194.

Barber et al., (2014). Integrating sustainability into business curricula: university of New Hampshire case study. Int. J. Sustain. High Educ.,15 (4), 473-493.

Bowerman, J. (2003). Leadership development through action learning: An executive monograph. Int. J. Health Care Qual. Assur. Inc. Leadersh. Health Serv., 16, 6–14.

Buil-Fabregá, M., Martínez Casanovas, M., Ruiz-Munzón, N., & Filho, W. L. (2019). Flipped classroom as an active learning methodology in sustainable development curricula. Sustainability, 11(17), 4577. https://doi.org/10.3390/su11174577

Caetano et al., (2015). Learning Sustainability and Social Compromise Skills: a New Track Is Born. ACM Press.

Caniglia, G., John, B., Bellina, L., Lang, D. J., Wiek, A., Cohmer, S., & Laubichler, M. D. (2018). The glocal curriculum: A model for transnational collaboration in Higher Education for Sustainable Development. Journal of Cleaner Production, 171, 368–376. https://doi.org/10.1016/j.jclepro.2017.09.207

Cocchiarella et al., (2016). Fruitful Futures: Imagining Pomona. Gaia.
Conger, J.; Toegel, G. (2002). Action learning and multi-rater feedback as leadership development interventions: Popular but poorly deployed. Journal of Change Management,3, 332–348.

Conger, J.; Toegel, G. (2002). Action learning and multi-rater feedback as leadership development interventions: Popular but poorly deployed. Journal of Change Management,3, 332–348.

Dirkx, J. M. (1998). Transformative learning theory in the practice of adult education: An overview. PAACE Journal of Lifelong Learning, 7, 1–14.

Drayson, R., Bone, E., Agombar, J., & Kemp, S. (2014). Student attitudes towards and skills for sustainable development. The Higher Education Academy.

Erpenbeck J. (2009). Was «sind» Kompetenzen? In: W.G. Faix (Ed.), Kompetenz. Festschrift Prof. Dr. John Erpenbeck zum 70. Geburtstag (pp. 1–57). Steinbeis-Edition.

Ferrer-Balas et al., (2009). Explorations on the University's role in society for sustainable development through a systems transition approach. Case study of the Technical University of Catalonia (UPC). J. Clean. Prod., 17 (12), 1075-1085.

“Global Action Programme on Education for Sustainable Development’’ (2015-2019). UNESCO, en.unesco.org/globalactionprogrammeoneducation

Granberg, O.; Ohlsson, J. (Eds.) (2006). Kollektivt Lärande i Arbetslivet. Studentlitteratu.

Hattie J. (2011). Which strategies best enhance teaching and learning in higher education? In: D. Mashek, E. Y. Hammer (Eds.), Empirical Research in Teaching and Learning (pp. 130–142). Wiley-Blackwell.

Hopkinson, P., & James, P. (2010). Practical pedagogy for embedding ESD in science, technology, engineering and Mathematics Curricula. International Journal of Sustainability in Higher Education, 11(4), 365–379. https://doi.org/10.1108/14676371011077586

Langdown and Vargas, (2015). Integrating sustainable development within teaching fashion education. In W. Leal Filho, et al. (Eds.), Integrative Approaches to Sustainable Development at University Level (pp. 539-550). Springer International Publishing.

Leal Filho, W., Sima, M., Sharifi, A. et al. (2021). Handling climate change education at universities: an overview. Environ Sciences Europe, 33 (109). https://doi.org/10.1186/s12302-021-00552-5.

Mezirow, J., (1997). Transformative learning: theory to practise. N. Dir. Adult Cont. Educ. 74, 5-12.

Mezirow, J. (2000). Learning as transformation: Critical perspectives on a theory in progress. Jossey-Bass.

Molthan-Hill, P., Blaj-Ward, L., Mbah, M. F., & Ledley, T. S. (2021). Climate Change Education at universities: Relevance and strategies for every discipline. Handbook of Climate Change Mitigation and Adaptation, 1–64. https://doi.org/10.1007/978-1-4614-6431-0_153-

Molthan-Hill, P., Worsfold, N., Nagy, G. J., Leal Filho, W., & Mifsud, M. (2019). Climate Change Education for universities: A conceptual framework from an international study. Journal of Cleaner Production, 226, 1092–1101. https://doi.org/10.1016/j.jclepro.2019.04.053

Mulà, I. (2017). Catalysing change in higher education for sustainable development: A review of professional development initiatives for university educators. International Journal of Sustainability in Higher Education,18(5), 798–820.

Papenfuss, J., Merritt, E., Manuel-Navarrete, D., Cloutier, S., & Eckard, B. (2019). Interacting Pedagogies: A Review and Framework for Sustainability Education. Journal of Sustainability Education, 20.

Raworth K. (2012). A Safe and Just Space for Humanity. Can We Live Within the Doughnut? Oxfam. https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/dp-a-safe-and-just-space-for-humanity-130212-en_5.pdf;

Rego, A., & Cunha, M.P. (2007). Workplace spirituality and organisational commitment: An empirical study. Journal of Organisational Change Management, 21(1), 53–75.

Rockström J, Steffen W, Noone K, Persson A, Chapin FS, Lambin EF, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ et al., (2009). A safe operating space for humanity. Nature, 461(7263), 472–475.

Ryan, A. (2012). Education for sustainable development and holistic curriculum change. The Higher Education Academy.

Rychen DS, Salganik LH, eds. (2003). Key Competencies for a Successful Life and Well-functioning Society. Hogrefe Publishing.

Schön, D.A. (1995). The Reflective Practitioner: How Professionals Think in Action (1st ed.). Basic Books.

Strachan, S., Logan, L., Willison, D., Bain, R., Roberts, J., Mitchell, I., & Yarr, R. (2021). Reflections on developing a collaborative multi-disciplinary approach to embedding education for sustainable development into higher education curricula. Emerald Open Research, 3, 24. https://doi.org/10.35241/emeraldopenres.14303.1

Sterling SR, Thomas I. (2006). Education for sustainability: The role of capabilities in guiding university curricula. International Journal of Innovation and Sustainable Development, 1(4), 349–370.

Stoltenberg U, Burandt S. (2014). Bildung für eine nachhaltige Entwicklung. In: H. Heinrichs, G. Michelsen (Eds.), Nachhaltigkeitswissenschaften (pp. 567–594). Spektrum.

Stöber, H., Gaebel, M., Morrisroe, A. (2021). Greening in European higher education institutions. European University Association.

Students Organising for Sustainability International (2020). Survey: Students, sustainability and education. SOS International. https://sos.earth/survey-2020/

Tilbury, D., & Ryan, A. (n.d.) (2002). Guide to quality and education for Sustainability in Higher Education. Retrieved April 10, 2022, from http://efsandquality.glos.ac.uk/

Too and Bajracharya, (2015). Sustainable campus: engaging the community in sustainability. Int. J. Sustain. High Educ., 16 (1), 57-71.

Tribelhorn T. (2016). Wirksamer Unterricht mit dem TAFEL-Prinzip. Praxisberichte. http://www.lernensichtbarmachen.ch/2016/03/wirksamer-unterricht-mit-dem-tafel-prinzip/

Trimingham et al., (2016). Global dimensions in engineering education: experiences from a collaborative project. In W. Leal, P. Pace (Eds.) Teaching Education for Sustainable Development at University Level. Springer.

University College London. (2022). Embed sustainability into the Curriculum. Retrieved April 10, 2022, from https://www.ucl.ac.uk/sustainable/education/embed-sustainability-curriculum

UN [United Nations] General Assembly. (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. United Nations. https://sustainabledevelopment.un.org/post2015/transformingourworld/publication;

Wals, A. E., & Blewitt, J. (2010). Third-wave sustainability in higher education: Some (inter) national trends and developments. In P. Jones, D. Selby, & S. Sterling (Eds.) Sustainability education: Perspectives and practice across higher education (pp. 55–74). Earthscan Publishing.

Weinert FE. (2002). Vergleichende Leistungsmessung in Schulen – Eine umstrittene Selbstverständlichkeit. In: F. E. Weinert (Ed.), Leistungsmessungen in Schulen (pp. 17–31). Beltz Verlag.

Weiss, M., Barth, M., & von Wehrden, H. (2021). The patterns of curriculum change processes that embed sustainability in Higher Education Institutions. Sustainability Science, 16(5), 1579–1593. https://doi.org/10.1007/s11625-021-00984-1

Wiek et al., (2014). Integrating problem - and project-based learning into sustainability programs: a case study on the School of Sustainability at Arizona State University. Int. J. Sustain. High Educ., 15 (4), 431-449.

ANNEX A:

Sustainability in the Curricula Desk Research

This educational framework was carried out in the framework of the Erasmus+ Key Action 2 Strategic Partnership project:

Green Erasmus
2020-1-BE01-KA203-074971

Brussels, 2022

Editors:

Matteo Vespa, European Students' Union
Martin Hammerbauer, European Students' Union
Vanda Bajs, European Students' Union
Zamzam Ibrahim, European Students' Union

Contributors

All project partners

Design:

Melike Semercioglu, Erasmus Student Network

This publication is the outcome of in-depth consultations undertaken by the Green Erasmus consortium:

Erasmus Student Network
European Students' Union
European University Foundation
Students Organising for Sustainability UK
Technische Hochschule Köln
Université Libre de Bruxelles

Co-funded by the Erasmus+ Programme of the European Union

This project has been funded by the support of the European Commission. This document reflects the views of only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

Introduction ____ 35

1. Curricula design: definitons and guidelines ____ 37

1.1. Encyclopaedia of Sustainability in Higher Education ____ 37

1.2. Education for Sustainable Development Guidance ____ 39

1.3. Embedding Sustainable Development in the Curriculum ____ 43

1.4. Embed Sustainability Into the Curriculum ____ 46

1.5. Integrating Sustainable Development into Higher Education. Guidelines with in-depth modules for the University of Bern: Foundations ____ 47

1.6. Guide to quality and education for sustainability in higher education ____ 52

1.7. The patterns of curriculum change processes that embed sustainability in higher education institutions ____ 56

1.8. Education for sustainable development and holistic curriculum change ____ 59

1.9. Reflections on developing a collaborative multi-disciplinary approach to embedding education for sustainable development into higher education curricula ____ 62

1.10. Student attitudes towards and skills for sustainable development ____ 65

2. Pedagogies and methodological approaches in including ESD in curricula ____ 67

2.1. Transformative learning and Education for Sustainable Development ____ 67

2.2. The role of transformation in learning and education for sustainability ____ 70

2.3. The role that marketing academics play in advancing sustainability education and research ____ 75

2.4. Mapping Master Students' Processes of Problem Solving and Learning in Groups in Sustainability Education ____ 80

2.5. Interacting Pedagogies: A Review and Framework for Sustainability Education ____ 84

2.6. Practical pedagogy for embedding ESD in science, technology, engineering and mathematics curricula ____ 86

3. Climate Change Education ____ 92

3.1. Climate Change Education at Universities: Relevance and Strategies for Every Discipline ____ 92

3.2. Handling climate change education at universities: an overview ____ 95

3.3. Climate change education for universities: A conceptual framework from an international study ____ 98

Conclusion ____ 101

Bibliography ____ 103

Introduction

According to the report by the European University Association (EUA) Greening in European higher education institutions: EUA Survey Data, greening is defined as 'increasing awareness and taking concrete action towards a green, environmentally-friendly and resource-efficient university' (Stöber et al, 2021, p3) and is essentially a qualitative measure of an HEI's commitment to environmental sustainability in both material and abstract terms.

The survey was intended to identify the initiatives and activities HEIs are undertaking in order to evaluate the feasibility of expanding these activities and initiatives on a wider scale by the EUA through collective action. The initiatives were assessed according to their positive outcomes, opportunities and challenges.

The results of this survey are intended for use in policymaking and advocacy for sustainable living on a multinational scale. It is evidence of HEI's responses to policy initiatives set by international organisations, for example, the UN Sustainable Development Goals (SDGs) and the European Green Deal, illustrating that HEIs are invested in adapting their processes, policies and strategies to 'greening'.

A majority of the literature states that initiatives that aim to support sustainable development within Higher Education Institutions (HEIs) are spearheaded by individual departments or faculties as opposed to on an institutional (HEI) level itself (Stöber et al, 2021, p3; LSD & ESD Consulting, no date; Strachan et al, 2021). Therefore, there is a clear shift towards placing more responsibility on HEIs with regards to curriculum design, research and innovation, campus design and engagement and communications, or strengthening those links where that has already been put in place.

Teaching, learning and assessment should take advantage of the learning opportunities offered on campus by the HEIs and the local community, as well as online environments. Moreover, campuses should be a 'living laboratory' in which students, amongst others, identify the economic, environmental and social changes that surround them and use the classroom as a space for students to identify barriers and challenges they and local communities can face and how to overcome them.

From the results of the above-mentioned survey, institutions confirm a broad range of challenges related to greening and environmental sustainability. The most frequently referenced are a lack of funding, indicated by around half, and for a third of them, a lack of staff engagement, coordination of activities and strategic support. Meanwhile, one of the potential drawbacks of including Education for Sustainable Development (ESD) in the curricula is the lack of access to measure whether the same university graduates will incorporate Sustainable Development (SD) in their workplace and implement and use the knowledge and skills they have acquired during their academic life.

Nonetheless, according to another survey by Students Organising for Sustainability International (SOS) (2020), in which more than 7000 students around the world took part, 90% of respondents say they are willing to accept a salary sacrifice to work in a company with a good environmental and social record and 92% agree that sustainable development is something which all universities and colleges should actively incorporate and promote.

What this indicates is a strong urge for change from both the institutional and students' sides and a need for active embedding of sustainability in the curricula. As part of this desk research, we seek to identify various methodological approaches and pedagogies on how to embed sustainability in curricula design, as well as identifying their advantages and obstacles.

This report is divided into three main sections, each of them consisting of several research sources on the given topic. The first one seeks to identify the definitions and guidelines on how to embed ESD in the course curricula as well as give individual examples of embedding ESD on the level of the individual HEI. The second chapter gives an overview of which type of methodological and pedagogical approaches and actions are used to embed ESD in curricula on a general level as well as focusing on specific degrees. The third section gives insight into the subtopic in ESD which is Climate Change Education (CEE) and stresses the challenges surrounding its integration in HEIs' curricula.

1. Curricula design: definitions and guidelines

1.1. Encyclopaedia of Sustainability in Higher Education

Author: Walter Leal Filho
Country: N/A
Date of the publication: 2019

Summary

This encyclopaedia is a tool, created with a wide target audience in mind, ranging from policymakers, senior and middle management within HEIs, architects and designers involved in campus design, as well as students and teaching staff directly. It is intended for use in implementing SD in Higher Education generally, and is spread over 5 sections, as detailed in the preface:

1. Policy-making, visioning, structures, management and strategies
2. Teaching, learning and competencies
3. Research and transformation
4. Campus greening, design, operations and carbon impacts
5. Students and stakeholders´ initiatives and involvement

The encyclopaedia states that work-integrated learning, for example placements and vocational courses, is a main focus of implementing SD within HE over the last decade, and as such more research into this area needs to be done. This need for research falls within more general research on SD and its applications within HE.

Main Findings

However, whilst this specific piece of literature suggests that there are specific areas ‘such as science and agriculture’ within specifically work-integrated learning for sustainability education (Wall and Hindley, 2019) within which it is difficult to find appropriate work-integrated learning opportunities. This may not be completely accurate, and is elaborated further in the fourth category of the encyclopaedia, outlined in the chapter ‘Embedding Sustainable Development in the Curriculum’, where it is explained that there are variety of ways to embed SD within the curriculum:

1. SD is fully integrated into the course.
2. SD is mentioned in a particular module of the course.
3. SD is not mentioned but you can see where it might fit.
4. SD cannot be easily integrated within the course.

This, in combination with Moltan-Hill et al.'s framework for approaches to including SD within HEIs curricula (2018) suggests that by working with both professionals involved in designing curricula for work-integrated learning and those specialising in SD, it is possible to find appropriate opportunities within work-integrated learning, which casts doubt on the validity and usefulness of the encyclopaedia within designing curricula.

The development and enhancement of work-integrated learning, as part of vocational education and training, has been a focus of significant educational reform over the last decade (Wall 2017; Wall et al. 2017a,b). As such, the practical implementation of work-integrated learning generally, and specifically in relation to sustainability education, will continue to be a focus of research and practice development. This reflects Leal's call for more research into applied sustainable development activity. Practical issues for work- integrated learning include access to relevant placements and access to placements which offer suitable scope for higher-level learning, development and impact appear to be a perennial and significant issue (Patrick et al. 2008). Some areas, such as science and agriculture, are particularly difficult to find appropriate work-integrated learning opportunities, which makes expansion in these areas near impossible (Edwards et al. 2015).

Strengths and drawbacks

The research showed us that people's opinions of their courses are polarised. They either believed that SD cannot be easily integrated within the course, or that it was already fully integrated. However, experience tells us that most courses actually fall into the second (SD is mentioned in a particular module of the course).and third categories (SD is not mentioned but you can see where it might fit). So it is important to take the time to really look at what you teach and how you are teaching to find the opportunities to integrate SD into what you do. One should not fall into the trap of thinking that SD needs to be mentioned in every discussion. The course content may mean the term SD is never explicitly mentioned, but issues of pollution and proper waste disposal, for example, are.

However, and with particular pertinence to the sustainable development goals of quality education for all, equality, and inclusive work, there continues to be difficult challenges with work-integrated learning. Some of the most significant challenges relate to the accessibility of work-integrated opportunities for higher education students with diverse profiles, including international students, students with refugee and migrant backgrounds and students with disabilities (physical or mental health), and their treatment during the workplace experience (Gribble et al. 2015; Wall 2017). Evidence suggests that the challenges these students face, in particular international students and students with refugee/migrant backgrounds, reflect wider trends in how migrant workers are treated in workplaces. Thus, further partnership working needs to be done to facilitate greater inclusivity to work-integrated learning experiences (Wall et al. 2017b).

1.2. Education for Sustainable Development Guidance

Author: Quality Assurance Agency for Higher Education (QAA) and Advance HE
Country: United Kingdom
Date of the publication: March 2021

Summary

The Education for Sustainable Development Guidance offers a framework to support curriculum design on the topic of Education for Sustainable Development (ESD) and offers different approaches on teaching, learning and assessment. Moreover, it considers many ways in which ESD can be implemented in the curricula and offers various suggestions for the design process and facilitating ESD as a focal point of the curricula framework.

It targets primarily higher education providers (HEPs) and aims to support students in their journey towards developing a sustainable future, while it has been prepared through a wide-sector consultation by representatives of the higher education, business and student communities that have expertise in ESD in the UK. Fundamentally, **the guidebook serves as a reference point for use in curriculum development, delivery and review and as an advocacy tool for those supporting an ESD agenda in their HE institution.**

The guidebook is divided into four main sections and goes as follows:

- 1st section: introduction to ESD and its links to the United Nations Sustainable Development Goals (UN SDGs) in 2015.
- 2nd section: overview on how to get started with ESD on a strategic and institutional level; iinput on how ESD can influence other institutional goals and aims and stresses key actors that can help with the framing and design of ESD across curricula.
- 3rd section: emphasises the importance of teaching, learning and assessment approaches for ESD, gives key competencies for sustainability, course and module learning outcomes for ESD and offers guidance on how to develop new learning environments to foster ESD.
- 4th section: detailed reference and resources list that provides additional information on various organisations that support the development and implementation of SD in different HEIs and in their curricula.

Methodology and main findings

The guidebook states that **ESD offers an opportunity to frame curricula and harmonise objectives such as internationalisation, decolonising learning, promotion of interdisciplinary and transdisciplinary learning as well as promotion of employability, civic engagement, equality, diversity and inclusion.**

However, the process of framing ESD is not linear, and therefore, asks for mapping exercises that could be done in the form of qualitative questioning to the target groups, such as students on the topic of 17 SDGs, as they can offer a good starting point for a discussion on introducing ESD in the curriculum. The students could be asked the following questions:

- How will my actions impact the causes of, and solutions to, poverty?
- How can my thinking respond to issues surrounding health, education, social and gender inequalities?
- How can I help to facilitate responsible consumption, production and economic development?
- How do I positively respond to the problems associated with climate change?

Starting a discussion with students around the intersection of ESD and SDGs can be highly valuable to those involved in curriculum design, course management and teaching to recognise ESD as a central part of the curriculum.

Therefore, a key methodological approach of positioning ESD within the curricula should require a wide consultation with key players in the topic such as students, employers and enterprises, academics, professional service teams and academic governance and various communities, while the guidebook itself provides guidance on how to include each individual group and an example of good practice for each of them.

For students, there is an example of the Sustainability Voice Representatives programme at Keele University that engages **students as co-creators for curriculum development.** At the annual Student Voice conference, student representatives are trained by university sustainability staff to have a better understanding of Education for Sustainable Development and overall their significant role in their academic programmes since, as Sustainability Voice Representatives, they can represent and discuss sustainability issues on their course.

For employers and enterprises, there is the example of the Radical Sustainability project that implements ESD as an industry-education partnership between the University of Gloucestershire and company Interface. The project combines the university's specialism in course-embedded ESD with a set of ongoing events that connect students, that have incorporated sustainability learning in their studies, with over a hundred professionals in different industry sectors.

For academics, the guidebook gives a case study of the University of the West of England's (UWE) Knowledge Exchange for Sustainability Education (KESE) group, which is a **cross-university staff team that aims to progress education for sustainable development through curriculum mapping, staff development, student engagement and celebration.** The group consists of **a representative from each academic department, the sustainability team and the student union,** while its main goal is to provide a space for **discussion of ESD within the university through sharing of good practices** across the institution and supporting staff who are eager to include ESD within their modules and programmes.

Furthermore, an example was given of **students and staff** of University of St Andrews **engaging with local communities** with the project Transition St Andrews. Through the project, the group has found different ways to tackle waste, grow their own food, rewild St Andrews, facilitate greener ways of travel and cultivate a local sharing economy.

In the third section, the guidebook provides another extensive set of good practices, but also gives an insight into three important aspects of embedding ESD within the curricula through teaching, learning and assessment. For teaching, it gives the examples of **five different teaching practices** that are stated below as well as gives practical examples for each teaching practice.

Collaborative learning: A method of learning that is often self-organised and occurs outside of the formal learning environment.

Enquiry-based learning: An approach based on self-directed enquiry or investigation in which the student is actively engaged in the process of enquiry facilitated by a teacher.

Play-based or playful learning: A range of structured or semistructured approaches that allow students to explore approaches, scenarios, actions and consequences in a safe learning environment.

Learning through storytelling: A process in which learning is structured around a narrative or story as a means of sense-making.

Problem-based learning (PBL): A style of active learning, PBL refers to learning opportunities that use real-world issues or problems to increase knowledge and understanding.

On the topic of learning, the **guidebook provides insight on how the eight UNESCO key competencies for sustainability** (systems thinking; anticipatory; critical thinking; strategic; collaboration; integrated problem-solving; self-awareness; normative competencies) **can be aligned with appropriate learning outcomes, including knowledge, skills and attributes/values** (see figure 1)

Learning outcomes		
Knowledge	Skills	Attributes and values
A student with systems thinking competency can:		
• Describe the relationships between environmental, social and economic systems, at scales from local to global level • Identify the tensions between the 17 SDGs and recognise their interconnections • Recognise that a collective effort is not necessarily just a simple sum of each individual's effort, but is likely to be more complex and have multiple drivers that may be personal, political or communal • Identify that positive or negative environmental change may arise from economic growth • Describe how power structures and political systems influence SD	• Recognise and understand relationships • Analyse complex systems • Consider how a system's constituent parts interact and operate at different scales and across time • Work with interconnectedness and complexity in a systemic context, synthesising diverse information and data to offer a range of potential solutions • Identify the interactions between social, economic and environmental systems • Assess a problem from different scales and perspectives	• Think systemically, in terms of recognising connections and interactions between factors, and understand that actions often have multiple consequences • Deal with and manage uncertainty • Appreciate the root causes of unsustainable development including environmental, social and economic actions, and their links to cultural considerations • Identify the factors that have the biggest potential for driving constructive change

Figure 1

Meanwhile, assessment criteria for the above-mentioned teaching practices are three-dimensional and are perceived as the following:

a) Assessment OF learning: demonstrates achievement of learning
b) Assessment AS learning: Empowers students to self-regulate and critically evaluate
c) Assessment FOR learning: provides feedback on teaching and learning

Strengths and drawbacks

Teaching, learning and assessment should take advantage of the learning opportunities offered on the campus and the local community, as well as online environments. Moreover, **camps should be a 'living laboratory' in which students, amongst others, identify the economic, environmental and social changes that surround them and use the classroom as a space for students to identify barriers and challenges** they and local communities can face and how to overcome them.

Meanwhile, one of the potential drawbacks of including ESD in the curricula is the lack of access to measure whether the same university graduates will incorporate the SD in their workplace and implement and use the knowledge and skills they have acquired during their academic life.

1.3. Embedding Sustainable Development in the Curriculum

Author: Jimmy Brannigan, Helen Deacon, Esin Esat, Paul Grimshaw, Lesley Harry, Mary Kelly, Deborah Meakin, Iain Patton, John Salter, Gillian Sinnott, Anita Stanley, Denise Summers
Country: United Kingdom
Date of the publication: N/A

Summary

The text is written as **a guide on how to embed sustainable development within the curriculum.** Moreover, it gives examples of good practices in order to encourage learning providers to integrate SD.

In order to form an efficient guide for learning providers the authors did research on how different learning institutions included SD into teaching and learning. Also, it is explained briefly how the presented information can be used to facilitate quality SD learning within simple steps. The research was based on interviews made with 35 institutions based in England, Wales and Scotland.

Furthermore, it introduces the definition of ESD given by UNESCO and by the SDE Network focusing on the key knowledge, key skills and key attitudes that ESD seeks to cultivate. The authors see the mentioned needed developments as a necessity for the bettering of our society.

The following sections of the guide are connected to specific examples of how the researched institutions embedded ESD into the curriculum. It is emphasised that **almost every course has an opportunity to integrate SD** in it. The main idea is that there is no unified way to do so but if you familiarise yourself with ESD and manage to identify parts from your course that have a connection to it. To easily do that, authors give seven different examples of ESD teaching:

1. Tutorials
2. Short courses
3. Key skills and skills for life
4. Projects
5. Community as a learning resource
6. The workplace as a learning resource
7. Enriched Curriculum

Methodology and main findings

The article introduces us to different approaches concerning the implementation of SD in the curriculum and encouraging SD learning outside the curriculum. Every explained methodology is connected to different educational institutions. The ways of implementation are divided in the mentioned seven examples.

Tutorials are seen as a way to encourage ESD. The way that they embed it in HEIs is at an institutional level by having a certain day of the year that is focused on SD. During that day they are introduced to the outside political environment by forming questionnaires for the local councillors revolving around sustainability.

Short courses are formed by institutions in order to build stronger links with employers and the local community and it helps recruit new learners. The author then gives examples of how the courses offer students to engage in sustainability forming partnerships. This allows identifying regional sustainability priorities that help develop and deliver relevant training.

Key skills and skills for life include forming and practicing critical thinking on how sustainability is relevant to their chosen career. One of the mentioned examples includes a HEI that developed scenarios for students to support communications skills that involved SD issues.

Projects are seen by the author as a popular way of teaching SD in institutions. The formed project can be part of "... a course or an institution-wide initiative" and can encourage cross-discipline working by forming connections with other institutions and the local community.

Community is perceived as a learning resource and gives an interesting perspective on SD. By doing so they tend to focus on the issues that affect the learners. In that way, the focus shifts from global problems to more local. Therefore, **the formation of SD in the curriculum is influenced by the local sustainability issues through the use of case studies that are introduced in certain classes.**

The workplace as a learning source is focused on colleges that **decided to build centres to show use of best practice in constructing a sustainable building** that is used as teaching material but also as a place to teach.

The enriched curriculum is the last mentioned methodology and it is a way to help tutors develop better skills in teaching SD. It is proposed that an institution can run an **Enrichment Programme in which it would introduce a new ESD short course, show SD themed films, adapt the existing activity to be connected to SD or run different types of craft activities.**

To sum up, all the given examples and the introduced methodologies are a way of embedding SD in curriculum in HEIs. The main idea is that the steps for doing so are simple and depend on the context in which the SD is implemented. It strongly depends on a good support system and forming connections with other HEIs, local communities and the outside political environment.

Strengths and drawbacks

The author states that introducing SD in the curriculum is a very simple process and that every HEIs has the possibility to do so. The mentioned approaches help integrate ESD into institutions using the existing curriculum.

By conducting research, it has been shown that half of the people that were questioned believed that SD cannot be easily integrated within the course. ESD is still in need to promote its integration. Which brings us to a still relatively small number of learning providers that have begun embedding SD in the curriculum.

1.4. Embed Sustainability Into the Curriculum

Author: ULC (University College London)
Country: United Kingdom
Date of the publication: January 14, 2022

Summary

The main ways to embed SD in HEIs is through **integrating experimental and interactive approaches,** critical reflection on values and assumptions known as transformative learning and the use of **participatory learning approaches,** group works and collaboration outside the classroom.

Moreover, forming a glocal curriculum in HEIs is seen as efficient in ESD. „**Glocal teaching** and learning environments are a promising way to provide more students with intercultural and professional competence necessary to address sustainability problems.“ (Caniglia et al 2018:375). It means **developing a curriculum in a holistic manner that allows transnational collaborations in HEIs for sustainable development** (ibid.369) by focusing on real-world case studies, project-based learning and use of the campus as a learning resource.

The identified learning activities that would be included in a glocal curriculum are:

- Case studies
- Stimulus activities
- Simulation

[1] ‘Glocal’: reflecting or characterised by both local and global considerations.

- Experiential project work
- Problem-based learning
- Scenario planning/Futuring
- Role-play

In addition authors state that an important part in integrating SD in curricula is by having continual assessment of the HEIs.

Strengths and drawbacks

Integrating SD in curriculum can benefit in engaging the perspectives of other interested parties and can have peer contribution and by forming a glocal curriculum it can raise awareness of students' living habits and the problems of sustainability that they are facing.

The possible barriers can be low resources for teacher preparation, possible resistance to change, unrealistic expectations and negative attitude.

1.5. Embed Sustainability Into the Curriculum

Author: Karl Herweg, Anne B. Zimmermann, Lara Lundsgaard Hansen, Thomas Tribelhorn, Thomas Hammer, Rolf Peter Tanner, Lilian Trechsel, Sabin Bieri, Andreas Kläy
Country: Switzerland
Date of the publication: 2017

Summary

The University of Bern had developed in 2013 a strategy whose goal is that every student should leave the university having studied the links between its major and SD. That is why a **Bachelor Minor and a Master Minor in Sustainable Development,** open to all students, were introduced in the curriculum, as well as a specialised continuing education course on SD. The University has also developed various university centres or units with research and teaching mandates in the field of SD: the Oeschger Centre for Climate Change Research, the World Trade Institute, the Interdisciplinary Centre for Gender Studies, and the Centre for Development and Environment. The University supports student projects in the field of Sustainability, participates in the 'Sustainability Day' with the participation of all the Higher Education Institutions of the canton of Bern, as well as the initiative 'Blue University' in relation to water as a resource and a human right. The Centre for Development and Environment is the body trusted to implement ESD: it carried out various projects funded by the Swiss Rectors' Conference and the University of Bern.

The Guidelines, composed of a Foundations document and four online in-depth modules, are integrated with two short explanatory videos (accessible to lecturers), workshops, personal consultations and other tools developed by the University's Centre for Development and Environment and its Educational Development Unit. The Guidelines are aimed to integrate SD in the lecturers' teaching, either in two lessons or more comprehensively. The Foundations describe the United Nations' understanding of SD, how science and SD values interplay in the context of Higher Education, the mandate given to the University of Bern by the cantonal government to establish SD in research, education, and operations, ESD at the university level, and guidance to select suitable ESD content, competences and teaching methods. The online in-depth modules offer concepts, tools, instructions, information, and examples, case studies of courses developed in different disciplines by the lecturers of the University, supplementary supporting material and other educational materials.

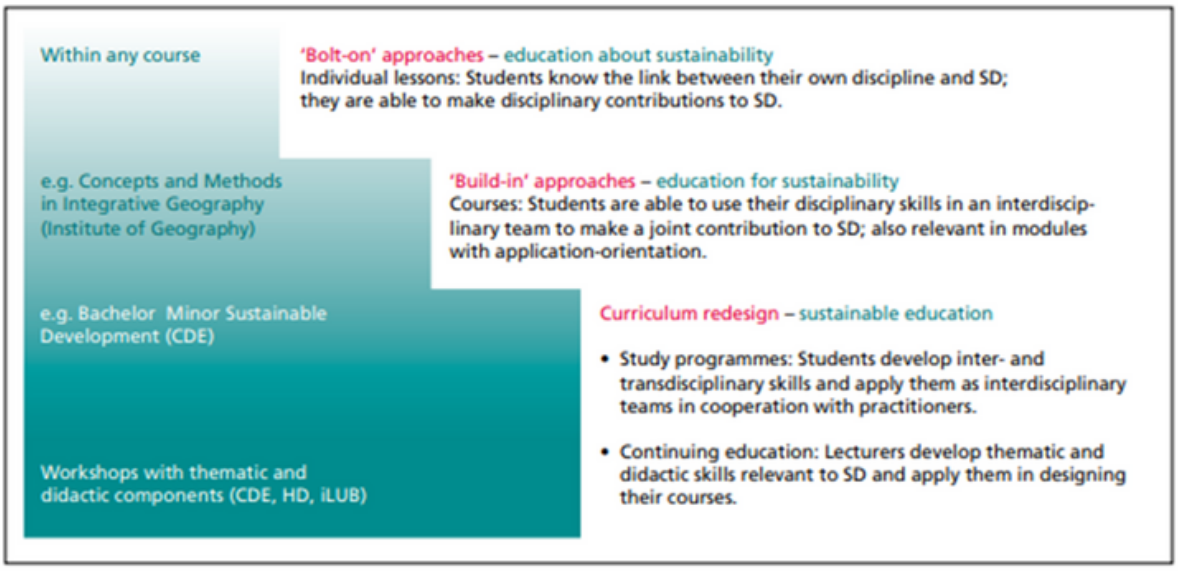
Methodology

The methodology of the integration of SD within the scientific realm of academia is based on the understanding that 'Sustainable Development is a normative principle and not a scientific concept': the existing disciplines have already developed research approaches, tools, and measures that can be favourable for SD, but their application needs an ontological and epistemological reflection on the nature and values of one's discipline, its boundaries, its potential of interdisciplinary cooperation in relation with the normative framework of SD. Once this process is done, it is possible to open up the possibility to interdisciplinary collaborations centred around real-life, and complex social-environmental issues: the interdisciplinary approach requires a basic understanding of the other scientific traditions, epistemologies, methods, and procedures, thus opening up new spaces of development and innovation also for one's own respective disciplines.

In fact, ESD ' enables all stakeholders in society to participate in the individual and societal search, learning, and shaping process of Sustainable Development [...], ESD is intended to enable students to think in terms of networks and connections, to understand complex society–environment interactions and processes, and to come up with hypotheses about causes and possible effects of such processes'.

Main findings

There are **three ways to integrate SD into teaching: 'bolt-on'** approaches (education about sustainability), **'build-in'** approaches (education for sustainability) and **curriculum redesign** (sustainable education).



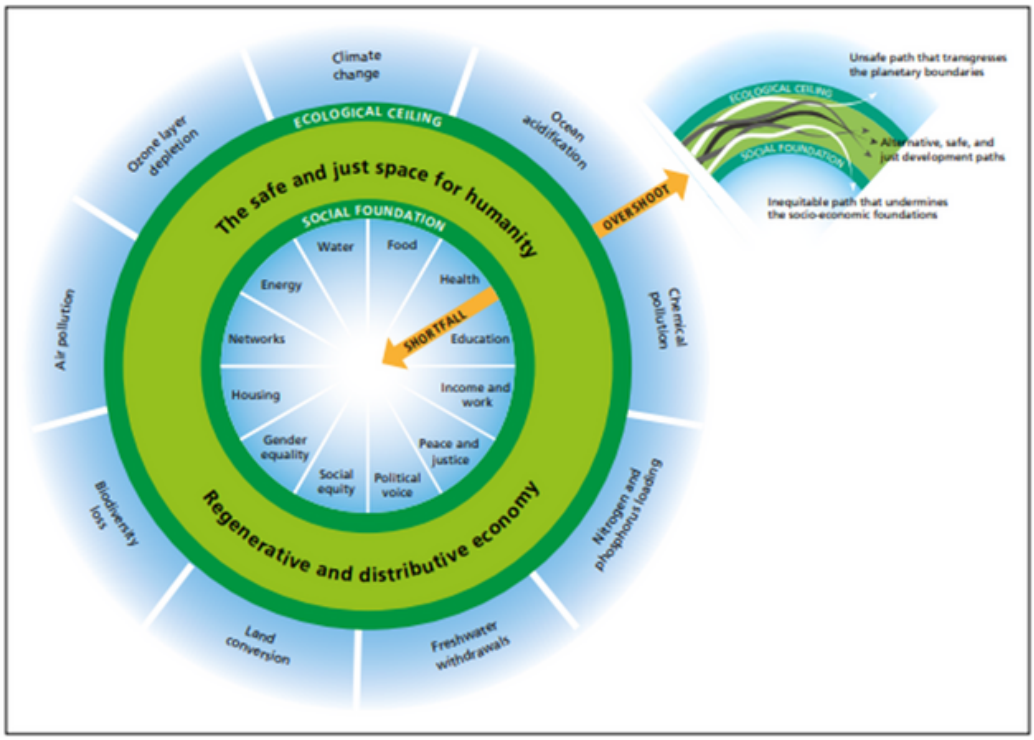
The **implementation of ESD** can happen following **three steps:**

1.' ***Identify educational content*** [...] , i.e.:
• the thematic links between a discipline and SD and the resulting scientific contributions to SD, and
• the specifics of these contributions by differentiating them into systems, target, and transformation knowledge.

2. Decide ***what competences*** [...] the students should acquire during the courses on SD, through:
• a rough definition of the focus of education (knowledge – skills – willingness), and
• differentiation between disciplinary and cross-disciplinary competences.

3. **Design** SD-relevant ***teaching–learning arrangements*** [...], by:
• identifying the desired intensity of learning processes (conformative, reformative, transformative), and
• using tips to develop corresponding teaching–learning events.'

1) Two **methods** are proposed **to find links between SD and a scientific discipline.** One is the **'Doughnut model'**, where the socially and ecologically just and safe space for human development is defined within the external limit of the 'ecological ceiling', and the internal social foundation, based on the internationally debated socio-economic minimum requirements for human wellbeing. Overstepping towards the outside (environmental pollution) or the inside (social injustice) would lead to unsustainable ways of development; at the same time, different SD models are possible between the 'social foundation' and the 'ecological ceiling'. A visualisation of the model and of its components can be found in the image below.



The elements composing the 'social foundation' and of the 'ecological ceiling' can provide the link between SD and one's own discipline, but other topics can be explored as well, such as faith, cultural sustainability, technology.

The second method is to use the **UN Sustainable Development Goals** (being the international consensus on SD) as a link between one's own discipline and SD. They are centred around 17 areas: no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; and partnerships for the goals.

Once the thematic links are found, the contributions the discipline can give to SD shall be categorised in each of the three types of knowledge:

- **descriptive 'system knowledge'**, which studies 'how the environment, society, and the economy function, either individually or as complex interactions',
- **normative 'target knowledge'**, i.e. '[s]cientific contributions to decide the direction in which these relations can be steered towards a sustainable form of development'
- **'transformation knowledge'**, i.e. '[s]cientific contributions to implementation, e.g. in the form of rules, solutions, measures, or technologies to promote SD; this includes monitoring and a review of goal achievement with disciplinary and interdisciplinary scientific methods.'

The methodological and methodical approaches of each discipline, including data collection and analysis, can be useful for all the three types of knowledge contributing to SD.

2) A definition of competence is 'cognitive abilities or skills which individuals have or can acquire to solve specific problems, as well as the related motivational, volitional (conscious, deliberate), and social willingness and abilities to apply solutions in variable situations successfully and responsibly'. They comprise knowledge, skills, and 'willingness' (attitudes and values). All of the three are key to promote real societal change towards SD, but while the first two can be tested during the lessons and inserted, in the learning outcomes, 'willingness' is manifest only outside or after education: but it can be stimulated, by discussing attitudes, mindsets, and values with the students.

In ESD, the inter- and transdisciplinary approach requires the development of both disciplinary competences and cross-disciplinary competences. Disciplinary competences are 'disciplinary, specialist knowledge and the corresponding methodological competences' of one's own discipline. Cross-disciplinary competences are of two types: competences that enable students to work cross-disciplinary and transdisciplinary, i.e. '. a basic understanding of theories, approaches, contents, and methods of other disciplines [...] networked thinking in linear and non-linear connections, foresighted reflection, interdisciplinary monitoring and evaluation, as well as participatory approaches'; and 'personal and social competences and the ability to act [...] to be able to work and communicate efficiently and effectively within a team. These competences include e.g. critically questioning values, assuming responsibility, social and communicative skills in negotiation processes with various actors, teamwork and team-conflict management, and the willingness to implement and shape things.'

1.6. Guide to quality and education for sustainability in higher education

Author: Daniella Tilbury, Alex Ryan
Country: United Kingdom
Date of the publication: 2010

Summary

"Guide to quality and education for sustainability in higher education" is a web page that is based on the project Leading Curriculum Change for Sustainability: Strategic Approaches to Quality Enhancement and was led by the University of Gloucestershire in collaboration with the UK Quality Assurance Agency and in partnership with four English HE institutions (Aston University, University of Brighton, Exeter University and Oxford Brookes University). It is an interactive guide with video clips, materials and tools designed to support pilot projects in universities to connect Education for Sustainability (EfS) with quality assurance and quality enhancement. Information given by the guide is gathered through the analysis of the already mentioned universities, their development projects and perspectives given by the national agencies and experts on the process of forming links between EfS and the curriculum. It has been developed for university leaders, academic managers, directors and leads in quality assurance roles, lecturers, educational developers and courses leads in order to understand better how EfS connect with curriculum agendas and quality issues. At the sector level it aims to better understand EfS in relation to quality.

The web page is divided into 4 categories: orientation with subcategories introduction (how the guide was developed and the project behind it) and landscape (how EfS and quality connect), pathfinder with subcategories understanding quality system (how HEIs quality system work) and changing quality system (insight and experience from the project), destination (how universities can respond to EfS) and kitbag (all materials and tools developed by the project).

Once the thematic links are found, the contributions the discipline can give to SD shall be categorised in each of the three types of knowledge:

- **descriptive 'system knowledge'**, which studies 'how the environment, society, and the economy function, either individually or as complex interactions',
- **normative 'target knowledge'**, i.e. '[s]cientific contributions to decide the direction in which these relations can be steered towards a sustainable form of development'
- **'transformation knowledge'**, i.e. '[s]cientific contributions to implementation, e.g. in the form of rules, solutions, measures, or technologies to promote SD; this includes monitoring and a review of goal achievement with disciplinary and interdisciplinary scientific methods.'

The methodological and methodical approaches of each discipline, including data collection and analysis, can be useful for all the three types of knowledge contributing to SD.

2) A definition of competence is 'cognitive abilities or skills which individuals have or can acquire to solve specific problems, as well as the related motivational, volitional (conscious, deliberate), and social willingness and abilities to apply solutions in variable situations successfully and responsibly'. They comprise knowledge, skills, and 'willingness' (attitudes and values). All of the three are key to promote real societal change towards SD, but while the first two can be tested during the lessons and inserted, in the learning outcomes, 'willingness' is manifest only outside or after education: but it can be stimulated, by discussing attitudes, mindsets, and values with the students.

In ESD, the inter- and transdisciplinary approach requires the development of both disciplinary competences and cross-disciplinary competences. Disciplinary competences are 'disciplinary, specialist knowledge and the corresponding methodological competences' of one's own discipline. Cross-disciplinary competences are of two types: competences that enable students to work cross-disciplinary and transdisciplinary, i.e. '. a basic understanding of theories, approaches, contents, and methods of other disciplines [...] networked thinking in linear and non-linear connections, foresighted reflection, interdisciplinary monitoring and evaluation, as well as participatory approaches'; and 'personal and social competences and the ability to act [...] to be able to work and communicate efficiently and effectively within a team. These competences include e.g. critically questioning values, assuming responsibility, social and communicative skills in negotiation processes with various actors, teamwork and team-conflict management, and the willingness to implement and shape things.'

Methodology and main findings

In the category 'Pathways: Institutional Pathways for EfS' we are given five examples of ways they connected EfS to their own quality assessment and quality education systems. Authors state that every change has to be supported on several levels through the HEIs and that the strategy has to be formed in line with specific institutional mechanisms, academic profile and education priorities of the organisation.

Firstly, we are given an example of Aston University that had the aim of better understanding the connection of sustainability in an educational context. The idea was to link the technological solution with the pedagogic aspects. To do so it restructured internally by working on staff supporting innovation, professional practice and sustainability and producing guidance for academics, managers and external partners (ibid.).

Secondly, the University of Brighton in order to effectively embed EfS in Quality Assurance (QA), started a project that used a cross-departmental team and consulted course leaders. After identifying needs and issues, support materials were produced to be used by academic staff in order to successfully follow the curriculum development

The third introduced example is the University of Gloucestershire, which aimed to create structures that would support curriculum change. For that purpose, they formed activities focused on EfS "[...]in formal policies and strategies for QA and QE, engagement with central and faculty QA staff, and producing guidance on EfS in the quality process and in specific subjects as well as new innovation funds."

The last mentioned example is Oxford Brookes University. Their main idea was intended to position and connect sustainability to the existing institutional practice. It ended by forming collaborations with educational development staff and the creation of a guide for teaching and learning to support the ongoing change in the curricula.

Through analysing the mentioned examples, the authors stressed that it was important to understand how their institutional locations and roles can support EfS initiatives. They then identified four main roles: academic champions (educators with the experience in EfS that can drive the support needed for the

change), sustainability researchers, students (important in actively supporting EfS) and sustainability teams (responsible for corporate sustainability initiatives). Moreover, a vital part of planning an institutional approach to EfS needs to include the making of strategic links with corporate agendas and educational themes and being aware of the context and the institutional starting point on Efs.

Strengths and drawbacks

Quality matters for the EfS because it can help to put emphasis on the overall student experience, it supports greater inclusion of student perspectives, increases the diversity of the student population and continual attention to cross-cutting education themes in the sector.
During the process of embedding, for some universities, issues were of practical nature, related to finding ways to implement and manage a new strategy into curricula. Furthermore, HEIs quality systems work differently in almost every institution and thus they are complex and can cause confusion in the understanding of how the university functions, how to address issues, how QA and Quality Enhancement (QE) aspects connect and how to introduce new themes to existing systems. Because of the complexity of HEIs, there is also a possibility of tensions on different levels of management and development:

- "Between **institutional approaches** (which are increasingly explicit since the widespread introduction of learning and teaching strategies) **and subject-specific practices**
- Between **strategic priorities for institutions** (covering research, engagement, corporate operations and institutional development as well as education) **and thematic education agendas**
- Between the 'compulsory' aspects of curriculum practice reflected through **the QA function** and the 'optional' dimensions reflected through **the QE function**" (Tibury et al.)

1.7. The patterns of curriculum change processes that embed sustainability in higher education institutions

Author: Marie Weiss, Matthias Barth, Henrik von Wehrden
Country: Lüneburg, Germany
Date of the publication: June 2021

Summary

Embedding education for sustainable development in higher educational institutions is recognized as a model of transition towards sustainable development. Through the article, we are given different implementation processes that lead to the institutionalisation of sustainability curricula in HEIs (Weiss 2021:1579). The given results are a synthesis and comparisons of 131 case studies via the case survey method that was used to transform qualitative data into quantitative data. Before analysing the research results, the authors give a brief introduction on the importance of the implementation of SD in HEIs and how they can differ.

The authors then explain aspects of ESD implementation:

1. Implementation process(es)
2. Type of implementation
3. Level of depth
4. Stages and dynamics
5. Impetus of change
6. Drivers and barriers

Furthermore, we are introduced to the research design and how it was conducted. Authors then explain in depth the different implementation processes, types of implementation, levels of depth in a curriculum change, stages and dynamics of curriculum change and the impetus of change. To do so they divide the gathered analysed data into six sustainability implementation patterns: collaborative paradigm change, bottom-up evolving institutional change, top-down mandated institutional change, externally driven initiatives, isolated initiatives and limited institutional change. After explaining each of the mentioned patterns the author introduces two distinct phases of implementation of sustainability curricula that were identified in all of them. The first is the initiation of sustainability in curriculum and the second is achieving and sustaining more comprehensive ESD Implementation.

Methodology and main findings

ESD can be embedded in a HEIs curriculum at a micro-level (teaching and learning in courses) and at a macro-level (programs and curricula) but the process of institutionalisation is still unclear. The process can differ from institution to institution because every HEI has its own individual context and history.

Collaborative paradigm change is the first mentioned cluster by the authors and it concerns the whole-institution approach" where the entire institution's curriculum integrates sustainability. Sustainability is supported by sustainability champions in HEIs, and externally by a broad range of stakeholders. The change can begin with a top-down or bottom-up approach but there is usually, in this type of change, top-management support that defines goals for HEIs and involves the campus community to do so. The result is a formalised strategy that can then be monitored and assessed by the HEIs. The author states that to ensure the change process, the needed resources are funding, faculty training, ongoing dialogue-focused communication and collaboration.

The second formed cluster includes **bottom-up initiation** and high levels of internal collaboration and in the later stages of the integration process leads to a more formalised support by the HEIs. The main facilitators are the students that form initiatives to incorporate ESD courses and programs within some departments. This cluster aims to see whether the implementation of these initiatives drives forward the transition from a bottom-up initiative to a leadership-supported one. In most cases, formalising the strategy enables ESD to be put in the institution's vision statement.

The third is a **top-down approach** that is characterised by initiation by presidential leadership and by a lower sense of faculty ownership. Usually, in these cases, there is a lack of motivation and intrinsic want for the implementation of ESD. Moreover, extrinsic motivation provides the need for curriculum change. The implementation strategy is formed from the top and a coordinational unit is established. Half of the HEIs that formed this cluster only partially integrated ESD to their vision statement. The main problems that occur are the lack of communication, a lack of involvement of the campus communities and a lack of a vision statement that would guide the process.

Cluster four is made of **cases that had externally driven initiatives** that tend to have weak internal support in contrast to the strong external support. The lack of inner support is the result of a lack of a strategic plan, presidential leadership, collaboration, coordination, communication, incentives, and organisational

structure. There are two subgroups that differ in how they cope with the lack. The first is when ESD is implemented at a program level with the support of national networks or Regional Centers of Expertise. The second explains how the external impetus comes from the government, giving the example of India where environmental studies are mandated by the country's Supreme Court.

The fifth cluster, the so-called **isolated initiatives**, consists of cases where there is a struggle to collaborate with other initiatives and there is a weak priority setting. The main identified characteristics are the involvement of few stakeholders and weak coordination, it can occur both top-down or bottom-up, with no or weak assessment, support by presidential leadership varies from medium to strong and it usually results in fragmented and isolated ESD implementation.

Cluster six are cases with a **bottom-up approach** to integration that **due to** their **lack of support** and many barriers struggle to efficiently implement ESD in curricula.

When comparing all the clusters authors identify two distinct phases of implementation of sustainability in curriculum implementation:

Phase 1: Initiation of sustainability curriculum implementation

- All stakeholders can initiate change through the clusters, various internal and external stakeholders can be found to initiate a full implementation process, including students, faculty, leadership, and external stakeholders
- Curriculum change can be driven by many stakeholders on different levels and their perceived status affects the change.
- "The implementation of sustainability curricula can begin with individual initiatives in education, campus operations, research, or outreach activities" (Weiss et al. 2021:1589)

Phase 2: achieving and sustaining more comprehensive ESD implementation

- Communication is key to succeed in having supporter of ESD implementation
- Collaboration within and among stakeholder groups to have a more comprehensive implementation and to help with a lack of resources and support.

To summarise, key influences in the implementation of sustainability found in the research are:

- The impetus for change is an important factor during the initiation of ESD,
- Communication is the key to obtain supporters,
- It is important to create a sense of ownership through vision statement and strategy and in collaboration with the internal and external stakeholders to have a comprehensive implementation
- Seeking collaboration and coalitions is critical and it can compensate for a lack of internal support
- "Coordinating various initiatives conserves resources while connecting individual ESD efforts and creating synergies among them." (ibid.1591)

1.8. Education for sustainable development and holistic curriculum change

Author: Alex Ryan
Country: York, UK
Date of the publication: 2012

Summary

It's a review and guide that was developed by Dr Alex Ryan from The Higher Education Academy in order to show educators and managers in HE institutions how to improve learning and teaching sustainable development.

The guide is divided into 4 sections:

1. Project landscape
2. Initial review - headline findings
3. Curriculum change – Case study
4. Strategic insights

In the first section Project landscape, the author explains who is the target audience and why, what is the background and terminology of education for sustainable development and what is the main focus of the research.

The second section is based on a review of twenty exemplar initiatives that made an effort to reorient the undergraduate curriculum in a broad range of HEIs. The author selected ten initiatives from the United Kingdom and ten international initiatives. The aim is to show the different ways in which initiatives approached the implementation of SD in curriculum.

The third section is grounded on three case studies that involved three universities in the United Kingdom. The selected universities are: University of Bradford, University of Gloucestershire and the University of Plymouth. For each given example it is explained actions and tactics which the universities made to embed education for sustainability across the curriculum. Moreover, it gives us a specific insight on what tactic worked well and why and what were the main difficulties that a university faced during implementation.

The last section summarises the guide into three insights that were taken out from the conducted research. The insights are as follows: ensuring academic credibility, joining vision and structure, and forecasting and localising.

Methodology and main findings

The text explains different approaches in introducing sustainable development in three different universities.

The first is an institutional approach called 'Ecoversity' that aims to change culture and practice in sustainability across the University of Bradford. It is directly supported by the Higher Education Funding Council for England (HEFCE) Strategic Development Fund (2007-2010). The HEFCE SDF bid provided £3.1 million, enabling it to develop a culture change programme as a part of the project. SD was introduced in the University's strategy and was developed with a three curriculum model for achieving change:

1. Formal curricula
2. Informal curricula
3. Physical curricula

The formal curricula involve official programmes of study across all academic units, the informal curricula are based on volunteering and other non-credit-bearing learning opportunities and the physical curricula focused on learning opportunities based upon corporate practice on campus (Ryan 2012:11). Through the process of implementing EDS the University made a formal commitment to actively work on it through the process of course development, review and validation.

The second case study is based on the sustainability strategy Promising futures (2009-2015) at the University of Gloucestershire. The main idea was to form a 'joined-up' approach to sustainability and the strategy was made to embed education for sustainability across the curriculum using a **'whole institution' approach.**That meant that EfS needed to be intertwined with every study at the University. The curriculum change was led by the formed Sustainability Team and overseen by the SD Committee. Support for the Sustainability Team was gained through the University's Centre for Active Learning, one Centre for Excellence in Teaching and Learning (CETL) funded by Higher Education Funding Council for England (HEFCE) from 2005 to 2010. In the beginning, the focus was on including EfS within key corporate documents to form a professional and curriculum support mechanism and developing academic initiatives around EfS. Some of the efforts in the embedding:

- Held development sessions
- Eight-month research on student learning and employer perspectives on sustainability in business
- An online archive was developed for teaching staff to share publications and materials on EfS and sustainability
- Review of related library stock of publications on sustainability
- Supervision was provided to support professional development activities
- Introductory guest lectures, seminars and external speaker series were organised on various business and sustainability topics.

The third example is the Centre for Sustainable Futures established in 2005 by Plymouth University to develop a whole institution approach on sustainability. The idea was to develop a strategy and activities for integrating sustainability in the University's curricula. The author states that the CSF was formed on a "... holistic '4C' approach, seeing curriculum, learning and teaching (and related research), campus change and community engagement mutually embedded and enhancing spheres and, as such, powerful." (ibid.28).

The author stresses out that the most efficient way to have an effective ESD is the **connection between curriculum change goals and central strategies and functions.** The goal is to "...harness governance and management mechanisms in tandem with academic enhancement activities, so that innovation and structure are joined together." (ibid.41).

Strengths and drawbacks

The most important thing to notice is that institutional approaches to embedding sustainability across the curricula enabled the researched universities to work on a curriculum change with a 'whole institution' approach. The benefits of that type of approach are not limited to formal education settings, but mainstream sustainability in all parts of the university and improve teaching and learning in HEI as well as form connectivity across academic units.

The drawbacks are that the connectivity that is needed for it to function in a large institution can be demanding and labour intensive. The possible organisational changes can stall the speed of progress in implementation.

1.9. Reflections on developing a collaborative multi-disciplinary approach to embedding education for sustainable development into higher education curricula

Author: Scott Strachan, Louise Logan, Debra Willison, Rod Bain, Jennifer Roberts, Iain Mitchell, Roddy Yarr
Country: United Kingdom
Date of the publication: March 2022

Summary

Sustainability has been identified by HEIs and ESD as a way of forming students to develop skill sets and knowledge which they would actively use in everyday situations. The biggest challenge in doing so is how can institutions and HEIs successfully embed ESD across curricula. The article is to show a selection of practical examples of how to do so.

The authors who worked on this article are academics and professional service staff at the University of Strathclyde who lead modules and programs connected to the ESD. All the given examples reflect on five approaches taken across four faculties at Strathclyde (Humanities and Social Sciences, Science, Engineering and Strathclyde Business School):

1. Vertically Integrated Projects for Sustainable Development
2. Multidisciplinary Perspectives of Sustainable Development
3. Social Responsibility Pathway
4. Infrastructure and Environment
5. Engineering for Global Development

The main idea is to show different types of approaches for embedding ESD into a curriculum. It has been written in a way to promote ESD and to help guide HEIs in the implementation of it.

Methodology and main findings

The idea of a sustainable institution shifted from being an institution that reduced its carbon footprint, transition to plastic-free campuses, etc. to a pedagogical one. Having a focus on teaching values and developing skills connected to the SD.

New pedagogies make a shift from traditional subject-based learning to transformational, experimental and action-oriented methods that are seen by the authors as necessary to educate for sustainable development. The HEIs are seen as responsible for forming agents for a sustainable future.

The authors identify the existing challenges as follows: "...initial and ongoing mapping of ESD, awareness-raising and capacity building, identifying priorities, barriers opportunities and gaps for ESD; integrating it within (regional and institutional) governance mechanisms, educational policy and strategy; staff development, and critically, addressing the "how to" practices and pedagogies educators should adopt and follow when educating for sustainable development." (Strachan et al 2021:3).

Listed challenges are the key to achieve a whole institution approach in embedding ESD across curricula in HEIs. Furthermore, the authors introduce five ESD initiatives embedded in Strathclyde's curricula.

Firstly, the Vertically Integrated Projects for Sustainable Development consisted of a programme of 21 research-based, student-centred, credit-bearing projects that served as a way to address SDGs. Students had the possibility of working in multidisciplinary and multi-level teams on those projects.

Secondly, Multidisciplinary Perspectives of Sustainable Development as a learning elective module that is available to all Strathclyde students at all levels and in all disciplines and whose purpose is to form an understanding of interconnectivity of various disciplines and SD.

The third introduced approach is the Social Responsibility Pathway which is a credit-bearing option for 3-year students that are a part of the Strathclyde Business School's Management Development Programme. It introduces project-based working in partnership with external organisations.

The fourth module Infrastructure and Environment is introduced as an interdisciplinary year 1 elective module aimed at Engineering and Science students. The model serves as a way of introducing principles of SD and examining modern global challenges.

The last, fifth, module Engineering for Global Development is a credit-bearing core module implemented in the 3 year of Civic and Environmental Engineering study. The method used in this model is problem-based learning framed around the Engineers Without Borders (EWB).

To summarise, the authors state that to achieve the needed change for embedding ESD in the curriculum the education systems must introduce new pedagogies that empower and engage both students and staff. (ibid.:4). Furthermore, for HEIs to do a whole system approach for the integration process they need to have firm deadlines and clear instructions to support associated teachings, collect regular feedback from staff members and students, and well developed resources for students and staff training and support.

Strengths and drawbacks

New pedagogical approaches stimulate pupils to "[...]ask questions, analyse, think critically and make decisions; that are cooperative rather than competitive; that offer opportunities for more interactive, exploratory, action-oriented, problem-based, experiential and transformative learning." (UNESCO's Global Action Programme on ESD:2018). The collaborative working and learning between staff and students is seen as an efficient way to develop students' world-view, life experience, skills and competencies and can impact the target communities as well as stakeholders.

On the other hand, embedding ESD can be very challenging. Crowded curricula can be a significant barrier to forming elective programmes across different year groups and different departments. Furthermore, introducing new ways of teaching can require additional time for training and support of staff across all faculties (Strachan et al 2021:11).

1.10. Student attitudes towards and skills for sustainable development

Author: Rachel Drayson, Elizabeth Bone, Jamie Agombar and Simon Kemp
Country: York, United Kingdom
Date of the publication: November 2014

Summary

The paper does not focus on a certain methodology of integration of ESD but on the attitudes students have towards ESD. It is based on an annual survey that was held between 2010 and 2013 and includes 21,304 student responses. It was done to reflect the demographic makeup of the UK students and was conducted for a fourth consecutive year. Main goals:

- Understand the student perspectives on sustainable development
- Identify students' needs and expectations for first-year students
- Track what students want and expect as they progress in their study
- Analyse longitudinal variability

Firstly, the author gives a background of the context of the research and then thoroughly explains every step done to conduct it so it can gather relevant materials needed to have a broader view on the student perspective in high education over ESD. The green economy is seen by the authors as a way of creating "[...] quality jobs that contribute to the recovery from economic crisis but at the same time secure the sustainable wellbeing of future generations."

Secondly, we are given an overview of research findings that pinpoint key trends seen in Higher Education among students. It shows the students' understanding, attitudes and behavior for sustainable development during HE.

All comes up in the last paragraph that is based on the variables found in the longitudinal study explained beforehand. Given recommendations are focusing on what each part of the community should do to successfully embed SD through all curriculum, extra-curricular, operational, research, and enterprise activities (Drayson et al 2014:50).

Methodology and main findings

The main findings are the recommendations that summarise the whole research and give the main ideas on how to incorporate sustainable development in HEIs. The recommendations are divided by roles that different positions hold.

Students should work on raising the importance of SD in formal curriculum, develop informal curricular activities that develop sustainability skills, and encourage institutions on a holistic approach to SD.

Academics should actively support the integration of SD in HE, conduct interdisciplinary research on the HE sector to demonstrate relevance of SD and make use of the Quality Assurance Agency (QAA) and HEA 'Education for sustainable development guidance. (ibid.49).

Higher education institutions should:

1. "Continue to encourage academic staff to develop formal and extra-curricular resources for sustainability and employability skills relevant to their discipline;
2. Continue enterprise work with employers and professional bodies to develop the skills and knowledge needed for business opportunities in an emerging sustainable economy;
3. Conduct further research on the importance of SD skills to graduate employers; community, student, and academic partnerships for SD; the different definitions and application of SD being used by students, academics, and policy makers." (ibid.)

Government and policymakers should increase their resources and support for HEIs where students have a demand for SD to be embedded in their studies, promote the relevance of SD and support HEIs in the evaluation of SD incorporation.

Employers and professional bodies should form connections with HEIs to identify needed knowledge and skills in a sustainable and responsible economy, work with academics to help incorporate professional sustainability skills and work with students' unions to provide relevant experience through work and internships.

The authors emphasise that everyone plays a role in integrating SD throughout all curriculum, extra-curricular, operational, research, and enterprise activities and for it to function every part has to actively play its part.

Strengths and drawbacks

The study mentioned by the authors that was conducted by Cotton D and Alcock P (2013) emphasises that participation in HE results in a significant positive association to environmental sustainability. The conducted research by the authors suggests that climate change helped drive the ESD agenda and that it has influenced students' understanding of sustainability.

On the other hand, work-based learning has been identified as valuable by multiple actors ``[...]recognising its potential to contextualise learning but also to enrich personal development'', but there is still a barrier because of the lack of opportunities in the SME sector. One of the issues that was mentioned by the authors was that students have a valuable role to drive the integration of ESD but they have a relatively short lifetime as a student in HEI.

2. Pedagogies and methodological approaches in including ESD in curricula

2.1. Transformative learning and Education for Sustainable Development

Author: Jörg Balsiger, Ruth Förster, Clemens Mader, Ueli Nagel, Helene Sironi, Sandra Wilhelm, Anne B. Zimmermann
Country: N/A
Date of the publication: 2017

Summary

According to the authors (the ESD Working Group of the Swiss academic society for environmental research and ecology - saguf), the Education for Sustainable Development (ESD) has gained increasing visibility and importance in the last two decades, as it has its integration into education curricula. However, they detect the risk of a distortion of the term into neoliberal and utilitarian discourses where the term sustainability is associated with the growth paradigm and with a utilitaristic view of nature as a mere resource for humans. In order to find a way to avoid this kind of distortion, the authors promote the concept of **'tranformative learning'**, as developed by Jack Mezirow in the 1970s, **adapting to the social dilemmas and needs of contemporary society.**

According to his views, grounded in cognitive and developmental psychology, there are **three orders of learning**, each of which has a higher degree of involvement of the learner. The first order of learning (**conformative**) is based on the reproduction of knowledge and in 'making things better'. The second order of learning (**reformative**) involves critical reflection and 'doing better things'. The third order of learning (**transformative**) involves the external observation of one's own worldview, in order to allow for cognitive and paradigm shifts. This level of learning is triggered by crises ('disorienting dilemmas') that uncover one's own 'meaning perspectives', i.e. the sets of beliefs, values, and assumptions that shape one's own identity and their interpretation and interaction patterns with the external environment. This 'state of liminality' (an in-between state of ambiguity and disorientation), often caused by intense emotional stress, allows the detachment from the previously owned worldview and the possibility to radically change perspective, therefore identity, interpretations and actions.

The 'social turn' of transformative learning (having been criticised to be too individualistic) implies the understanding of power relations in interlocking structures of class, race and gender, one's own body awareness, one's own visions of alternative approaches to living, and one's own sense of possibilities for social justice, peace and personal joy. The link between the individual change and the societal one requested by sustainable development (SD) is that the latter is a consequence of a massive number of individual paradigm changes. Integrating transformative learning within ESD requires a paradigm shift in teaching and learning, based on a process of collective awareness for engagement in concrete initiatives and a participatory, integrative, reflective approach and a constant re-negotiations of the practices and values.

Methodology

The methodology of the pedagogy used has its roots in cognitive and evelopmental psychology. In transformative learning applied to ESD, the focus is on the process of **collective awareness which then translates into concrete initiatives.** In order to succeed, therefore, it needs to focus on the **'learning space'**, the setting, which becomes **the catalyst to the paradigm changes** and therefore becomes the 'message' itself of ESD: it has to be participatory, reflective, integrative, and requires a restorative approach and a safe space for the learning process. It requires a deeper transformation of learning, not just curricula, but rather institution-based; it requires the possibility to create such a state of liminality, and a conscious transformation of learning and learning environments.

Main findings

The authors underline a number of **key conditions** to accelerate the progress towards the paradigm **shift to transformative learning** of ESD within higher education:

- **Normativity**: 'ESD must build on transformative learning and explicitly integrate critical reflection on goals and values. While some of these have to be negotiated as they may vary in time or space (e.g., minimum income), others are non-negotiable (e.g. human rights). Power relations at all levels must be scrutinised, as they underpin the unsustainability of prevailing economic systems. At the same time, transformative learning must not be used to instrumentalize learners but to empower them for autonomous critical action';
- **Social context** : 'Transformative learning has to encompass critical reflection about the social context, which includes the educational environment as an institutional setting subject to power relations';
- **Liminality**: 'While views on transformative learning note the importance of a disorienting dilemma, coping with liminality is a non-negligible responsibility. Competences, among educators, are needed to recognize and accompany a learning edge, assess the risks of frustration and abandonment, help learners get past the in-between state, and facilitate the reconstruction and assimilation of sustainable meaning perspectives';
- **Transformative teaching**: '[it] should include among other elements an emphasis on personal experience; inter- and transdisciplinarity [...]; service-learning arrangements; self-organised engagement with knowledge, values, and emotions; and living labs. A role shift is also necessary. Teachers take on the role of coaches, facilitating learning and co-learning among students but also between students and teachers. The UNECE ESD Competence Framework (2011) highlights what educators need for teaching sustainability: holistic approaches, envisioning change, and achieving transformation.';
- **Leadership for change** : 'Whereas transformative leadership is shared among many actors, competences and knowledge for sustainability transformations are widely lacking. Even though ESD policies in higher education exist all over Europe, professional training to develop institutional leadership and competences for transformative education rarely does'.

Strengths and drawbacks

The main strength of transformative learning for ESD is its ability to conduct a paradigm shift in education. Incorporating the Sustainable Development Goals (SDGs) in education, just as much as ESD, risks being used as a way to put a 'label' on content without actually pursuing any change in formats, contents or methodologies of teaching and learning - similar to what has been called 'greenwashing'. For the SDGs and ESD to succeed, a structural transformative approach is needed, and transformative learning has the potential to give the tools to perform such change.

At the same time, its 'revolutionary' nature makes it difficult to achieve, especially in identifying the gradual steps towards achieving it. Faced with institutional rigidity and traditions, it is easier that ESD takes a 'conformative' or 'reformative' approach, rather than a transformative one. That is what the authors detect in how Swiss higher education institutions are implementing ESD: '[m]ost SD curricula and ESD settings are of the traditional kind that prioritises knowledge over competence and competition over collaboration [...]. With regard to SD, progress resembles cosmetics rather than transformation, even though some universities have begun to create opportunities for change'.

2.2. Transformative learning and Education for Sustainable Development

Author:W.Leal Filho, S.Raath, B.Lazzarini, V.R.Vargas, L.de Souza, R.Anholon, O.L.G.Quelhas, R.Haddad, M.Klavins, V.L. Orlovici
Country: N/A
Date of the publication: 2018

Summary

The paper analyses the current state of the debate about transformative learning for ESD and provides examples from seven countries, four of which in Europe. The authors define some proposals coming from the debate about learning and ESD. The complementarity of whole curriculum reform with individual specialised courses is complemented with the expansion to non-traditional dimensions of sustainability, based on cultural-aesthetic, political-institutional and religious-spiritual perspectives.

Such an integration would allow students to go beyond the environmental/biophysical dimension of sustainability towards a more holistic approach that would convey the causes, the consequences of current trends and the urgency to change the paradigm away from the overexploitation of the planet's resources. In order to do that, Mezirow's transformative learning is an asset to promote change within Higher Education Institutions. In this perspective, HEIs would become knowledge and reflection centres promoting critical thinking, as well as societal and community engagement, where teaching, research, operations and relations with local communities are integrated with the principles of sustainability. About 600 universities around the world would have adopted this vision.

SD is characterised by complex, multi-stakeholder real-life problems with high social and environmental relevance: to address this, a transdisciplinary approach which also integrates non-academic knowledge and expertise should be promoted, in an effort to integrate theory and practice. The latter can be achieved by the approach between university and community and the use of the campus as a learning laboratory. 'Inter-transdisciplinary working groups can list the problems experienced by the community and they can become topics to be debated in the classroom. Educators and students can use the theory taught in the discipline to perform the real projects mentioned [...]. Besides, the inclusion of students in the dialogue with communities can present opportunities to learn and understand different points of view'. To that, the authors support service-learning in the framework of internships programmes, both abroad and at home.

Furthermore, the campus should be included in the sustainability projects, with a view of an integrating approach to the local community and an efficient use of resources. However, in order to do that, an institutional transformative approach is needed according to the principles of 'synergy'. In order to achieve that, a trans-disciplinary case study approach which can lead to the creation of trans-disciplinary academic units lead to the development of new skills, and capacity for action that therefore is reflected in the learning environment, to the benefit of the students. In that, a transformational leadership approach, where 'the leader is concerned and shows respect for employees[,] they are conscious of the individuality of each person, they focus on developing employees' loyalty, trust and justice relationships and works to increase employee self-esteem, confidence and effectiveness ', together with the ability to listen and respect the ideas of students, teachers and university employees with a democratic spirit, are needed to ensure flexible and comprehensive strategies.

A summary of the case studies can be found in the following table.

Table 1
Overview of the case studies.

Case studies	Campus operations/ management	Existence of a SD unit at the university	Learning and teaching for sustainability programme	Faculty professional development, pedagogical innovation related to ESD	Integrating sustainability in research	Outreach, external operations, partnerships with communities, governmental actors and NGOs
University of Latvia	X	X	X	X	X	X
University of Damascus (Syria)	X	X	X	X		
State University of Campinas (Brasil)	X		X	X		
Manchester Metropolitan University (UK)	X	X	X	X	X	X
University of Belgrade (Serbia)		X	X			X
Polytechnic University of Catalonia (Spain)	X	X	X	X	X	X
North-West University (South Africa)	X		X	X	X	X

In particular, we focus on the following case studies:

- **University of Latvia**, Latvia: the national 'Law on Environmental Protection (as of 15 November 2006, "Section 42. Environmental Education) [...] states that environmental education and education for sustainable development shall be included in the mandatory curriculum of the subject or course standard in accordance with the specific character of each subject by coordinating and ensuring succession in different education fields of study.' There exists a focus group on education transformation and education for sustainability composed of teachers working on teachers training improvement. Furthermore, ESD is closely linked with environmental education, climate change and global change education. 'Sustainability studies are offered as electives in nearly all universities in Latvia, however, the study time allocated is quite low (just some hours per week in 1 semester). In some of them, study courses on environmental education and education for sustainable development are a mandatory element of study curricula for all students. Specialised universities in Latvia (technical and medicine universities), which are oriented towards strictly monodisciplinary education in branches of science, medicine or technology, see their specialisation as their main strength and are more reluctant to integrate education for sustainable development. In this respect, the University of Latvia is a leading national university in respect to both support for the transformation of education and education for sustainability. The formal responsibility at the University of Latvia about education for sustainability is the Centre for Education for Sustainable Development which functions to coordinate activities with ministries (Ministry of Education and Science and Ministry of Environmental and Regional Development), NGOs as well as UNESCO'. Its role is to develop study materials and study methods, and support student-centred learning in sustainability and the greening of university campuses.

- **Manchester Metropolitan University**, UK: '[t]he university has developed policy frameworks that address education for sustainable development through different university strategies such as the learning, teaching and assessment strategy, the environmental sustainability strategy and the environmental sustainability policy. The Environment Team of the university also publishes a report through the annual statement.' The Centre for Excellence in Learning and Teaching provides workshops on ESD open to all teaching and professional staff supporting learning. Furthermore, all staff must complete a unit on ESD part of the postgraduate certificate. Finally, the centre provides online material for teachers and externals about ESD integration in curricula and innovative pedagogies. There have also been specific initiatives on ESD in the Art School, in fashion (Langdown and Vargas, 2015) and in art and design (Cocchiarella et al., 2016). Another example is an interdisciplinary project with undergraduate students of the School of Art and the Engineering Department, which was based on community service and problem-based learning around wool production in Northwest England.

- **University of Belgrade**, Serbia: environmental issues are being integrated in science faculties and in the faculties of social science at the postgraduate level. In the Faculty of Political Science, besides the introduction of sustainability principles in interdisciplinary courses in Social and Political Ecology, the Centre for Ecological Policies and Sustainable Development has been established, which in 2011 organised a symposium on sustainable university development and an awareness campaign among the Serbian youth to promote change in their everyday activities. The University joined in 2016 the Inter-University Sustainable Development Research Programme, under which students of the Faculty of Philosophy and Faculty of Safety researched student perceptions of the faculty environment and sustainability issues.

- **Polytechnic University of Catalonia (UPC)**, Spain: The University developed in 2015 a Sustainability Plan, and focused on complementary activities for engineering students. The transversal competency 'Sustainability and Social Compromise' is mandatory in all courses of bachelor and master of UPC. Furthermore, specific programmes were developed, such as the master of Science and the Doctorate programme in Sustainability. The UPC also established a Research Institute for Sustainability Science and Technology. This led UPC to steer the European initiative 'Global Dimension in Engineering Education', which focuses on increasing the awareness, critical understanding and attitudinal values of students in technical universities related to Sustainable Human Development (SHD) and its relationship with technology. NGOs were involved in academic practices for students and teachers linked to SHD.

Methodology

The authors describe the employment of transformative learning as applied to ESD. They recommend inter and transdisciplinary approaches, the integration of theory and practice, the individual commitment and development of synergic actions in groups, the ethical discussions and reflections, the adoption of critical thinking. At the same time, there is no approach fitting all, and the European School of Sustainability Sciences and Research, an inter-university consortium based at the Hamburg University of Applied Sciences in Germany, will act as a reference centre for research, teaching and training on matters related to sustainable development.

Main findings

From the interrelation between the theory and the practice of the case studies, the authors identified 'six main lessons:

1. it is essential to help students to develop a critical understanding and change in attitudinal values about global SD challenges;
2. students and faculty can strongly benefit from the cooperation with civil society organisation in the integration of SD;
3. the critical analysis of case studies focused on SD, based on real projects implemented by NGOs, help students make links to the real world and contextualise theory;
4. the involvement of non-academic experts (such as NGOs practitioners) in formal teaching activities, enrich students' learning experience;
5. the capabilities of academic staff to support learning transformation processes are too often assumed, and more attention should be devoted to faculty professional training;
6. the existence of transformational leadership, may help in fostering innovation in Learning and Education for Sustainability'.

Strengths and drawbacks

The theoretical debate and the case studies show that change is possible and give some concrete examples towards that path. At the same time, there is the recognition that change is coming at a slow pace. According to the authors, this is due to the traditional departmental, compartmentalised structure of universities and its disciplinary boundaries, which reflect compartmentalisation of learning

and research at all levels. Furthermore, change towards ESD is normally promoted by committed individuals, while the institutional transformation needed has to happen at the level of policy and decision making, including the criteria to incentivise scientific research, still based around disciplines, and by promoting the importance of individual initiatives, of quality of teaching and rethinking the assessment of individual research, still largely based on the quantity of production.

Other problems are lack of awareness, abstract approaches, lack of funding, few financial rewards to educators participating in transformative schemes, individualistic approaches to research, and the existence of bureaucratic systems that hinder the flexibility and the undertaking of integration activities. A possible solution can be the development of an interdisciplinary 'sustainability science', which would allow students to present to students global issues such as extreme poverty, human rights, globalisation, equality issues, professional ethics and environmental challenges.

2.3. The role that marketing academics play in advancing sustainability education and research

Author: Joya A.Kemper, Paul W.Ballantine, C. Michael Hall
Country: New Zealand
Date of the publication: March 2021

Summary

The article explores positions, views and opportunities for academics in the field of marketing which strive to improve the conditions for research and education in sustainability. Some marketing academics who advocate for the importance of sustainability education for today and the future as well have difficulties incorporating this concept into their academic work.

Marketing is usually not perceived as a field with close ties to sustainability, as its traditional approach is to teach people how to sell more and maximise profits. Nevertheless, some academics feel that this concept is too limiting and doesn't enable enough space to talk about environmental concerns. The authors of this study, therefore, conduct interviews with marketing academics from various parts of the world in a semi-structured way in order to hear about their experience with

sustainability promotion at their institutions – conducting sustainability-related marketing research, including it in the courses or promoting it within the university's internal structures.

The responses gathered provide an insight into the position of academics, who would like to be more environmentally-friendly, but face various obstacles, whether formal or informal. One point that stands out is the need for the so-called "champions of change" who would be willing to be the first in line to promote a progressive approach. Furthermore, the authors fill in the gap in the responses by theoretical literature review, naming organisational issues by incorporating environmental education and identifying possible countermeasures on how to tackle them.

Methodology and main findings

The main method used in this research is the conduction of interviews with marketing academics. These interviews are semi-structured, which means that there might be slight differences in the way they are run when an area for further exploration arises. There were 18 interviews in total, with academics being equally divided into 3 regions: Australasia, North America and Europe in order to diversify their responses and make findings more robust across the globe. Except for 2 physical meetings, all the rest were carried out via on-line tools or telephone due to geographical distance. The academics were selected with respect to their affiliation with the field of sustainability.

The interview lasted from 35 to 140 minutes with an average time of 70 minutes. Topics discussed were their experience being marketing academics with partial focus and/or interest in sustainability. Since the scene is relatively small, their names were changed for the sake of anonymity. The authors also asked them about their views on the concept of "institutional entrepreneurs", which are people who strive to change and innovate organisations from within. As the authors' research suggests, people who wish to connect existing processes and structures with environment and sustainability often need to take on this role and become local champions of change. Once a person willing to be this champion campaigning for their cause is found, it is easier for their colleagues to speak up and follow them.

The theoretical part describes that there are quite a lot of barriers to these sustainability-related changes in HEIs. Some might be institutional, such as lack of leadership or structural constraints, lack of resources or personal reasons, such

as lack of will to change, lack of support, peer pressure and adverse reactions to sustainability integration. Furthermore, there are external pressures as well from stakeholders, who might include businesses, other academic bodies, NGOs or the public sector. Another factor to count on is student demand for this particular school or school rankings. For the area of business schools, who are the leaders in marketing education, the pressure to maintain the current profit- and consumption- oriented approach is a strong factor too. In the end, sustainability-minded marketing academics often find themselves in an uneasy situation. As some interviewed participants noted, they would like to incorporate sustainability more and show students that not everything is about producing more, consuming more; and they are slightly frustrated about the marketing teaching expected from them.

Participants also often felt lacking the power to affect things (internal processes, research orientation, course content) at their institutions, and perceived that those who actually can make these changes are the university's management or program managers. One participant also stressed how bludgeoning is the bureaucracy in academia which takes a lot of their energy. Nevertheless, another participant spoke about the freedom in teaching, noting that they are able to adjust the content without their colleagues even knowing.

Another topic discussed was the role of academics as educators. They did not feel particularly valued or rewarded by other staff, but it brought them more personal satisfaction. One interviewed participant stated that teaching is usually assigned to those who do not wish to conduct research. As a result, the status of staff that teaches was perceived as somewhat lower to research-focused staff.

An interesting observation was made when participants stated that they do not perceive a single sustainability-focused course as something helpful, and its effect might actually be the opposite. Instead, they preferred having sustainability intertwined in multiple courses without a single one stressing it in particular.

Then, the participants were asked about the need for research publishing. Researchers face pressure to publish often and in as prestigious journals as possible, nevertheless, there are few such opportunities at the intersection of marketing and sustainability. The takeaway message was that researchers themselves are incentivized to focus on the traditional areas of marketing such as advertising, as these stand a better chance for a publication in a highly-ranked journal. Even in research, environmental concerns in marketing are a niche area. This leads to another finding – some researchers stated that they had to focus on the traditional marketing at the beginning of their careers to make themselves

established (or even recognized at all). In addition to that, it was stated that not even the publication in sustainability might do the work in the end, as the end readers of this research would probably be only their already like-minded colleagues from academia.

Some of the answers also came to rather pessimistic conclusions, e.g. that there either needs to be a major disaster which will bring a wider audience to the topic of sustainability, or that the older generation needs to retire before the younger, more progressive people are allowed to make a change.

Overall, the participants agreed that it is (and will be) very difficult to change the general opinion on marketing, and some even added that though sustainability is an increasingly visible topic, very few researchers chose to pick it as their primary specialisation.

After the interviews ended, the authors reflected on the answers and supplemented key areas with a theoretical framework. Ultimately, they presented a matrix of situations that sustainability-minded researchers can encounter, describing the internal dynamics of change. Some activities, such as teaching in classrooms, brought little to no recognition but had the potential to influence a large number of students. Then there was research, which benefited the staff member's position, but the effect on actual change was quite low. Ultimately, it was identified that a viable approach is to utilise external experience (such as other work in the field of sustainability), which legitimised the researchers and at the same time provided them with enough captivating material to examine and teach in classes. In the end, this might create a win-win situation of both impact and recognition.

Since external dynamics of change were not discussed as much in the interviews, the authors examined available research materials in this area and followed with a compilation of their own. Identified factors that can affect change included journal rankings, where higher ranking of sustainability-related ones could incentivize more focus on environmental matters among a wider base of academic staff. Other factors were e.g. access to external funding or the influence of accreditation agencies.

The authors also included a set of strategies that **academics** could use to promote change by rather soft, and sometimes disruptive and manipulative means. To sum up, they need to act **as "institutional entrepreneurs"** who flexibly change their tactics according to surrounding conditions. The four frameworks when conformity does not work are compromise, avoid, defy and manipulate.

Compromising by balancing interests and avoiding conflict by negotiating are considered undisruptive approaches, whereas defying the demands of the institution and manipulating fall under the “active resistance” category. Defying includes actions such as publishing in ones preferred journals or creating own course content regardless of institutional recommendations. Manipulating requires certain political skills and experience, together with leveraging one’s position with work-related factors or social capital. This is probably the most difficult, but also the potentially most beneficial strategy out of all the four mentioned.

Strengths and drawbacks

The strength of this research lies in the interviews with actual researchers with gaps being supplemented by theoretical research. **The perspective of marketing academics might be, to some extent, useful even for assessment of other fields, especially describing the relationship within institutions in terms of need for research and relatively low priority of teaching.** Besides that, knowing the situation of researchers is crucial to evaluate how sustainability-focused changes would affect their jobs and positions at their institutions. An identified good practice that could theoretically be promoted is the combination of work in academia and other sustainability-related work experience. Overall, the paper provides an insight into the life of an academic trying to highlight the need for sustainability and the barriers they encounter.

This, however, can also be interpreted as a drawback; the article does not mention the actual content of the courses, rather the internal operations of the academic world. Furthermore, tactics could be explored in the first step (semi-structured interviews) rather than relying mostly on theoretical concepts. In the end, however, the paper provides a solid background into the situation of actors that ultimately carry out education in sustainability.

2.4. Mapping Master Students' Processes of Problem Solving and Learning in Groups in Sustainability Education

Author: Anette Oxenswärdh and Ulrika Persson-Fischier
Country: Sweden
Date of the publication: June 2020

Summary

This article examines the course ''Projects in multidisciplinary teams'' of the Master's programme Sustainable destination development at Uppsala University on the Campus of Gotland that took place in the spring of 2020. The main goal of the programme was to help students attain the necessary skills and knowledge that will enable them to engage and work with destination development that leads to increased sustainability for all parties, visitors, hosts and locals.

The programme is purposely held on the island of Gotland in the Baltic sea as the location of the island enables the students to have a 'living laboratory' experience. In other words, students are encouraged to deal with real destination development cases and challenges during their studies, amongst others, through collaboration with the local community, businesses, organisations and public authorities. The programme also uses a pedagogy of ESD (education for sustainable development) in which teamwork is an essential part of learning.

The programme follows the SDGs, in particular, the Partnership for Sustainable Development (number 17), which indicates the importance of collaboration between different stakeholders and sectors. Thus, the programme offers three specialisations: entrepreneurship, nature-based tourism and heritage politics. In all three specialisations, the students were working with real sustainability challenges in regard to destination development and were engaged in 11 projects during the 2020 course.

The study itself emphasises the importance of sustainability as a concept for any organisational context and goes beyond the realm of sustainable destination development. For students to understand the **goals of sustainability and the responsibilities it carries, the programme promotes problem-solving, teamwork, innovation approaches, collaboration with tourist organisations as well as uses design-thinking as a method.**

Methodology

This study used a qualitative approach, therefore, during the course "Projects in multidisciplinary teams", teachers had meetings with groups of students. During these meetings, students presented their overall progress and received feedback from the teachers. At the end of the course, each group presented their final presentation together with the proposed solutions on the topic of a particular sustainability challenge they were dealing with. Consequently, teachers had focus group interviews with the groups of students on their perception of learning, while in parallel they also disseminated an online survey to five 'problem owners' (see table).

The interview for the students revolved around the study background, members of the study group, the problem owner and the assignment or the challenge given to the students as well as the description of the whole process, including specific questions regarding the method used in the course such as questions on the design-thinking method, group processes and student learning. Meanwhile, the questions to the problem owners disseminated through an online survey contained questions on how they perceived the student project.

Study groups consisted of three to four members all from different nationalities and with various study backgrounds. The students came from 14 different countries around the world: Czech Republic, Germany, Austria, France, Finland, Brazil, Mexico, Indonesia, China, Italy, Iran, USA, Spain, Vietnam and Kazakhstan, while problem owners were local entrepreneurs in the tourism industry.

Table 1. The entrepreneurs and their challenges given to students.

Entrepreneur	The Challenge
Gotland Excursion	To map how accessible the city of Visby is for people with disabilities and to make suggestions for improvement. Design a sustainable tour for the disabled.
County Board of Gotland	How can the use of plastic in the tourism industry in Gotland be reduced?
Uppsala University	To organise training on sustainability for BnB organisers.
Tourist attraction Lummelunda cave	Designing for more user areas of the attraction.
Village development of Hemse	To develop Hemse as a place and destination.
Roombler	To develop a membership programme for the site.

Main Findings

The students' responses in the study demonstrate that it was not easy for them to slip into the problem owners' shoes and understand their needs and stated several reasons why it was hard to think and work as a problem owner. Firstly, students state there were so many different problems for one problem owner which made it difficult to define one target group. Secondly, they struggled with communication and a large amount of information. Nonetheless, the student remarked that the process went on better with each step.

Most student groups started their process by brainstorming due to their lack of knowledge on the topic, while they identified that discussing the problem with different people and gathering information helped them define target groups and the problem itself. To be able to concretely identify the problem, the students use the tool of 5 why's to come to the root of the problem. They also visited the problem owners, talked to the owners and locals as well as looked for information and advice online as well as from their course teachers and fellow students. Some groups also used qualitative interviews, open-ended questionnaires for data collecting and testing a prototype of the problem area, while some even mentioned using their own life experiences.

The overall goal of this course was to propose solutions to the problem owners on how to include sustainable solutions in the hospitality industry by which students note that time was a big factor in producing a good-quality proposal to the problem owners. Taking the time to gather various feedback from the problem owners made students come up with alternative solutions. Depending on the topic of the project the group of students worked on, various sustainability goals were incorporated into their solution proposals and later on in their responses to the study.

Furthermore, one of the major implications of this study is that the course has given students the opportunity to deepen their understanding of both the barriers and benefits of working with heterogeneity in groups. Also, the study notes that all group learning, particularly when it comes to the topic of sustainability, needs a well organised and functioning process that can guarantee productive collaboration between students to find sustainable solutions.

Strengths and drawbacks

The study has demonstrated that on the one hand, the design-thinking method helps students gain and organise the knowledge they need to solve the project/challenge. On the other hand, the method also created confusion and frustration among the students due to its iterating process, new approaches to the problem and a lack of students' experience to work in a team. The students identified the amount of time it took to organise a team that works effectively as a main weakness of that method. For that reason, some students claim that this method does not promote creativity, but instead is too controlling and predictable, while stressing that the overall output could be 'manipulated' by strong leaders.

However, some are critical and claim that the design-thinking model is too steering and rigid. Some felt that they did not have sufficient knowledge of the method when the project started, despite being given two full days of introduction to the method. Despite this, most students would like to use the method in the future for problem solving

The study also shows that heterogeneity and diversity in regards to values and beliefs give added value to the overall implementation of the innovative project as it provokes tacit knowledge. Due to the students' diversity in values and beliefs, during their initial brainstorming session after the initial training in design thinking, the students have the opportunity to learn together, but necessarily the same things (Granberg). Nonetheless, they need to come to a consensus regarding how to approach their challenge.

Action learning appears to be a favourable way of learning new behaviours and developing problem-solving competences through real-world situations such meeting stakeholders, approaching problems by visiting places, etc. Meanwhile, problem owners also influence students' learning by motivating and offering a social context and real-life experience. Based on their responses, this depends on the level of individual students' involvement in the project. Furthermore, the problem owners stress that this project enabled reciprocal learning as they also noted they gained knowledge on how to solve problems in regards to sustainability within their work.

2.5. Interacting Pedagogies: A Review and Framework for Sustainability Education

Author: Jason Papenfuss, Eileen Merritt, David Manuel-Navarrete, Scott Cloutier, Bonnie Eckard
Country: Arizona, United States of America
Date of the publication: April 2019

Summary

The main goal of this article is to provide us with a framework for advancing our teaching methods in sustainability education. Moreover, it aims to illuminate ways in which pedagogies for sustainability education interact. The main idea is to show possible innovations in sustainability education by focusing on institutions of higher learning which are seen by the authors as having a vital role in the shift toward sustainability (UNESCO, 2018).

The article is divided into the following paragraphs:

1. The Emergence of Sustainability Education
2. Transformative Learning Theory and Sustainability Education
3. Freire's Emancipatory Learning
4. Mezirow's Critical Reflexivity
5. Developmental and Extra-Rational Transformative Learning
6. The Interactive Pedagogy Framework
7. Contemplative Pedagogy: Toward a Fourth Wave of Sustainability Education

In the first paragraph authors give a brief history of the beginning of sustainability education that happened during the 20th century. As the authors state, Institutions of Higher Learning (IHLs) have been recognized as the main subjects for promoting sustainable development and for making people feel more involved in the problem so they could address it. Because of the growing amount and complexity of sustainability challenges, it became necessary to include it in IHLs curriculums. The authors depict four waves of sustainability in IHLs that they further explain in the ongoing paragraphs.

In the second paragraph, they introduce the transformative learning theory and propose a classification for dominant strands: the emancipatory, the critical-reflexive, the developmental, and the extra-rational (Dirkx, 1998).

The next three paragraphs explain those strands by introducing the main philosophy behind them as well as putting them in context to explain why they were formed as such. Furthermore, giving us an overall introduction to the sixth paragraph in which they give an example of the interactive pedagogy framework that they see as an essential method for sustainability education.

The last paragraph gives yet another way of tackling environmental education. We are given a vision of how contemplative practices can be used to raise awareness on the importance of environmental sustainability by forming empathetic connections.

Methodology and main findings

Institutions of higher learning are identified as having a crucial role in SD. While most IHLs mostly have non-formal sustainability education on their campuses some of them started to develop formal changes towards an ESD. Many see that emancipatory and transformative learning is required to incorporate in the teaching and learning sustainability for it to be effective. At the beginning of incorporating sustainability in IHLs, the main focus was on reducing environmental impacts and less on pedagogy and it is called the campus greening movement (Wals & Blewitt, 2010). After which it began to question the traditional methods of teaching and learning and started to use collaborative, community-based and service-learning processes. Moreover, efforts were put into training teachers to implement sustainability in their courses.

Authors perceive that the HEIs should prioritise training for transformative learning in order to embed sustainable education. They state that the positive side is that it aims to question and transform social structures and individuals. Implementing transformative and emancipatory pedagogies can be challenging but it is needed to assist sustainability education.

The last introduced is contemplative pedagogy as a new wave of teaching and learning sustainability in HEIs. Contemplative education as a form of transformative education is seen as an efficient pedagogical method for social and individual transformation.

Strengths and drawbacks

Integrating different emancipatory and transformative pedagogies can help students, academics and university personnel in teaching and learning sustainability, thereby emancipating and transforming students into potential social innovators.

The most visible barrier according to the authors is the common inflexibility of the existing IHLs that can therefore resist the adoption of new pedagogies.

2.6. Practical pedagogy for embedding ESD in science, technology, engineering and mathematics curricula

Author: Peter Hopkinson and Peter James
Country: Bradford, United Kingdom
Date of the publication: May 2010

Summary

Science, technology, engineering and mathematics (STEM) are significant to sustainable development. Moreover, STEM students are seen as a huge factor in contributing to greener technologies and greener lifestyles. The article's purpose, as stated by the authors, is to review and introduce examples on embedding education for sustainable development into STEM subjects.

The first paragraph underlines the main challenges of embedding ESD in STEM curricula. On one hand, the authors state that a lot of challenges apply to high education initiatives and are not unique to ESD (Hopkinson 2010:367). On the other hand, introducing science and technology lecturers to ESD is looked upon as harder than social science and humanity lecturers.

The second paragraph illustrates recent examples of sustainability within the STEM curriculum. The examples are divided into 4 sections:

1. Engineering
2. Environmentally responsible laboratory-based practices
3. Environmentally responsible fieldwork practices
4. Re-thinking practical experiments

Every section gives different approaches and practical ways of implementing SD into STEM subjects while explaining the possible difficulties surrounding the topic, and also providing solutions to surpass them.

In the last paragraph, the authors summarise the previous sections and give an overall idea of the positive aspects of embedding SD into STEM curricula. Highlighting the possible problems that can be encountered along the way and stressing the importance of a top-down institutional vision and academic policy for ESD together with an academic implementation strategy.

Methodology and main findings

The main goal is to develop a way to make students more aware of the connection between their subject and sustainable development and HEIs are responsible to do so. Coral (2009) identified problem-based learning through role-play, back-casting and graphic learning as valuable pedagogical strategies for integration of SD in engineering education in his “Engineering education for a sustainable future” case studies.

There are 4 different examples of different strategies in incorporating SD within the STEM curriculum.

The first example is focused on engineering. Authors mention that a number of STEM courses introduce environmental and social issues through modification of existing content, or by forming a new course. Moreover, the UK Royal Academy of Engineering has developed a guide and case studies for students to gain relevant knowledge and skills to apply in their professions. The best way to teach ESD is to form an interdisciplinary, student-centred approach that involves teamwork. The idea has also been implemented into a teaching initiative at the University of Manchester and consisted of an optional 12-week course. During the course, the students had to analyse problems collaboratively and produce a professional report at the end. (ibid.368).

The second example is based on the research on environmentally responsible laboratory-based practices. The authors introduce the laboratory research and technical staff Lab RATS initiative at the University of California as a good example of shining light on the issue of sustainable laboratories. The initiative employs students as interns to conduct research on laboratories by providing them with firsthand experience. Meanwhile, academic staff, technicians and lab managers hope to indirectly influence students by raising awareness on the topic of sustainability.

The third example is environmentally responsible fieldwork practice. It focuses on how STEM subjects work away from their institution and the environmental impact that they can have. Fieldwork and field trips are seen as valuable learning experiences for teaching and raising awareness on student impact through everyday choices.

The final, fourth, example introduces us to the Green Chemistry movement that helps in rethinking practical experiments. The movement has a significant institutional base. Moreover, it influenced the curriculum at the postgraduate level and started new Green Chemistry Master courses.

Furthermore, we are given a whole university approach to embed EST through the Ecoversity initiative at the University of Bradford. The ways they approached the curriculum are, as the authors state:

- incorporation of ESD as a strategic corporate aim within our new corporate strategy (2009-2014)
- a course review and approval process that requires all new courses and courses subject to five-year review to demonstrate how and where they articulate ESD;
- appointment of academic as ESD champions to spearhead curriculum change within their academic areas; and
- funding to stimulate and support specific disciplines focused on curriculum interventions and/or curriculum development.

Small group exercises, discussions and students' reflections on the independence of their practice and SD were given positive feedback in later evaluation. Students found that working in groups and actively reflecting on topics that have not been learnt as a part of their course was a stimulating experience and was having an impact on their professional activities.

Overall, **implementing SD in STEM has a greater possibility of success when their connection can correlate through core scientific and technical competencies such as "...analytical rigour, critical thinking, and empirical observation and testing, and build on –rather than work against –existing disciplinary, departmental and teaching and learning cultures**"(ibid.11). The best way to do so is by embedding new learning activities within traditional laboratory, fieldwork and problem-solving.

Strengths and drawbacks

Practical and collaborative pedagogies explained through this article prove to positively influence students by making them feel more skilled and employable. The new forms of collaborations between academics, students and laboratory staff help promote and raise awareness of the environmental impact of laboratory operations. Moreover, the changes can help increase student employability and develop their practical knowledge and skills.

On the other hand, innovations in university curricula can attract opposition and thus it can take a long time for SD to get embedded in a curriculum. Also, many academics and students find SD to be a partly ideological concept and if it is forced into a specific area of expertise it can be negative. The way to avoid that possible situation is that the ESD related changes have to be clearly related to the core scientific and technical competencies.

2.7. Flipped Classroom as an Active Learning Methodology in Sustainable Development Curricula

Author: Marian Buil-Fabregá, Matilde Martínez Casanovas, Noemí Ruiz-Munzón , Walter Leal Filho
Country: Tecnocampus, affiliated to Pompeu Fabra University in Barcelona, Spain
Date of the publication: August 2019

Summary

The article introduces flipped classrooms as a new type of methodology for learning SD. It explains how it can be used and implemented in the classroom. The research shown is based on a survey of 154 students that were taught by flipped classroom methodology through the period from 2015to 2019 in the University Tecnocampus, affiliated with Pompeu Fabra University in Barcelona, Spain.

In the first section of the article, the authors explain how education tackles the challenge of finding a way of teaching that will improve the learning process of SD for students. We are given the idea of the concept of flipped classroom and how it differs from normal learning processes. Moreover, the authors explain the role given to the student and the teacher emphasising the teacher as the one with the higher responsibilities as he has to be a guide to facilitate learning.

The second section focuses on the conducted research that was meant to measure the efficiency of flipped classroom learning. Firstly, the authors present the used methodology and explain why it was used and how. Secondly, we are introduced to the questionnaire used in the research that was based on Assessment Instrument for Sustainability in Higher Education (AISHE 2.0).

The third section provides us with the results of the research. The discussion in this part focuses on the pros of flipped classroom learning elaborating on how it can help students become more engaged with the process of learning and be more alert to SD development issues and the possible cons of the used methodology of the research.

Methodology and main findings

The flipped classroom is a method to incorporate active learning. It is based on the idea that students get all the important information for the ongoing lecture before class so that when they come to class they can actively participate in discussions and have more opportunities for high-level learning. The authors state that "the flipped classroom methodology reverses the normal learning process by moving the lectures out of the classroom and moving the concepts learnt in class through the use of learning activities" (Buil-Fabregá et al 2019:1).

"According to the Flipped Learning Network, in 2014 (FLN 2014) the flipped classroom approach has four pillars. In order for teachers to achieve this approach, they have to take these four elements into consideration:

I. Flipped learning requires flexible environments.
II. L: Flipped learning requires a shift in learning culture.
III. I: Flipped learning requires intentional content.
IV. P: Flipped learning requires professional educators" (ibid. 2)

Moreover, there are two roles involved in the flipped classroom: the student and the teacher. As it is written down in the four pillars this type of method requires professional educators. In this type of method, they do not transfer knowledge directly, instead, they have to be a guide to facilitate learning, increase student participation and "...must create learning conditions based on questions"(ibid.).

Meanwhile, the student is no longer a passive receiver; they have to take responsibility for their learning because the time with the teacher is no longer used to transfer information. Before class, they get learning materials that they have to go through so when they come to class they can actively participate, ask questions and give feedback. The authors explain the process of the flipped classroom is divided into four steps:

1. The preparation of work materials (texts, videos, reference papers, network resources etc.) for individual and collaborative activities

2. Developing a learning environment using Moodle that is available 24h a day. As they progress they are then divided into groups. During class they are answering questions by the teachers and after they have to think about those questions and discuss them in given groups or through organised forums.

3. Presentations of group work in order to discuss the information and answers they gathered on a given subject. After the discussion, the groups were "[...] reorganised for final reflection to encourage collaborative learning[...](ibid.4). At the end, the students conclude on the most relevant topics of the contents.

4. Students unify all the gathered contents from them, develop their final work and get ready for the final exam.

To summarise, the authors show that using flipped classroom methods promotes active learning and helps students acquire competence for ESD because it offers a holistic approach to a learning experience.

Strengths and drawbacks

The study shows that flipped classrooms facilitate critical thinking and improve student participation inside and outside the class. This active learning strategy helps develop competences required for ESD. It gives the possibility for students to organise their time and learn at their own individual pace and it also increases collaboration between students. Furthermore, the results of the conducted research show that the students that were following a flipped classroom methodology are more alerted to the SD development issues.

On the other hand, this type of approach faces problems such as:

- Students coming unprepared to the class
- Lack of quality equipment in class
- Not all of the students have the available technical support to prepare for class
- Teachers have to be highly trained professionals that are acquainted with flipped classroom methodology
- The material that is given to the students has to be high quality

This article doesn't give the perspective of teachers in this type of learning but it states that they have a considerable workload of creating material for learning at home.

3. Climate Change Education

3.1. Climate Change Education at Universities: Relevance and Strategies for Every Discipline

Author: Petra Molthan-Hill, Lia Blaj-Ward, Marcellus Forh Mbah, and Tamara Shapiro Ledley
Country: United Kingdom
Date of the publication: July 2021

Summary

The article talks about climate change education and its possible impact on climate change mitigation and adaptation. Universities still don't invest in or recognise the importance of climate change education (CCE). The aim of this article is to highlight the importance of HEIs in providing solutions to possible challenges .

In the first section, the authors explain mitigation, adaptation and climate science education as core dimensions of climate change education, while also offering possible ways on how climate change mitigation and adaptation can be integrated into different disciplines. The disciplines are: linguistic, literal studies, psychology, agriculture, environmental management and education.

After addressing climate change education in specific subjects the authors introduce us firstly to a framework for mainstreaming climate change education in high education curricula, secondly to a whole-institution approach in embedding CCE and lastly to different sector-wide initiatives to support the integration of CCE in university curricula focusing on the United Kingdom as it is the first country in the world to passed legislation concerning climate change (Molthan-Hill 2021:47).

Methodology and main findings

HEIs have the main role in climate change adaptation by incorporating into every part of their curricula. To effectively teach and learn about climate change adaptation the author recommends: new active learning techniques using cross-discipline curricula, connecting learning to local problems, nourishing problem-solving and critical thinking skills, using storytelling teaching techniques and teacher education. Moreover, it is important that universities embed climate change (CC) into broader curricula and make efforts to increase its visibility.

Taking a whole-of-Institution approach in regards to embedding CCE means that the university is fully integrating CC in every part of their activities. Such is the University of Glasgow. In 2019 it developed a draft of the climate change strategy. The idea is to embed sustainability in the curriculum, develop teaching tools for staff and students and facilitate change. In 2020, they had consultations about integrating sustainability into the curriculum through which they gathered 1300 individual responses. Furthermore, the University of Sheffield did a similar effort in integrating sustainability education into every course they have. The last given example of this approach is the University of Toronto. They embedded sustainability in every part of their curriculum and also are actively promoting active solution-oriented teaching. They have several active courses that revolve around sustainability development. Moreover, the authors conclude that in order to successfully incorporate CC into a university there has to be a clear institutional mission statement, developed learning and teaching strategy, and enough resources to ensure that it will be effectively implemented in all parts and levels of the university. At last, the University of Winchester launched a course for student teachers in partnership with an external organisation. The course ends in getting accreditation as a UN Climate Change Teacher.

Later on, the authors state that stakeholders need to support climate change in education in every part of a university. Governments have to include CCE in their policies and guide the integration of it in every level of education, leaders of universities need to be sustainable and make teaching sustainability a priority, deans of faculties need to make CCE a priority, course leaders need to find out a way to connect their subjects with CCE, lecturers and researchers need to develop teaching materials and students need to be active participants in the creation of learning materials.

To summarise, the authors state that universities need to take a whole university approach to integrate CCE in every discipline and at every level. Authors find that the university has to be an active promoter of education on climate change and to do so it has to have cross-sector collaboration, educational assessment, form interactive engaging teaching methods such as role-playing games and workshops that meet the interdisciplinary needs, form active individuals that will make an impact on the world around them.

Strengths and drawbacks

New pedagogies that are being developed for ECC are actively engaging students in the learning process. Students form knowledge that can then be used to influence areas that affect them and make them more adequate to actively participate in civil society.

Meanwhile, the full integration of CCE into university curricula needs the active and continuous support of many stakeholders. In other words, there is a big possibility that CCE won't be implemented effectively in the case there are not enough resources to train teachers nor actions that would help the integration process.

3.2. Handling climate change education at universities: an overview

Author: Walter Leal Filho, Mihaela Sima, Ayyoob Sharifi, Johannes M. Luetz, Amanda Lange Salvia, Mark Mifsud, Felicia Motunrayo Olooto, Ilija Djekic, Rosley Anholon, Izabela Rampasso, Felix Kwabena Donkor, Maria Alzira Pimenta Dinis, Maris Klavins, Göran Finnveden, Martin Munashe Chari, Petra Molthan-Hill, Alexandra Mifsud, Salil K. Sen and Erandathie Lokupitiya
Country: Bucharest, Romania
Date of the publication: September 2021

Summary

Universities have the responsibility to implement climate change as part of their teaching and research in order to prepare students to have the needed knowledge and skills to actively contribute to the reduction of and adaptation to climate change.

The paper identifies how different universities implement the topic of climate change in terms of teaching, research and training of teaching staff. Bibliometric analysis, a survey and case studies were conducted in order to get a broader view of the ongoing practices at universities. The bibliometric analysis was done in 2020 on 414 articles that were analysed using VOSviewer. Furthermore, the survey was conducted as a part of an international study aimed at identifying knowledge gaps on CCE at universities. 129 university staff from 45 countries participated in the survey. In the end, 12 case studies were created and involved 12 universities based on two criteria: the Academic Ranking of World Universities 2020 (www.shanghairanking.com/index.html) and the geographic location of universities (5 from Europe, 3 from North America and 4 from other parts of the world) (Leal Filho et al 2021:6).

The author, after giving a detailed context of the conducted research, summarises the gathered information in 4 sections:

- Accredited teaching programs of all levels of studies and research activities
- Various training events focused on staff and/or students
- Public initiatives
- Other climate change-related activities

Through the sections, they present different teaching and research practices on developing climate-related actions in the 12 universities.

Methodology and main findings

Universities are recognised as important in educating and training students on how to overcome challenges posed by climate change. In order to act according to their role, they need to develop advanced curricula, programs, capacity building and interdisciplinary collaborations (ibid.3). Authors state that HEIs are spaces where there is the possibility of production of knowledge for tackling current social issues.

Results of the research show that more than half of the participants indicate that they feel prepared to teach a topic related to climate change and 53% of the respondents stated they already received training on climate change. Moreover, as for the efficiency to promote CCE respondents mention that the best way is through problem-based learning, followed by experiential learning and fieldwork while online courses received the lowest means. Respondents agree that universities should embed CCE because of the growing demand for experts in climate change (ibid.10).

Furthermore, most respondents/universities from Asia, Africa, the Americas and Australia and some western and northern European countries identified as climate active universities while universities mainly from Central, Eastern and Southern Europe and some institutions in Africa have been identified as less climate active universities. The main drivers for improvement of CCE given by the research are, firstly, additional resources (71.3%), secondly, national guidelines to address climate change in curricula (63%) and lastly the increased attractiveness to students (62%). The last survey questioned what is the potential for CCE and how it could be addressed. Respondents described how training on CCE can be addressed at the university level by introducing climate change aspects in the existing courses, designing new interdisciplinary courses, developing a flexible and interdisciplinary curriculum, increasing staff training and capacity, by enhancing partnership and collaboration between universities and by organising events as workshops, seminars and conferences. Some respondents mention student involvement, the creation of special departments on CC and community outreach as important ways of addressing CC at universities.

The second part of the research findings consist of individual cases on the ways implementation of CC occurred in their institutions:

- KTH Royal Institute of Technology goal is to integrate climate action in all education programs and at all levels. It has been actively collaborating with their Student Union and student associations to support them.

- The University of Caminas implemented courses in undergraduate and graduate programs that focus on climate change issues. Also, the university has the Centre for Meteorological and Climate Research Applied to Agriculture (CEPAGRI) which performed research and climate change is seen by them as an important focus
- The University of Latvia has developed several elective study courses that revolve around climate change and sustainable development.
- The Fernando Pessoa University formed a PhD program and did a workshop that addresses climate change.
- The University of Colombo formed courses at various levels of studies, a postgraduate program, and hosted conferences to address climate change.
- Hamburg University of Applied Sciences has climate change topics integrated in Bachelors and Masters degree programs. Moreover it delivered training on climate change for over 3000 academic staff.
- The University of British Columbia addressed climate change by actions within their campuses (Climate Action Plan). The idea is to engage staff and students in the process providing a channel of communication to actively engage in the actions.
-

To fully integrate climate change in their curriculum HEIs need to take actions that:

- put cross-cutting emphasis on climate change, across courses and disciplines;
- Identify specific strengths and weaknesses in the curriculum for further improvement;
- provide training programs for academic staff, so as to encourage their greater engagement;
- build a bridge between climate change teaching and research to maximise the synergies.

Strengths and drawbacks

On one hand, education for sustainable development can be beneficial in empowering people to build knowledge, skills, values and behaviours that are necessary for sustainable development.

On the other hand, the implementation of SD in the curriculum can be challenging and it is possible that not all students and teachers may favour it. Furthermore, lack of funding and lack of staff expertise are seen as the most occurring barriers that needed to be overcomed in the researched HEIs.

3.3. Climate change education for universities: A conceptual framework from an international study

Author: Petra Molthan-Hill, Nicholas Worsfold, Gustavo J. Nagy, Walter Leal Filho, Mark Mifsud
Country: United Kingdom
Date of the publication: April 2019

Summary

HEIs are identified as having an important role in climate change education (CCE). Having the key role in encouraging students and staff to raise awareness and make them active participants in solving challenges that the world is facing. The paper is an analysis of how HEIs in 45 different countries approach CCE and how they are embedding CCE into their curricula. The analysis is based on an online questionnaire, quantitative data analysis and inductive reasoning (Molthan-Hill 2019:1096). A total of 212 responses were gathered from the survey.

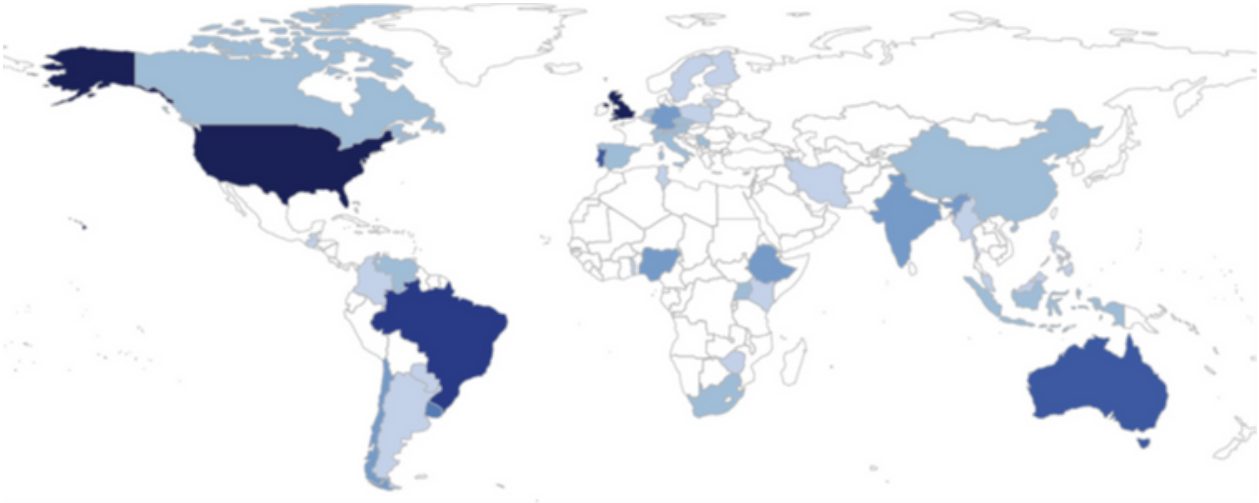


Figure 1: Countries where respondents were working at the time of the survey. Darker colour represents more responses.

Authors identified three approaches HEIs can use to embed CCE: Piggybacking, mainstreaming and connecting (transdisciplinary). In the first section, we are introduced to the importance of climate change education and what the overall position of education for climate change is. Furthermore, the second section explains how CCE is still an under-researched topic and introduces different ways of teaching CCE and pinpointing the possible difficulties. Furthermore, the authors explain in detail the mentioned three different approaches to embedding CCE (piggybacking, mainstreaming and connecting) which they use as main approaches that came up in the research from the gathered materials.

Methodology and main findings

Through the research, respondents mentioned different approaches that their institution uses to implement CC:

- Academic research,
- Public dissemination,
- Technical plans to monitor and reduce carbon emissions or other forms of waste, implementing plans through changes to the curriculum and
- Changing governance structures to integrate climate change as an issue into the core business
- Strategy of the university.
- External benchmarking (only four respondents mentioned this approach)

The different approaches were not limited to particular geographical regions or countries but implementation through governance were more common in European, American and Australian universities (ibid.1097).

Piggybacking is seen by the universities as the easiest approach to embed climate change into education. Primarily, because the existing educational structures are not changed and climate change education is embedded into already existing modules and courses. Piggybacking is an easy way of embedding CCE into curricula but is still a narrow curricular approach and some of the respondents reported that the integration was not done consistently. Just a few responses had given examples of piggybacking.

Mainstreaming is an approach in which HEIs embed CCE into a broader curriculum. This approach is similar to the whole university approach by integrating CCE into an entire curriculum. One of the mentioned ways is the use of the university campus as a living lab or the the creation of an Education for Sustainable Development program.

Specialising is an approach where HEIs create specific modules, courses and degrees. For example, masters are formed to become agents for sustainability and climate change. This type of approach is reported to be common in several countries in South America.

Connecting is considered the most innovative approach and it means implementing CCE via new cross-disciplinary courses. For example, a course on climate change available for all students. One Brazilian university tried to form an education network for sustainability for all undergraduate courses but some respondents reported that their activities were department-specific.

Some respondents identify several of the four given approaches taking place at only one university.

To conclude, because of the increasing attention and therefore relevance given to climate change, HEIs have to integrate it in their curricula. It is seen as crucial for HEIs to move from piggybacking towards mainstreaming, specialising and connecting.

Strengths and drawbacks

By implementing CCE, higher education institutions can encourage people to be more active individuals. Furthermore, they can be active participants in facilitating a positive change in the world.

Teaching CCE within the ESD can be at risk because institutions and academics prefer to focus on other topics in the EDS framework than climate change. The authors state that even if you embed CCE into curricula, cognitive dissonance can still happen. Meaning, individuals become passive collectors of knowledge and do not act upon the knowledge they have obtained, which is considered one of the main learning outcomes of teaching.

Conclusion

There are many challenges concerning the integration of sustainability in curriculum design, including lack of funding, lack of staff engagement, coordination of activities and strategic support. Furthermore, one of the potential flaws of including ESD in the curricula is the lack of possibility to measure whether the university graduates that had ESD incorporated in their curricula will use the academic knowledge they have obtained in their workplace.

Another issue that occurs in the integration of ESD in curricula, is the opposition in opinion, which can stall the process of ESD implementation. Many academics as well as students still perceive ESD as a somewhat ideological concept that is being forced into a specific area. For this particular reason, ESD related changes in the curricula need to be clearly linked to core scientific and technical competencies.

Moreover, what this particular desk research shows in numerous articles is the need for a wide-consultation with key players on the topic, such as students, employers and enterprises, academics, professional service teams and academic governance and various communities.

On the topic of pedagogy for sustainability education, it is emphasised that the pedagogical approach should not be centralised on an institutional yet alone national level, but should depend on the context in which the curricula is being developed. ESD is usually developed in curricula at a micro- level (teaching and learning in courses) and at a macro-level (programs and curricula). However, the process of institutionalisation is still unclear. The process can and should differ from institution to institution because every HEI has its own individual context and history.

Regardless of the institution in which the embedding of ESD will take place, it is beneficial to use a ‘whole institution’ approach in which embedding ESD does not only reduce itself to formal education settings, but integrates itself in all parts of the university, improves teaching and learning and creates connections between academic units.

Some authors also stress the importance of work-integrated learning as a main focus of implementing SD within HE over the last decade, and emphasise that more research needs to be done in this field. On the other hand, others perceive

that the HEIs should prioritise training for transformative learning in order to embed sustainable education regardless of its challenging format, as it is needed to assist sustainability education. What needs to be borne in mind when implementing transformative learning is not to instrumentalise its learners, but to foster their own critical opinion.

When looking at Institutions of higher learning (IHLs), at the beginning of incorporating sustainability in these institutions, the main focus was on reducing environmental impacts and less on pedagogical approaches. During the last decade, IHLs began to question the traditional methods of teaching and learning and started to use collaborative, community-based and service-learning processes.

To reiterate the position already stated in the research article Education for sustainable development guidance, to successfully implement ESD in curricula the following three-step approach is needed:

1. Academic staff should be encouraged to develop formal and extra-curricular resources for sustainability and employability skills relevant to their discipline;
2. Continue enterprise work with employers and professional bodies to develop the skills and knowledge needed for business opportunities in an emerging sustainable economy;
3. Conduct further research on: the importance of SD skills to graduate employers; community, student, and academic partnerships for SD; the different definitions and application of SD being used by students, academics, and policy makers.

From the side of external collaborators in embedding ESD in curricula, government and policymakers should increase their resources and support for HEIs where students have a demand for SD to be embedded in their studies, promote the relevance of SD and support HEIs in the evaluation of SD incorporation. Meanwhile, employers and professional bodies should form connections with HEIs to identify needed knowledge and skills, work with academics to help incorporate professional sustainability skills and work with student unions to provide relevant experience through work and internships.

Furthermore, an important subtopic that is being introduced as part of ESD in HEIs in Europe and across the world is Climate Change Education (CCE). For this to be successful, universities are encouraged to take a whole-university approach to integrate CCE in every discipline and on every level. Same as in integrating ESD in curricula, CCE seeks for cross-sector collaboration, educational assessment, interactive teaching modes and interdisciplinary workshops.

Bibliography

- Balsiger, J. (2015). Transdisciplinarity in the classroom? Simulating the co-production of sustainability knowledge. Futures, 65, 185–194.
- Barber et al., (2014). Integrating sustainability into business curricula: university of New Hampshire case study. Int. J. Sustain. High Educ.,15 (4), 473-493.
- Bowerman, J. (2003). Leadership development through action learning: An executive monograph. Int. J. Health Care Qual. Assur. Inc. Leadersh. Health Serv., 16, 6–14.
- Buil-Fabregá, M., Martínez Casanovas, M., Ruiz-Munzón, N., & Filho, W. L. (2019). Flipped classroom as an active learning methodology in sustainable development curricula. Sustainability, 11(17), 4577. https://doi.org/10.3390/su11174577
- Caetano et al., (2015). Learning Sustainability and Social Compromise Skills: a New Track Is Born. ACM Press.
- Caniglia, G., John, B., Bellina, L., Lang, D. J., Wiek, A., Cohmer, S., & Laubichler, M. D. (2018). The glocal curriculum: A model for transnational collaboration in Higher Education for Sustainable Development. Journal of Cleaner Production, 171, 368–376. https://doi.org/10.1016/j.jclepro.2017.09.207
- Cocchiarella et al., (2016). Fruitful Futures: Imagining Pomona. Gaia.
- Conger, J.; Toegel, G. (2002). Action learning and multi-rater feedback as leadership development interventions: Popular but poorly deployed. Journal of Change Management,3, 332–348.
- Dirkx, J. M. (1998). Transformative learning theory in the practice of adult education: An overview. PAACE Journal of Lifelong Learning, 7, 1–14.
- Drayson, R., Bone, E., Agombar, J., & Kemp, S. (2014). Student attitudes towards and skills for sustainable development. The Higher Education Academy.
- Erpenbeck J. (2009). Was «sind» Kompetenzen? In: W.G. Faix (Ed.), Kompetenz. Festschrift Prof. Dr. John Erpenbeck zum 70. Geburtstag (pp. 1–57). Steinbeis-Edition.
- Ferrer-Balas et al., (2009). Explorations on the University's role in society for sustainable development through a systems transition approach. Case study of the Technical University of Catalonia (UPC). J. Clean. Prod., 17 (12), 1075-1085.
- “Global Action Programme on Education for Sustainable Development’’ (2015-2019). UNESCO, en.unesco.org/globalactionprogrammeoneducation

- Granberg, O.; Ohlsson, J. (Eds.) (2006). Kollektivt Lärande i Arbetslivet. Studentlitteratu.
- Hattie J. (2011). Which strategies best enhance teaching and learning in higher education? In: D. Mashek, E. Y. Hammer (Eds.), Empirical Research in Teaching and Learning (pp. 130–142). Wiley-Blackwell.
- Hopkinson, P., & James, P. (2010). Practical pedagogy for embedding ESD in science, technology, engineering and Mathematics Curricula. International Journal of Sustainability in Higher Education, 11(4), 365–379. https://doi.org/10.1108/14676371011077586
- Langdown and Vargas, (2015). Integrating sustainable development within teaching fashion education. In W. Leal Filho, et al. (Eds.), Integrative Approaches to Sustainable Development at University Level (pp. 539-550). Springer International Publishing.
- Leal Filho, W., Sima, M., Sharifi, A. et al. (2021). Handling climate change education at universities: an overview. Environ Sciences Europe, 33 (109). https://doi.org/10.1186/s12302-021-00552-5.
- Mezirow, J., (1997). Transformative learning: theory to practice. N. Dir. Adult Cont. Educ. 74, 5-12.
- Mezirow, J. (2000). Learning as transformation: Critical perspectives on a theory in progress. Jossey-Bass.
- Molthan-Hill, P., Blaj-Ward, L., Mbah, M. F., & Ledley, T. S. (2021). Climate Change Education at universities: Relevance and strategies for every discipline. Handbook of Climate Change Mitigation and Adaptation, 1–64. https://doi.org/10.1007/978-1-4614-6431-0_153-
- Molthan-Hill, P., Worsfold, N., Nagy, G. J., Leal Filho, W., & Mifsud, M. (2019). Climate Change Education for universities: A conceptual framework from an international study. Journal of Cleaner Production, 226, 1092–1101. https://doi.org/10.1016/j.jclepro.2019.04.053
- Mulà, I. (2017). Catalysing change in higher education for sustainable development: A review of professional development initiatives for university educators. International Journal of Sustainability in Higher Education,18(5), 798–820.
- Papenfuss, J., Merritt, E., Manuel-Navarrete, D., Cloutier, S., & Eckard, B. (2019). Interacting Pedagogies: A Review and Framework for Sustainability Education. Journal of Sustainability Education, 20.
- Raworth K. (2012). A Safe and Just Space for Humanity. Can We Live Within the Doughnut? Oxfam. https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/dp-a-safe-and-just-space-for-humanity-130212-en_5.pdf;
- Rego, A., & Cunha, M.P. (2007). Workplace spirituality and organisational commitment: An empirical study. Journal of Organisational Change Management, 21(1), 53–75.

- Rockström J, Steffen W, Noone K, Persson A, Chapin FS, Lambin EF, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ et al., (2009). A safe operating space for humanity. Nature, 461(7263), 472–475.
- Ryan, A. (2012). Education for sustainable development and holistic curriculum change. The Higher Education Academy.
- Rychen DS, Salganik LH, eds. (2003). Key Competencies for a Successful Life and Well-functioning Society. Hogrefe Publishing.
- Schön, D.A. (1995). The Reflective Practitioner: How Professionals Think in Action (1st ed.). Basic Books.
- Strachan, S., Logan, L., Willison, D., Bain, R., Roberts, J., Mitchell, I., & Yarr, R. (2021). Reflections on developing a collaborative multi-disciplinary approach to embedding education for sustainable development into higher education curricula. Emerald Open Research, 3, 24. https://doi.org/10.35241/emeraldopenres.14303.1
- Sterling SR, Thomas I. (2006). Education for sustainability: The role of capabilities in guiding university curricula. International Journal of Innovation and Sustainable Development, 1(4), 349–370.
- Stoltenberg U, Burandt S. (2014). Bildung für eine nachhaltige Entwicklung. In: H. Heinrichs, G. Michelsen (Eds.), Nachhaltigkeitswissenschaften (pp. 567–594). Spektrum.
- Stöber, H., Gaebel, M., Morrisroe, A. (2021). Greening in European higher education institutions. European University Association.
- Students Organising for Sustainability International (2020). Survey: Students, sustainability and education. SOS International. https://sos.earth/survey-2020/
- Tilbury, D., & Ryan, A. (n.d.) (2002). Guide to quality and education for Sustainability in Higher Education. Retrieved April 10, 2022, from http://efsandquality.glos.ac.uk/
- Too and Bajracharya, (2015). Sustainable campus: engaging the community in sustainability. Int. J. Sustain. High Educ., 16 (1), 57-71.
- Tribelhorn T. (2016). Wirksamer Unterricht mit dem TAFEL-Prinzip. Praxisberichte. http://www.lernensichtbarmachen.ch/2016/03/wirksamer-unterricht-mit-dem-tafel-prinzip/
- Trimingham et al., (2016). Global dimensions in engineering education: experiences from a collaborative project. In W. Leal, P. Pace (Eds.) Teaching Education for Sustainable Development at University Level. Springer.
- University College London. (2022). Embed sustainability into the Curriculum. Retrieved April 10, 2022, from https://www.ucl.ac.uk/sustainable/education/embed-sustainability-curriculum

- UN [United Nations] General Assembly. (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. United Nations. https://sustainabledevelopment.un.org/post2015/transformingourworld/publication;
- Wals, A. E., & Blewitt, J. (2010). Third-wave sustainability in higher education: Some (inter) national trends and developments. In P. Jones, D. Selby, & S. Sterling (Eds.) Sustainability education: Perspectives and practice across higher education (pp. 55–74). Earthscan Publishing.
- Weinert FE. (2002). Vergleichende Leistungsmessung in Schulen – Eine umstrittene Selbstverständlichkeit. In: F. E. Weinert (Ed.), Leistungsmessungen in Schulen (pp. 17–31). Beltz Verlag.
- Weiss, M., Barth, M., & von Wehrden, H. (2021). The patterns of curriculum change processes that embed sustainability in Higher Education Institutions. Sustainability Science, 16(5), 1579–1593. https://doi.org/10.1007/s11625-021-00984-1
- Wiek et al., (2014). Integrating problem - and project-based learning into sustainability programs: a case study on the School of Sustainability at Arizona State University. Int. J. Sustain. High Educ., 15 (4), 431-449.

ANNEX B:

Case Study Template (Questions for the interviews).

Case study template

Background information of the person interviewed	
Name	
Contact details	
Job description	
Department/Faculty and University	
City and Country	

Summary of the case study

Question and notes

MOTIVATIONS AND PROGRESS TOWARDS EMBEDDING SUSTAINABILITY
1. Would you say your department/faculty/university considers environmental sustainability an important subject to be incorporated in the curricula?
2. Why has your department / faculty / university decided to implement the embedding of environmental sustainability within the curriculum / why is it important?
3. At what level is environmental sustainability embedded within the curriculum? Is it embedded in the programme/course/teaching and learning methods or all the mentioned parts of the curricula? Why is that the case?

APPROACHES TO EMBEDDING SUSTAINABILITY

4. How has your department / faculty / university approached embedding sustainability?
   - What actions have been taken so far to include the topic in the curricula?
   - Who has been involved in implementing environmental sustainability at your department/faculty/university?
   - In which department did your institution decide to embed sustainability first and why?

5. Why did you take this particular approach in the process of implementation? Was there anything innovative about it?

6. What examples of teaching methods / pedagogies does your department / faculty / university use to implement Education for Sustainable Development (ESD)?
Why have you opted to use these methods?

7. What was involved in terms of logistics, time or resources, to enable implementing sustainability in the curricula?

8. What pedagogical approach would you emphasise as most efficient to embed ESD in the curricula and why?

9. Are there certain fields of study that are considered easier to embed ESD in the curricula than others? Please elaborate in more detail on this.

10. What obstacles in general would you identify in implementing sustainability in the curricula?

11. What advice would you give to members of other HEIs who want to follow your example?

12. What is your department/faculty/university's stand on implementing Climate Change Education (CCE) in the curricula?
   - What are the main reasons pro/against implementing it in the curricula?

IMPACTS
13. What competences in students does your department/faculty/university seek to develop through implementing ESD in the curricula?
14. What difference has your implementation of ESD made for students? - Please provide statistics if possible (eg. results from surveys).
15. What difference has your implementation of ESD made for staff? - Please provide statistics if possible (eg. results from surveys).
16. What competences in students does your department/faculty/university seek to obtain after implementing ESD in the curricula?
Any additional information you would like to share with us, and/or comments?

Main conclusions (post-interview)

Links, resources and further information

Please include any additional information and/or links such as:

- Programmes
- Good practices
- Guides/resources
- Videos
- Relevant articles/blogs

ANNEX C:

Mapping of Competences Framework

1.0 Mapping of Competence Framework

This final element of the framework focuses on competences for sustainability that are the desired outcome of integrating Education for Sustainable Development (ESD) within curricula.

Firstly, it is useful to consider what is meant by a sustainability competence, and the recently published EU GreenComp - the European sustainability competence framework
- (Bianchi, et al., 2022) offers a useful definition:

> *"A sustainability competence empowers learners to embody sustainability values, and embrace complex systems, in order to take or request action that restores and maintains ecosystem health and enhances justice, generating visions for sustainable futures. This definition focuses on developing sustainability knowledge, skills and attitudes for learners so they can think, plan and act with sustainability in mind, to live in tune with the planet."*

With this in mind, a **mapping exercise** has been completed **to develop a comprehensive listing of the range of competences put forward as contributing to the progression and achievement of sustainability.** This map is designed as a resource for educators to gain an overview of a broad range of sustainability competences, drawn out through a literature review. It then goes on to signpost readers to key literature sources and other resources for commonly identified competences. The purpose of the mapping is not to propose a priority set of competences, but to **enable educators to gain a quick understanding of each competence and signposting to a set of references which will enable them to find out more.** The competence map can be found in section 4.1 of this report.

As a final element in this exercise, the same approach was then applied to teaching approaches and methods, recognising that **particular pedagogies have been proposed as being more relevant to supporting the development of sustainability competences.**

1.0.1 Navigating the competence map

The table, or map, below outlines all competences identified in the literature review. Reflecting the approach adopted by many existing competence frameworks, and to aid usability, the competences identified have been grouped into three categories. The categories defined draw on David Orr's 'head, heart, hands' model (Orr, 1992) of ecological literacy, and include:

- Ways of thinking and planning (head)
- Values and beliefs (heart)
- Ways of acting and doing (hands)

This model was identified as providing a useful framework to organise the competences identified in the literature review due to its holistic nature - it incorporates all three domains of learning identified in Bloom's Taxonomy (Bloom, 1956) which is widely used in educational settings to set learning outcomes and also to assess learning. The three domains of learning are mirrored in the 'head, heart, hands' model as they include:

- Cognitive domain (concerned acquisition and application of knowledge)
- Affective domain (concerned with processing of attitudes and emotions)
- Psychomotor domain (concerned with physical application of skills).

In each case, a short description of the competence is provided along with the sources included in the literature review which propose the competence as contributing to the achievement of sustainable development.

The literature review process highlighted the common proposition of some competences, and in addition, some authors went as far as suggesting competences which should be seen as priorities. These competences have been highlighted using the symbol ** in the map below. Readers are encouraged to **navigate to the section of this report associated with each of these common competences to find a more detailed description of each, along with additional resources beyond those originally included in the literature review.** These resources have been captured as they offer educators an accessible overview of the competence (for example video formats), and therefore the opportunity to rapidly increase understanding of each.

1.1. The Competences Map

Head

Ways of thinking and planning

COMPETENCES	
Exploratory thinking	Drawing on different disciplines, traditions and cultures to develop creative ideas and novel approaches. **Key sources:** *(Bianchi, et al., 2022).*
**Critical thinking	Able to consider information and arguments in a way that assesses assumptions and influences (personal, social, cultural) on thinking and conclusions. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017) (Rieckmann, 2012), (Cebrian, et al., 2020), (UNESCO, 2017).*
**(Integrated) Problem framing/solving	Able to identify the nature and complexity of problems, taking a transdisciplinary, collaborative approach to understand problems from a variety of perspectives and build viable solutions. Described by some authors as a 'meta-competency' that integrates multiple other key competencies for solving problems and fostering sustainable development. **Key sources:** *(Bianchi, et al., 2022), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016)*
**Futures/anticipatory thinking	Able to develop visions of alternative sustainable futures and scenarios and the steps needed to achieve these. Recognises repercussions of choices and actions on communities locally, nationally or internationally both now and in the future. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (University of Leicester Career Development Service, n.d.), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Giangrande, et al., 2019), (Redman & Wiek, 2021), (Demssie, et al., 2019)*
**Inter/transdisciplinary thinking	Uses knowledge and methods from different disciplines, and recognises benefits of gathering perspectives from a range of stakeholders. **Key sources:** *(Lozano, et al., 2017), (Cebrian, et al., 2020), (University of Leicester Career Development Service, n.d.), (Rieckmann, 2012), (Giangrande, et al., 2019), (Demssie, et al., 2019)*
**Values/normative thinking	Able to differentiate, specify, compare, apply, reconcile and negotiate extrinsic and intrinsic values in society, recognising how they are contextually, culturally and historically reinforced with positive and negative outcomes. Able to recognise how they align with sustainability values informed by concepts of justice, equity and responsibility. **Key sources:** *(Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (UNESCO, 2017), (Giangrande, et al., 2019), (Redman & Wiek, 2021)*
** Systems thinking	Approaches problems from all sides, considering time, space and context in order to understand interactions within and between systems. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Redman & Wiek, 2021), (Tejedor, et al., 2019), (Rieckmann, 2012).*
**Strategic thinking/planning	Able to design and implement systemic and transformational interventions, actions and strategies that take into account unintended consequences and spillover effects. **Key sources:** *(Arizona State University, 2018), (Lozano, et al., 2017), (Rieckmann, 2012) (Giangrande, et al., 2019), (Wiek, et al., 2011), (Wiek, et al., 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019) (UNESCO, 2017)*

Heart

Values and beliefs

COMPETENCES	
Commitment to learning	Willingness to learn and innovate, and initiation of own learning. **Key sources:** *(Lozano, et al., 2017), (Demssie, et al., 2019)*
**Self-reflection / awareness	Able to reflect on own values and others, how they might change over time and evaluate how they align with sustainability, and how these might be contradictory. **Key sources:** *(Bianchi, et al., 2022), (UNESCO, 2017), (Brundiers, et al., 2021), (Giangrande, et al., 2019)*
**Commitment to social justice and inclusion	Promotes equity and justice among present and future generations, and also amongst humans, nature and the environment. Includes responsibility for one's own actions. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (Rieckmann, 2012), (Giangrande, et al., 2019) (Demssie, et al., 2019)*
**Affinity for and connection to all life/common good	Recognises that humans are part of nature and showing respect for biological and cultural diversity and all forms of life on earth. **Key sources:** *(Bianchi, et al., 2022), (Cebrian, et al., 2020), (Quendler & Lamb, 2016), (Glasser & Hirsch, 2016)*
Commitment to active participation	Belief in and commitment to active participation across communities in order to reach sustainability solutions. **Key sources:** *(Cebrian, et al., 2020), (Gil-Domenech, et al., 2021)*

Hands

Ways of acting and doing

COMPETENCES	
**Communication	Able to communicate effectively using different methods and tools, adapting to different audiences. Remaining critical and evaluating different media. Listens actively to others' viewpoints and concerns. **Key sources:** *(Lozano, et al., 2017), (University of Leicester Career Development Service, n.d.), (Redman & Wiek, 2021), (Rieckmann, 2012), (Demssie, et al., 2019)*
Planning and implementation	Able to collectively plan and realise a planned solution towards a sustainable vision and to monitor and evaluate this process - recognising that problem solving is a long-term iterative process. **Key sources:** *(Brundiers, et al., 2021), (Redman & Wiek, 2021)*

Resource utilisation	Able to efficiently use material resources, but also in the allocation of 'human' resources and institutional arrangements to tackle sustainability challenges. **Key sources:** *(Demssie, et al., 2019), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*
Discipline specific competences	That complement sustainability and general competences. **Key sources:** *(Redman & Wiek, 2021)*
Maintaining healthy mental and emotional states (intra-personal)	Able to recognise mental and emotional health and take action to maintain healthy mental and emotional states. **Key sources:** *(Giangrande, et al., 2019), (Redman & Wiek, 2021)*
Balancing dimensions of sustainable development	For example able to challenge a focus on economic dimensions at the expense of social and environmental. **Key sources:** *(Demssie, et al., 2019)*
Adaptability	Being able to flex, adapt and adjust opinions and behaviours in relation to complex challenges, and changing contexts. **Key sources:** *(Bianchi, et al., 2022), (Demssie, et al., 2019)*
Individual initiative	Understanding what types of action are possible, as well as the confidence and willingness to act. **Key sources:** *(Bianchi, et al., 2022), (Demssie, et al., 2019)*
**Empathy	Accepting and embracing diverse opinions, experiences and perspectives and acting with compassion and sympathy in relation to the needs and actions of others. **Key sources:** *(Lozano, et al., 2017), (Redman & Wiek, 2021), (Rieckmann, 2012)*
Coping with ambiguity and uncertainty/resilience	Able to manage conflicts and setbacks, competing or contradictory interests and goals. Able to maintain hope. **Key sources:** *(Lozano, et al., 2017), (Rieckmann, 2012), (Giangrande, et al., 2019), (Glasser & Hirsch, 2016)*
**Collaboration and collective action	Ability to coordinate, motivate, negotiate, collaborate and cooperate (mediating and resolving conflicts where needed) to achieve goals and address sustainability problems. **Key sources:** *(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Glasser & Hirsch, 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019)*
Political and community	Positively influences stakeholders at a political level (at local, regional, national or international scales) and demanding accountability for unsustainable action. **Key sources:** *(Bianchi, et al., 2022), (Rieckmann, 2012), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*
Motivate others and self	Able to encourage oneself to take action when required and encourage others to do the same. **Key sources:** *(Cebrian, et al., 2020), (Wiek, et al., 2016), (Hoffmann, et al., 2022)*
Discipline specific competences	That complement sustainability and general competences. **Key sources:** *(Redman & Wiek, 2021)*

Using individual experiences	For example uses local knowledge cultures, languages etc to realise sustainable development goals. **Key sources:** *(Demssie, et al., 2019)*
Understanding and modelling sustainable behaviour	Acts in a way that mirrors the change one wants to see, by acting in ways that are in accordance with sustainability goals. **Key sources:** *(Glasser & Hirsch, 2016), (Quendler & Lamb, 2016), (Gil-Domenech, et al., 2021), (Tejedor, et al., 2019)*

1.1.1. Ways of thinking/planning (head)

Amongst the range of competences proposed as contributing to the development of individuals and communities able to tackle issues related to sustainability are those that involve developing particular ways of thinking and planning (head).

The competences that were proposed most frequently during the literature review (identified using ** in the 'map') include:

- Systems thinking
- Critical thinking
- Strategic thinking / planning
- Values / normative thinking
- Futures / anticipatory thinking

Integrated problem solving is also included within this list, as whilst not as commonly identified by the sources reviewed through this process, it is often considered a 'meta-competence'. It incorporates a number of the commonly proposed competences which feature in this section.

It is worth noting that 'ways of thinking and planning' are amongst the most commonly proposed competences when looking across all three categories used in the mapping process (head, heart, hands).

Competence: Systems thinking

Definition: Systems thinking can be described as the ability, through the application of complex analytical approaches and models, to understand complex systems and sustainability challenges across multiple scales (local to global) and fields (economic, social and environmental).

Through this, actions and interventions designed to meet sustainability goals can be analysed for the extent to which they change systems, and address or extend sustainability challenges.

References and resources: The following table outlines relevant references and resources on systems thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)
(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Redman & Wiek, 2021), (Tejedor, et al., 2019), (Rieckmann, 2012)

Additional sources
• Hoffmann et al, (2022), Ten steps towards systems thinking: An Education for Sustainable Development manual for teachers, educators, and facilitators • Open University, Systems thinking and practice • Open University, Mastering systems-thinking in practice • Open University Open Learn, What is systems thinking? • Learning for Sustainability, Systems thinking • Sustainability Science Education, What is systems thinking? • Sustainability Science Education, Systems thinking for educators

Competence: Critical thinking

Definition: Critical thinking can be described as the ability to challenge norms, practices and opinions when considering an argument and recognising that there are different points of view in each situation. This includes the ability to reflect on one's own values, perceptions and actions and recognise the impact of these.

References and resources: The following table outlines relevant references and resources on systems thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)
(Bianchi, et al., 2022), (Lozano, et al., 2017) (Rieckmann, 2012), (Cebrian, et al., 2020), (UNESCO, 2017)

Additional sources
• University of Hull – Hull University Library, Defining critical thinking [Critical thinking 1] • Leeds University Library, A critical thinking model • Open University, Sharpening your critical thinking

Competence: Strategic thinking/planning

Definition: The strategic thinking competence involves the ability to develop and implement innovative solutions that propel sustainable development action on a local and global scale. This includes the consideration of unintended consequences of these solutions.

References and resources: The following table outlines relevant references and resources on strategic thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)
(Arizona State University, 2018), (Lozano, et al., 2017), (Rieckmann, 2012) (Giangrande, et al., 2019), (Wiek, et al., 2011), (Wiek, et al., 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019) (UNESCO, 2017)

Additional sources
• Sustainability Science Education, Strategic thinking for educators • Sustainability Science Education, What is strategic thinking? • BEE Environmental Communication, A systems story (systems thinking) • Baumgartner, R. and Kourhonen, J, (2010), Strategic thinking for sustainable development, Sustainable Development, 18, p. 71-75 • Systems Innovation, Systems thinking

Competence: Values/normative thinking

Definition: Values/normative competence is the ability to differentiate, apply and negotiate values in society, recognising how they are reinforced and the subsequent outcomes of this. In a sustainable development context, values, principles, goals and targets are negotiated, taking conflict of interests, contradictions and uncertain knowledge into account.

This competence is based on acquired knowledge including concepts of justice, integrity, equity and ethics, this knowledge is necessary to know what is essential and what can be discarded when transitioning to a sustainable development pathway.

References and resources: The following table outlines relevant references and resources on values/normative thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (UNESCO, 2017), (Giangrande, et al., 2019), (Redman & Wiek, 2021)

Additional sources

- Sustainability Science Education, What is values thinking?
- Sustainability Science Education, How to use values thinking
- Sustainability Science Education, Values thinking for educators
- Blok et al, (2015), Dealing with the Wicked Problem of Sustainability: The Role of Individual Virtuous Competence, Business & Professional Ethics Journal, 34 (3), p. 297-327

Competence: Futures/anticipatory thinking

Definition: Futures/anticipatory thinking is the ability to analyse, evaluate and envision alternative sustainable future scenarios, applying the precautionary principle, and identifying how to, and implementing steps to, attain these alternative scenarios. This includes dealing with the repercussions of choices and actions on different communities and on future generations.

This competence involves comparative, creative and constructive skills and comfortability with uncertainty.

References and resources: The following table outlines relevant references and resources on futures/anticipatory thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (University of Leicester Career Development Service, n.d.), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Giangrande, et al., 2019), (Redman & Wiek, 2021), (Demssie, et al., 2019)

Additional sources

- Sustainability Science Education, What is futures thinking?
- Sustainability Science Education, Futures thinking for educators
- Government Office for Science, (2021), A brief guide to futures thinking and foresight
- Geden, M. et al (2019), Construction and Validation of an Anticipatory Thinking Assessment, Frontiers in Psychology (10)
- Keeler, L, (2010), Anticipatory Competence as a Key Competence in Sustainability Education
- Competencies for a sustainable socio-economic development (CASE), What competencies matter? Anticipatory competence

Competence: Interdisciplinary thinking

Definition: Interdisciplinary thinking involves the capability to recognise the value of approaching an issue from the perspective of various disciplines and stakeholders, utilising values and knowledge of various disciplines.

References and resources: The following table outlines relevant references and resources on interdisciplinary thinking. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)
(Lozano, et al., 2017), (Cebrian, et al., 2020), (University of Leicester Career Development Service, n.d.), (Rieckmann, 2012), (Giangrande, et al., 2019), (Demssie, et al., 2019)

Additional sources
• University of Edinburgh, Why do we need interdisciplinary approaches to sustainability? • InformEd, How interdisciplinary thinking can help you learn more • https://www.uu.nl/en/education/educational-development-training/knowledge-dossier/a-four-stage-model-for-interdisciplinary-learning • Dreyfuss, S, (2011), Something essential about interdisciplinary thinking, Issues in integrative studies, 29, p. 67 • Spelt, E.J.H., Biemans, H.J.A., Tobi, H. et al. Teaching and Learning in Interdisciplinary Higher Education: A Systematic Review. Educ Psychol Rev 21, 365–378 (2009)

Competence: Integrated problem framing/solving

Description: This competence involves being able to link the social, economic and ecological dimensions of a problem, envisioning equitable and inclusive ways to move forwards with the problem, including the exploration of less ideal future scenarios, and developing ways to transition to a more sustainable pathway.

This competence is sometimes described as a 'meta-competency', encompassing other key competencies that foster sustainable development such as systems thinking, strategic thinking, values thinking and futures thinking.

References and resources: The following table outlines relevant references and resources on integrated problem framing/solving. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Bianchi, et al., 2022), (Arizona State University, 2018), (Wiek, et al., 2011), (Wiek, et al., 2016)

Additional sources

- Haney, A. B., Pope, J., & Arden, Z. (2020). Making It Personal: Developing Sustainability Leaders in Business. Organization & Environment, 33(2), p.155–174

1.1.2. Values and beliefs (heart)

The competences proposed as contributing to the development of individuals and communities able to tackle issues related to sustainability also include the individual's values and beliefs (heart).

As with section 4.1.1, the competences that were proposed most frequently during the literature review form the focus of the collation of references and resources that will support educators to further their understanding. The most frequently proposed competences in this area (identified using ** in the 'map') include:

- Self-reflection/awareness
- Commitment to social justice and inclusion
- Affinity for and connection to all life

Competence: Self-reflection/awareness

Description: The ability to reflect on one's own values and positionality, as well as that of others, recognising how the wider impact they might have and how they may change over time. Additionally, it involves being able to evaluate how values align with sustainability.

References and resources: The following table outlines relevant references and resources on self-reflection and awareness. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Bianchi, et al., 2022), (Brundiers, et al., 2021) (Giangrande, et al., 2019)

Additional sources

- Learning for Sustainability, Reflective and reflexive practice
- Jaakkola, N, Karvinen, M, Haiko, K, Wolff, L-A, Mattelmaki, T and Friman, M (2022), Becoming Self-Aware—How Do Self-Awareness and Transformative Learning Fit in the Sustainability Competency Discourse?, Frontiers in Education, 7
- Brownhill, S, (2021), Self-reflection: the what, the why and the how
- University of Oslo, Self-awareness competency
- Frank, P, (2021), A proposal of personal competencies for sustainable consumption, International Journal of Sustainability in Higher Education, 22 (6), p.1225-1245
- Inner Development Goals, Background, method and the IDG framework, '1 – Being – relationship to self'
- Quality Assurance Agency for Higher Education, (2023), Transition skills and strategies: Critical self-reflection
- Times Higher Education, How to encourage student self-reflection

Competence: Commitment to social justice and inclusion

Description: This competence can be summarised as the commitment to and promotion of equity and justice among present and future generations. It considers equity and justice for humans, nature and the environment and includes taking responsibility for one's own actions.

References and resources: The following table outlines relevant references and resources on commitment to social justice and inclusion. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Bianchi, et al., 2022), (Brundiers, et al., 2021) (Giangrande, et al., 2019)

Additional sources

- Mahdavi, P, (2022), Social justice through and beyond higher education
- Cambridge University Press, Cambridge Life Competencies: Social responsibility
- Cambridge University Press, Cambridge Life Competencies: Explaining social responsibility
- Agyeman, J, Bullard, R and Evans, B, (2002) Exploring the Nexus: Bringing Together Sustainability, Environmental Justice and Equity, Space and Polity, 6:1, 77-90
- University of Colorado Boulder, Equity and sustainability
- Outrage and Optimism, Episode 188. The path to sustainability is equity
- Leach, M, Reyers, B, Bai, X, Brondizio, E, Cook, C, Díaz, S, Espindola, G, Scobie, M, Stafford-Smith, M and Subramanian, S, (2018), Equity and sustainability in the Anthropocene: A social–ecological systems perspective on their intertwined futures. Global Sustainability, 1

Competence: Affinity for and connection to all life

Description: The ability to recognise that humans are part of nature, and show respect and concern for biological and cultural diversity and all forms of life on earth. This competence can also include an ability to reflect on the limits to exploiting nature. It can also include an appreciation of human and cultural diversity also encompassed in the competence of 'commitment to social justice and inclusion'.

References and resources: The following table outlines relevant references and resources on affinity for and connection to all life. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources

Sources (literature review)

(Cebrian, et al., 2020), (Demssie, et al., 2019), (Glasser & Hirsch, 2016), (Rieckmann, 2012) (Quendler & Lamb, 2016)

Additional sources

- University of Derby Online Learning, What is nature connectedness?
- Lakenau, G, (2018), Fostering connectedness to nature in higher education, Environmental Education Research, 24(2), p. 230-244
- Barrable, A, (2020), A new focus for education? Nature connection as a goal for all education: Theoretical, research and practical perspectives
- Planetary Health Education Framework
- Fish, R and McKelvey, H, (2022), Valuing nature: The roots of transformation

1.1.3. Ways of acting and doing (hands)

Also amongst the range of competences proposed as contributing to the development of individuals and communities able to tackle issues related to sustainability are those that involve developing particular ways of acting, of doing (hands).

As with section 4.1.1, the competences that were proposed most frequently during the literature review form the focus of the collation of references and resources that will support educators to further their understanding. The most frequently proposed competences in this area (identified using ** in the 'map') include:

- Collaboration and collective action
- Communication
- Empathy

Competence: Collaboration and collective action

Description: Collaboration and collective action can be described as the ability to understand and respect the perspectives, needs and actions of others, including peers and those inside and outside of their institution. Learning from others, facilitating collaboration, dealing with group conflicts, participatory problem solving and acting collective for change are key aspects of achieving goals and addressing sustainability issues. It is often grouped with other competences and described as interpersonal competence (Northwestern University, (no date)).

References and resources: The following table outlines relevant references and resources on collaboration and collective action competence. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence. on this competence.

Sources (literature review)
(Bianchi, et al., 2022), (Lozano, et al., 2017), (UNESCO, 2017), (Arizona State University, 2018), (Wiek, et al., 2011) (Wiek, et al., 2016), (Brundiers, et al., 2021), (Rieckmann, 2012), (Glasser & Hirsch, 2016), (Redman & Wiek, 2021), (Demssie, et al., 2019)
Additional sources
• Cambridge University Press, (2019), Cambridge Life Competencies Framework: Collaboration – Introductory guide for teachers and educational managers • Cambridge University Press, Cambridge Life Competencies: Explaining collaboration • University of Strathclyde, Teamwork and collaboration skills • Indiana University, (2020), Staff competencies • Australian Research Alliance for Children and Youth, (2013), Collaborative competencies/capabilities • Hale, L, (2023), Learning to do: collaborative learning – EAP meets ESD, presentation at BALEAP Professional Interests Meeting: EAP for a More Sustainable World, 3/3/23 • Inner Development Goals, Background, method and the IDG framework, '4 – Collaborating – social skills'

Competence: Communication

Description: Communication competence can be described as the ability to communicate effectively using different methods and tools – verbal and non-verbal. It involves the ability to adapt and frame communications according to different audiences, but also moves beyond the relaying of information from one party to the other and includes the outcome of developing relationships between parties involved. Receiving viewpoints and information is also a vital element of communication, coupled with the ability to critically evaluate perspectives. Communication is also described as a key aspect of 'interpersonal competence'.

References and resources: The following table outlines relevant references and resources on communication. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)
(Lozano, et al., 2017), (University of Leicester Career Development Service, n.d.), (Redman & Wiek, 2021), (Rieckmann, 2012), (Demssie, et al., 2019)

Additional sources
• Kiessling C, Fabry G, (2021), What is communicative competence and how can it be acquired? GMS Journal for Medical Education, 38(3) • Cambridge University Press, (2019) Cambridge Life Competencies: Communication – Introductory guide for teachers and education managers • Cambridge University Press, Cambridge Life Competencies: Explaining communication • Evans, T (2019), Figure 4: Interpersonal and communication competence, in Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities, Sustainability, 11(19) • Palacios, J and Cruz, E, (2022), Promoting communications skills is just as vital as course content, Times Higher Education: Campus • Metusalem, R, Belenky, DM, and DiCerbo, K, (2017). Skills for Today: What We Know about Teaching and Assessing Communication, Pearson, London • Hargie, O, (2006), The handbook of communication skills 4th Edition, Routledge, London

Competence: Empathy

Description: Empathy can be described as the ability to identify and understand different opinions, experiences and perspectives, accepting and embracing the value of this diversity of opinion in a sustainable development context. This leads to greater compassion for the needs and understanding of the actions of others. Again, empathy is described as a key aspect of interpersonal competence (Coursera, 2023).

References and resources: The following table outlines relevant references and resources on empathy as a competence. It includes references included in the literature review that identified the full list of competences presented in this report, as well as accessible and practical resources on this competence.

Sources (literature review)

(Lozano, et al., 2017), (Redman & Wiek, 2021), (Rieckmann, 2012)

Additional sources

- A Rounder Sense of Purpose, Empathy
- Lin, C and Li, Y-Y, (2022), Empowering undergraduate students to take action: an empathetic mindset towards education for sustainable development, International Journal of Sustainability in Higher Education (ahead of print)
- The Greater Good Science Centre at the University of California, Berkeley, Empathy - defined
- Qjala, M, (2014), Emotional awareness: On the importance of including emotional aspects in education for sustainable development, Journal of Education for Sustainable Development, 7(2)
- Inner Development Goals, Background, method and the IDG framework, '4 – Collaborating – social skills'

1.2 Mapping pedagogies for ESD competences

UNESCO (2017) describes Education for Sustainable Development (ESD) as having the aim of:

'empowering and motivating learners to become active sustainability citizens who are...able to participate in shaping a sustainable future'.

Authors suggest that there are no 'correct' pedagogies to achieve ESD, but that consensus does exist on the types of methods that achieve this outcome (University of Plymouth, (no date)).

The same UNESCO report (UNESCO, 2017) goes on to describe pedagogies that contribute to this as:

- Learner-centred
- Action-oriented, and
- Transformative.

Figure 1 below outlines these core tenets of ESD pedagogies, as described by UNESCO, in further detail.

Figure 1 | ESD key pedagogical approaches (UNESCO, 2017)

Learner-centred	Learner-centred pedagogy sees students as autonomous learners and emphasizes the active development of knowledge rather than its mere transfer and/or passive learning experiences. The learners' prior knowledge as well as their experiences in the social context are the starting points for stimulating learning processes in which the learners construct their own knowledge base. Learner-centred approaches require learners to reflect on their own knowledge and learning processes in order to manage and monitor them. Educators should stimulate and support those reflections. Learner-centred approaches change the role of an educator to one of being a facilitator of learning processes (instead of being an expert who only transfers structured knowledge) (Barth, 2015).
Action-oriented learning	In action-oriented learning, learners engage in action and reflect on their experiences in terms of the intended learning process and personal development. The experience might come from a project (in service-learning), an internship, the facilitation of a workshop, the implementation of a campaign, etc. Action-learning refers to Kolb's theory of the experiential learning cycle with the following stages: 1. Having a concrete experience, 2. Observing and reflecting, 3. Forming abstract concepts for generalisation and 4. Applying them in new situations (Kolb, 1984). Action-learning increases knowledge acquisition, competency development and values clarification by linking abstract concepts to personal experience and the learner's life. The role of the educator is to create a learning environment that prompts learners' experiences and reflexive thought processes.
Action-oriented learning	Transformative learning can best be defined by its aims and principles, rather than by any concrete teaching or learning strategy. It aims at empowering learners to question and change the ways they see and think about the world in order to deepen their understanding of it (Slavich and Zimbardo, 2012; Mezirow, 2000). The educator is a facilitator who empowers and challenges learners to alter their worldviews. The related concept of transgressive learning (Lotz-Sisitka et al., 2015) goes one step further: It underlines that learning in ESD has to overcome the status quo and prepare the learner for disruptive thinking and the co-creation of new knowledge.

Bearing this in mind, a similar mapping approach has been adopted to identify **pedagogies that are commonly proposed as fulfilling these core principles of teaching and learning for ESD.** Whilst there are a wide range of pedagogies and pedagogical tools that contribute to the development of the competences outlined previously in this report, we focus here on the more frequently identified approaches and methods in the literature review. There may also be a variety of 'sub-pedagogies' within each approach (for example, up to four types of service learning have been identified (University of Central Arkansas , no date)).

As with the approach to competency mapping, the key sources in the literature review proposing the pedagogy are listed along with a range of resources designed to support educators in developing their understanding of the method. Similarly, the ** symbol is also used to identify pedagogies that are more commonly proposed in the sources reviewed.

Pedagogy/teaching and learning approach	Key sources
**Problem/project-based learning (PBL)	Learning through the use of real-world problems, usually in small groups. Key sources: *(Tejedor, et al., 2019), (Lozano, et al., 2017), (Bianchi, et al., 2022), (Advance HE / Quality Assurance Agency for Higher Education, 2021), (Cotton & Winter, 2010), (Lambrechts, et al., 2013)*
**Service learning	A form of experiential learning which sees students interacting with and tackling projects or problems in their communities. Key sources: *(Tejedor, et al., 2019) (Lozano, et al., 2017), (Lambrechts, et al., 2013)*
**Simulation and role play	This describes a range of approaches that involve students adopting the identities of different stakeholders in a given scenario. Key sources: *(Lozano, et al., 2017), (Cotton & Winter, 2010), (Bianchi, et al., 2022), (Tejedor, et al., 2019)*
**Case studies	Case study approaches see students working with detailed accounts of situations or scenarios which form the basis of research, discussion and reflection activities. Key sources: *(Tejedor, et al., 2019) (Lozano, et al., 2017), (Cotton & Winter, 2010), (Lambrechts, et al., 2013)*
Place-based learning	Approaches which focus on developing students' sense of place and learning through exploring their environment. Key sources: *(Lozano, et al., 2017)*
Outdoor learning	An umbrella term for approaches which predominantly involve activities and experiences for learners in the outdoors. Key sources: *(Bianchi, et al., 2022), (Lambrechts, et al., 2013)*
Reflexive accounts/diaries	These tools/approaches provide students with an opportunity to reflect on their position in relation to their learning, skills and action (for sustainability). Key sources: *(Cotton & Winter, 2010)*
Learning through story-telling	Uses stories or narratives to structure learning as a means of making sense of sustainability issues. Key sources: *(Advance HE / Quality Assurance Agency for Higher Education, 2021), (Cotton & Winter, 2010)*
Games and gamification	These describe the integration of structured or semi-structured games into learning experiences allowing students to explore actions and outcomes. Key sources: *(Bianchi, et al., 2022) (Advance HE / Quality Assurance Agency for Higher Education, 2021)*

1.2.1 Key ESD pedagogies in detail

Pedagogy: Problem/project-based learning (PBL)

Description: Problem-based learning is a method of learning whereby students are encouraged to learn about concepts and principles through the use of real-world problems, instead of simply presenting them with facts and concepts. Usually in small groups, students examine and analyse information, investigating different perspectives and experiences around the problem, to find possible solutions. Project-based learning is very similar to problem-based learning in that it involves groups of students finding solutions to a real-world problem. However, in project-based learning, students go further and are directly involved in the solution, often sharing final products with relevant stakeholders.

This allows students to better understand the problem and the linked concepts and principles, develop their communication skills, problem-solving skills and critical thinking skills.

References and resources: The following table outlines relevant references and resources on problem/project-based learning. It includes references included in the literature review that identified the list of commonly proposed pedagogies presented in this report, as well as accessible and practical resources on this approach.

Sources (literature review)
(Tejedor, et al., 2019), (Lozano, et al., 2017), (Bianchi, et al., 2022), (Advance HE / Quality Assurance Agency for Higher Education, 2021) (Cotton & Winter, 2010), (Lambrechts, et al., 2013)
Additional sources
• Maastricht University, Problem-based learning at Maastricht University • University of Groningen, Project-based learning • Advance HE, Problem-based learning • Carvers, R, Wiek, A, de Kraker, J, Martens, P and Lang, D, (2016), Problem-based and project-based learning for sustainable development, in 'Sustainability Science: An Introduction', Eds. Heinrichs, H, Martens, P, Michelsen, G and Wiek, A, Springer • Keele University, Why use PBL in sustainability education?

Pedagogy: Service learning

Description: Service learning is a form of experiential learning where students learn knowledge and skills through interacting with and tackling projects or problems in their community. Through this, students develop a deeper understanding of problems at hand and the wider complexities. Usually, reflection plays an important role in this form of learning.

References and resources: The following table outlines relevant references and resources on problem/project-based learning. It includes references included in the literature review that identified the list of commonly proposed pedagogies presented in this report, as well as accessible and practical resources on this approach

Sources (literature review)
(Lambrechts, et al., 2013) (Tejedor, et al., 2019) (Lozano, et al., 2017)

Additional sources
• SLIHE EU, Service-learning in higher education in central and eastern europe - shared experiences from SLIHE • European Observatory of Service Learning in Higher Education, Service learning resources library • Europe Engage,(2017), Guidelines for institutionalization of service-learning • Aramburuzabala P, McIlrath, L and Opazo, H (eds), (2019), Embedding Service Learning in European Higher Education: Developing a Culture of Civic Engagement, Routledge, London • European Association of Service Learning in Higher Education

Pedagogy: Simulation and role play

Description: This describes a range of approaches that involve students adopting the identities of different stakeholders in a given scenario. The identities or roles are usually unfamiliar to the student and require them to 'act things out' , requiring them to draw on knowledge and skills gained in theory and put them into practice. It is suggested that activities should draw on as close to real-life settings as possible to enable students to develop close to 'real world' experience (Harvard University, no date).

References and resources: The following table outlines relevant references and resources on role play / simulations. It includes references included in the literature review that identified the list of commonly proposed pedagogies presented in this report, as well as accessible and practical resources on this approach.

Sources (literature review)
(Lozano, et al., 2017), (Cotton & Winter, 2010), (Bianchi, et al., 2022), (Tejedor, et al., 2019)

Additional sources
• EU Creates, Toolkit for co-creative learning: Simulation and role play • EU Creates, Introduction to simulation and role play • Sutcliffe, M, Simulations, Games and Role-play from The Handbook for Economics Lecturers • Anastasiadis, S, Spence, L, Vazquez-Brust, D and Wagner, S, (2016), Games and simulations in teaching sustainability • Cranfield University, (2018), Teaching sustainability: More than just a game

Pedagogy: Case studies

Description: Case study pedagogies involve students interacting with detailed accounts of real-world examples and issues. It encourages examination of and engagement with issues from a range of different perspectives with the aim of students becoming actively engaged with the materials and the underlying (sustainable development) issues they consider. Pedagogical approaches using case studies usually involve students carrying out a phase of research prior to reflection and discussion. They are considered a form of active learning, with students required to apply their knowledge and skills to complete the 'task' (State of New York University Cortland, no date).

References and resources: The following table outlines relevant references and resources on problem/project-based learning. It includes references included in the literature review that identified the list of commonly proposed pedagogies presented in this report, as well as accessible and practical resources on this approach.

Sources (literature review)

(Lozano, et al., 2017), (Cotton & Winter, 2010), (Bianchi, et al., 2022), (Tejedor, et al., 2019)

Additional sources

- Boston University Centre for Teaching and Learning, Using case studies to teach
- Fox, A, (2018), Using case study pedagogy to promote sustainability
- Addo, R, Koers, G & Timpson, W, (2022) Teaching sustainable development goals and social development: a Case study teaching method, Social Work Education, 41:7, 1478-1488
- State of New York University Cortland, (no date), Case Study Method of Instruction

References

Advance HE / Quality Assurance Agency for Higher Education, 2021. Education for Sustainable Development Guidance, s.l.: s.n.
Arizona State University, 2018. Arizona State University: Key competencies in sustainability. [Online]
Available at:
https://static.sustainability.asu.edu/schoolMS/sites/4/2018/04/Key_Competencies_Overview_Final.pdf
[Accessed 2023].

Bianchi, G., Pisiotis, U. & Cabrera Giraldez, M., 2022. GreenComp The European sustainability competence framework, Luxemburg: Publications Office of the European Union.

Bloom, B.S. (1956) Taxonomy of Educational Objectives, Handbook: The Cognitive Domain, David McKay, New York

Brundiers, K., Barth, M., Cebrián, G. & al, e., 2021. Key competencies in sustainability in higher education—toward an agreed-upon reference framework. Sustainability Science, Volume 16, pp. 13-29.

Cebrian, G., Junyent, M. & Mula, I., 2020. Competencies in Education for Sustainable Development: Emerging Teaching and Research Developments. Sustainability, 12(2), p. 579.

Cotton, D. & Winter, J., 2010. 'It's Not Just Bits of Paper and Light Bulbs': A Review of Sustainability Pedagogies and Their Potential for Use in Higher Education. In: P. S. D. a. S. S. Jones, ed. Sustainability Education: Perspectives and practice across higher education. London: Routledge.

Coursera, 2023. What Are Interpersonal Skills? And How to Strengthen Them. [Online]
Available at: https://www.coursera.org/articles/interpersonal-skills
[Accessed April 2023].

Demssie, Y., Wesselink, R., Biemans, H. & Mulder, M., 2019. Think outside the European box: Identifying sustainability competencies for a base of the pyramid context. Journal of Cleaner Production, Volume 221, pp. 828-838.

Giangrande, N. et al., 2019. A Competency Framework to Assess and Activate Education for Sustainable Development: Addressing the UN Sustainable Development Goals 4.7 Challenge. Sustainability, 11(10).

Gil-Domenech, D., Magomedova, N., Sanchez-Alcazar, E. S. & Lafuente-Lechega, M., 2021. Integrating Sustainability in the Business Administration and. Sustainability, Volume 13.
Glasser, H. & Hirsch, J., 2016. Toward the Development of Robust Learning for Sustainability Core Competencies. Sustainability: The journal of record, 9(3).
Harvard University, no date. Role play. [Online]
Available at: https://ablconnect.harvard.edu/role-play-research
[Accessed April 2023].

Hoffmann, T. et al., 2022. Ten steps towards systems thinking: An Education for Sustainable Development manual for teachers, educators, and facilitators. [Online]
Available at: https://esd-expert.net/files/ESD-Expert/pdf/Was_wir_tun/Lehr-und-Lernmaterialien/Ten-steps-towards-system-thinking_Book.pdf
[Accessed April 2023].

Lambrechts, W. et al., 2013. The integration of competences for sustainable development in higher education: an analysis of bachelor programs in management. Journal of Cleaner Production , Volume 48, pp. 65-73.

Lozano, R. et al., 2017. Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A literature review and framework proposal. Sustainability, 9(10).

Northwestern University, (no date). Interpersonal Competence. [Online]
Available at: https://www.northwestern.edu/studentaffairs/assessment/learning-outcomes/division-student-learning-outcomes/interpersonal-competence.html#:~:text=The%20Interpersonal%20competence%20domain%20focuses,capacity%20for%20interdependence%20and%20collaboration.
[Accessed April 2023].

Orr, D., 1992. Ecological Literacy: Education for a Postmodern World. Albany, New York: State of New York University.

Quendler, E. & Lamb, M., 2016. Learning as a lifelong process - meeting the challenges of the changing employability landscape: competences, skills and knowledge for sustainable development. International Journal of Continuing Engineering Education and Life Long Learning, 26(3), pp. 273-293.

Redman, A. & Wiek, A., 2021. Competencies for Advancing Transformations Towards Sustainability. Frontiers in Education, Volume 6.

Rieckmann, M., 2012. Future-oriented higher education: Which key competencies should be fostered through university teaching and learning?. Futures, 44(2), pp. 127-135.
State of New York University Cortland, no date. Case Study Method of Instruction. [Online]
Available at: https://web.cortland.edu/frieda/id/IDtheories/43.html
[Accessed April 2023].

Tejedor, G. et al., 2019. Didactic Strategies to Promote Competencies. Sustainability, Volume 11.

UNESCO, 2017. Education for Sustainable Development Goals: Learning objectives, Paris: UNESCO.

University of Central Arkansas , no date. Types of Service-Learning. [Online]
Available at: https://uca.edu/servicelearning/types/
[Accessed April 2023].

University of Leicester Career Development Service, n.d. [Online].
University of Plymouth, (no date). What is Education for Sustainable Development?. [Online]
Available at: https://www.plymouth.ac.uk/students-and-family/sustainability/sustainability-education/esd
[Accessed April 2023].

Wiek, A. et al., 2016. Operationalising competencies in higher education for sustainable development. In: M. Barth, G. Michelson, M. Rieckmann & I. Thomas, eds. Routledge handbook of higher education for sustainable development. London and New York: Routledge, pp. 241-260.

Wiek, A., Withycombe, L. & Redman, C., 2011. Key competencies in sustainability: a reference framework for academic program development. Sustainability Science, Volume 6, pp. 203-218.