Teaching sustainability within the context of everyday life: the case of the EUSTEPs project

Sara Moreno Pires, Research fellow, University of Aveiro
Mahsa Mapar, Research Fellow, Aberta University
Mariana Nicolau, MSc, University of Aveiro
Nicoletta Patrizi, Research fellow, University of Siena
Georgios Malandrakis, Assistant Professor, Aristotle University of Thessaloniki
Federico M. Pulselli, Associate Professor, University of Siena
Paula Bacelar Nicolau, Assistant Professor, Aberta University
Sandra Caeiro, Associate Professor, Aberta University
Alessandro Galli, Director Mediterranean-MENA Program, Global Footprint Network
(Correspondig author)
alessandro.galli@footprintnetwork.org
Mobile: +39 3479034977
18 Avenue Louis-Casai
1219 Geneva - Switzerland

Abstract

In a world characterized by a global ecological overshoot, education plays a critical role in achieving sustainable development as it helps expanding basic sustainability literacy, narrowing social gaps, favoring a decent quality of life, and it contributes to increased awareness of ecosystems' challenges across all sectors of society. Education is key to nurturing generations of sustainability-minded citizens and future leaders who accelerate the transition to a one-planet compatible society.

Despite the essential role of Higher Education Institutions (HEIs) in contributing to a sustainable society, there is still a tension between different normative views of what sustainable development is, and an agreed holistic understanding of how to incorporate sustainability-related initiatives into HEIs is still lacking. Nonetheless, given the importance of HEIs in our societies and considering the number of students, as well as teaching, administrative and management staff they host every day, it becomes fundamental to ensure that sustainability is not only taught but also practiced within campuses. To this end, a strategic partnership across four European universities and an international Non-Governmental Organization (NGO) was created in 2019 to set up the 3-year ERASMUS+ funded project entitled "Enhancing Universities' Sustainability Teaching and Practices through Ecological Footprint (EUSTEPs)".

Through a "learning-by-doing" approach, the main aim of the EUSTEPs project is to equip EU university students and the Higher Education community with science-based knowledge, multidisciplinary skills, and the transdisciplinary mindset that enable them to participate in the societal effort towards sustainability. EUSTEPs takes a 360-degree approach to sustainability, allowing the diverse academic community to understand, realize, and learn the full complexity of the economy-society-environment relationships, in an engaging and captivating manner.

Based on the concept of sustainability in everyday life rather than through a mere abstract teaching of intangible theories and concepts, the project is divided into two main phases: (i) development of a teaching module and a Massive Open Online Course (MOOC) customized for the four project target groups including students, teaching staff, administrative staff, and management bodies of universities. The developed module is interactive, innovative and applicable at European level and beyond, thus contribute to Sustainable Development Goal (SDG) 4 and, (ii) implementation of an online University Footprint Calculator, co-developed through a participatory process by academics, PhD students, and administrative staff. The outcomes of the calculator will allow users to identify universities' unsustainability drivers and initiate the necessary process to lower the impact of HEIs and their working spaces, thus

contributing to SDGs 11 (sustainable cities & communities), 12 (responsible consumption & production), and 13 (climate action).
In the long run, EUSTEPs project outcomes will be transferred to other EU and non-EU universities to ensure their widespread integration into education plans and curricula thus guiding students and the wider academic community through a knowledge-awareness-action journey.
Aim of this paper is thus to 1) present the EUSTEPs module, its pedagogical approach and structure (i.e., student's module syllabus), as well as the expected learning outcomes and competencies gained by the four project target groups, 2) critically review the outcomes of the first pilot teaching of the EUSTEPs module conducted in Spring 2020 at the 4 univiersities and 3) engage the wider academic community into the process of development of a EU-wide University Footprint Calculator.

Keywords: Higher education institutions, sustainability, Ecological Footprint, teaching module, EUSTEPs.

1. Introduction

The recognition that we are living a global crisis of values, ideas, perspectives, and knowledge – which makes it also a crisis of education (Orr, 1994) – is the first step towards a needed change in the Higher Education Institutions (HEIs) systems. HEIs – meaning the organizations that provide higher, postsecondary, and/or third-level education such as traditional universities, profession-oriented institutions or community colleges, liberal arts colleges, institutes of technology and other collegiate-level institutions – are ethically and morally responsible to increase the awareness, knowledge, skills, and values needed to create a more sustainable way of living (Cortese, 2003).

Four European HEIs - Aristotle University of Thessaloniki (Greece), University of Aveiro (Portugal), Aberta University (Portugal), and University of Siena (Italy) - along with the international Non-Governmental Organization (NGO) Global Footprint Network joined efforts in a common project to change the way sustainability is envisioned, teached and accomplished among and inside HEIs. The project, named Enhancing Universities' Sustainability Teaching and Practices through Ecological Footprint (EUSTEPs), funded by the ERASMUS+ program, proposes an approach to introduce and raise awareness not only among professors and students all over the European Union, but also administrative and management staff, aiming for a conscious insight of personal behavior as well as greater understanding on the functioning of the institutions. The EUSTEPs rationale is centered on guiding sustainability matters and educating the wider academic community through the Ecological Footprint (EF) concept, a very popular sustainability tool with an acknowledged capacity to communicate the scale and significance of humanity's overuse of the planet's natural resources in simple and powerful terms (Collins et al., 2020).

EUSTEPs sets-out to deliver the following four key objectives: 1) to develop interactive teaching modules, materials and tools for the wider academic community; 2) to build a Massive Open Online Course made available through the project web-platform to scale-up project outcomes and enlarge the target audiences; 3) to involve all members of the university community in innovative "learn-by-doing" activities to co-develop an online, freely available University Footprint calculator, to thus 4) initiate a process of greening of campuses via reducing their resource demand.

The main aim of this paper is to understand how the development and testing of a new teaching module for HEIs students can contribute to the development of ideal competences and pedagogical approaches towards sustainability, and the fostering of collaboration among HEIs.

2. Holistic integration of sustainability into Higher Education Institutions: evolution, barriers and challenges

Since the 1972 United Nations (UN) Stockholm Conference, the education system has been recognized as key in fostering environmental protection and gained a central role in easing the transition to a sustainable world. Twenty years later, the UN Agenda 21 (UNCED, 1992) has called for reorienting education towards sustainable development and UN and UNESCO have launched respectively the Decade of Education for Sustainable Development in 2005-2014 (UN, 2002), and its follow-up Global Action Programme on Education for Sustainable Development (UNESCO, 2014).

HEIs, therefore, play a crucial role in transforming societies (Ramos et al., 2015) as they create knowledge for, and transfer it to, the society, thus preparing students for their future role in society (Stough et al., 2018). Despite the essential role of higher education in contributing to a sustainable society, there is a tension between different normative views of what is "sustainability/sustainable development" and "what universities should do" (Stough et al., 2018). From the 1987 Brundtland Report (WCED, 1987) to the 2012 Rio Earth Summit (UN, 2012), several events and declarations (see Figure 1) contributed to the building-up of the sustainable development concept as an established field of research (Wilson and Wu, 2017) and fostered higher education for sustainable development. Although these documents

contain important guidelines for education, they do not offer concrete operational prescriptions on what to do (Roorda, 2002).
The most recent impetus was given by Agenda 2030 (UN, 2015), with education as both a stand-alone goal (Sustainable Development Goal - SDG 4) as well as included as a target in several other SDGs, notably those on health, growth and employment, sustainable consumption and production, and climate change (UNESCO, 2016). The development of the UNESCO Education 2030 Framework for Action that followed the establishment of SDG4, then contributed to setting several strategic approaches: from strengthening policies, plans, legislation, and national systems to emphasizing equity, inclusion, and gender equality (UNESCO, 2016).
As a consequence, several universities across the world have signed declarations to promote SD in higher education, showing how important the latter has become. Yet, according to Lozano et al. (2013), the number of HEIs that signed these declarations is small compared to the total number of universities in the world.

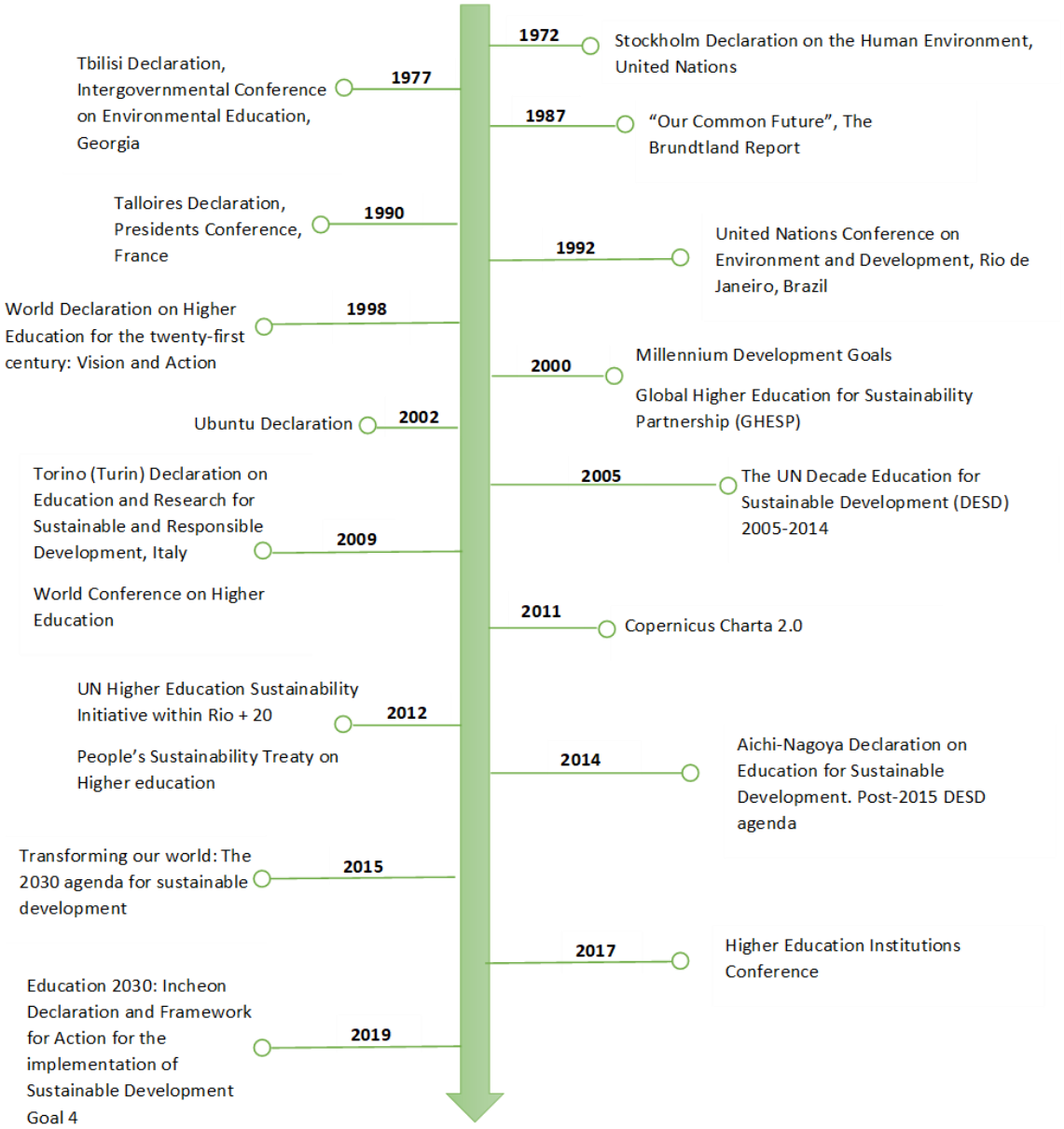

Figure 1. Timeline of major international sustainability milestones
Source: Authors' elaboration

In the last two decades, a shift has taken place from teaching environmental issues to a broader sustainability agenda, geared at empowerment and capacity building of those involved in education (Disterheft et al., 2015). Also, the focus of the literature on environmental sustainability has then shifted to issues of pedagogy, competences, community outreach, and partnerships towards sustainability. As a result of this evolution, the ESD paradigm is currently addressing comprehensive transformative learning and provides equal attention to the environment, society, the economy, and the institutional dimensions, particularly within the realms of campus life (including employees, students, and campus operations) (Lidstone et al., 2015, Spangenberg, 2002).
Progress on the holistic integration of sustainability into university practices, termed as "sustainability integration in higher education", has recently been gaining increasing attention worldwide (Alonso-Almeida et al., 2015; Lozano et al., 2015a; Kapitulčinová et al. 2018), with a stronger interest in HEIs in Europe (Karatzoglou, 2013; Lozano et al., 2015a). However, the adoption of whole-institution approaches and integrated frameworks by the academic community still appears to be in initial stages (Lozano et al., 2013a, 2013b; Sammalisto et al., 2015 in Kapitulčinová et al. 2018). Some of the identified key reasons and barriers for this integration are summarized in Table 1.

Table 1. Main barriers and challenges towards sustainability integration within HEIs (Source: Authors' elaboration)

Type of barriers and challenges	Examples of Barriers/ Challenges
Human resources	Lack of unity and harmony / Limited specialization/ Lack of staff to coordinate sustainability efforts
Cultural barriers	Cultural differences / Resistance to cultural change
Social and Institutional barriers	Lack of capacity and pressure from society
External funding/ Budget/ Finance	Few financial resources or available external funding for sustainability projects
Leadership and management	Few incentive structures / Lack of strategic leadership
Governance and policy-making structure	Conservative organizational structures based on a hierarchy of administration, faculty, staff, and students
Misdirected criteria for evaluation	Lack of clear evaluative structures / indicators for university policy and plans
Collaborative barriers	Few networks among HEIs to foster cooperation
Teaching and Learning settings in communities and institutions	Lack of understanding, ability and skill of staff to infuse ESD subjects
Internal barriers	Competitive environment between and within: students, faculty, departments, universities.

To overcome the mentioned barriers, some recommendations have been proposed by different authors (e.g. Lozano, 2006; Adams et al., 2018) but always underlying that there are no single "recipes" of what "ingredients" to use to ensure success (Kapitulčinová et al. 2018).

From the goals of this paper, we, therefore, intend to explore how to overcome those barriers and to endorse new strategies to improve sustainability teaching and curricula in HEIs.

3. Mapping sustainability competences and pedagogical approaches

Research on the connection between how courses are delivered (pedagogical approaches) and the sustainability competences they might generate has historically been limited, although several studies have been devoted to this topic in recent years (Lozano et al. 2019).
Although sustainability is one of the founding principles to help learners to develop an understanding of the world as an interconnected whole, and take into consideration the consequences of their actions (e.g. Vare et al., 2019), promoting systems-thinking and the capacity to handle complexity is not the only competency when considering ESD. The need to develop anticipatory or future thinking - considering the long-term impact – is also key to support learners as they explore alternatives for the future and use these to consider how behaviors might need to change (e.g. Rieckmann, 2012). Tools are also necessary so that learners may build normative competences, since they help to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets (Wiek, Withycombe, and Redman, 2011). Similarly, strategic abilities have proven to be useful, giving students the tools to jointly design and deliver transformative interventions, transitions, and governance strategies for sustainability (Lozano et al., 2017).
All competences must be acquired while enduring transdisciplinary work, hence it helps learners to act collaboratively both within and outside of their discipline, perspectives, and values (Vare et al., 2019). Beyond the more evident skills, students must also be equipped with the ability to understand philosophical perspectives on ethics, social justice, and community-building, while bearing in mind the concepts of social responsibility, ecological integrity, and equity (Lozano et al., 2017). Finally, tolerance for ambiguity and uncertainty alongside the capacity to understand how different assessment frameworks can guide the understanding of conflicting goals and of uncertain knowledge or contradictions (Rieckmann, 2012) are also critical competences that must be developed when approaching sustainability through teaching within HEIs.
These competences should be acquired and developed by employing different pedagogies. The more universal ones are related to case studies that enhance the descriptions of settings, problems, and controversies in SD definition, side by side with lecturing, which provides access to different materials, such as videos or assignments, inside the classroom context. Similarly, encouraging teamwork through interdisciplinary team teaching is beneficial as well as fostering mind, cognitive and concept maps to deliver a visual impact of sustainability related concepts. Promoting the development of project, problem or challenge-based learning usually directs students to non-linear learning and to engage more in collaborative groups, the community, or business partnerships (Lozano et al., 2017).

3.1. Overview of Footprint teaching methods: projects, tools, outcomes, and challenges

At the core of the EUSTEPs module, there is the Ecological Footprint framework. This methodology is not new in the ESD field, as it has been used during the last 15 years in several teaching exercises – although with different approaches and targeting different populations – stimulating wide-ranging discussions on how to best influence sustainability education and awareness (Collins et al., 2020).
Creating awareness stands as one of the main objectives of the Ecological Footprint (Collins et al., 2020), as this tool enables individuals to observe and realize the impact of their actions on the planet. By means of a simple message and visually happealing results, Ecological Footprint applications inform about the number of planets needed to sustain an individual life if all humanity were to follow its same lifestyle. Despite existing and acknowledged limitations, teaching and applying EF to every person's reality – by having students' calculating their own EF – inspires debate and generates awareness of personal impact (Collins et al., 2018). Identifying own's Footprint drivers then raises incentives to a shift of attitude and helps

quantify the influence each one may have in changing the course of the world. Overall, the EF has proven to be an asset when it comes to create awareness and raise attentiveness towards sustainability, inspiring thoughtful behaviors (Collin et al., 2020).
Calculating individual EF is not the only way to incorporate this tool in the classroom as its range of application is vast and should be considered in other scenarios. Previous studies have shown, for instance, that calculating the EF of a University encouraged students to become more engaged with the Footprint tool and the work that supports it (Conway, Dalton, Loo, Benakoun, 2008; Lambrechts and Van Liedekerke, 2014). Moreover, it brought attention to areas that need improvement inside HEIs, in order to become more sustainable and, with the assistance of students, some concerns have been pointed out as possible ecological enhancements. Also, studies have considered the possibility of using EF as a tool for campus operations and policy development (Venetoulis, 2001).
As the use of the EF in HEIs' context progresses, more spheres of sustainability could be addressed from this tool, from allowing students to obtain greater knowledge and awareness of their personal impact on sustainability, to stimulating actions and changes in both personal and campus life, for both students and the wider academic community (e.g., teachers, administrative and management staff).

4. Context and Methods

The development of innovative teaching tools and approaches stands as one of the main goals of the EUSTEPs project, with a focus on 1) horizontal integration of sustainability in education, 2) engaging and empowering all university members, 3) facilitating communication and coordination among different HEIs and, 4) fostering new pedagogical tools.
Since the EUSTEPs project intends to pursue learning tools that can be transposed throughout European universities and be taught in different courses for different target groups, the first step was to design a new module to teach sustainability to one of the intended target groups: university students.
The team in charge of content development included seven professors and one post PhD researcher from the four partner universities, with different backgrounds and different scientific fields, from education and pedagogy to environmental sciences, and up to public administration and policies. The methodology applied to design the module consisted into four main steps: i) the initial structure and the content of the module was created, based on an integrative literature review upon pedagogies, competences, barriers and challenges conducted by the EUSTEPs team, ii) the EUSTEPs team worked on the development of the structure, contents, materials, pedagogies, and aimed competences, iii) in Spring 2020 semester, the module was taught in the four partners universities, and finally iv) the effectiveness of the module assessed, among others, through the feedback gained from the students, who were the recipients of this module, and the professors, who implemented it. Data from both sources (students and educators) were collected and analyzed through an online survey tool (namely Limesurvey).
The module was envisaged to be implemented in two different forms: *face-to-face* and *distance learning*, to reflect the needs of different university types. Aristotle University of Thessaloniki, University of Aveiro, and University of Siena prepared the face-to-face course, while Aberta University framed the online version since it is a distance learning university. However, due to the COVID-19 outbreak, only the University of Aveiro managed to implement the module face-to-face, while the Aristotle University of Thessaloniki and the University of Siena implemented an "online version" of the module, making the necessary adaptation required for that type of teaching. The University of Aberta implemented the module as it was originally planned, namely through distance learning.
The developed module covers three main topics concerning: i) sustainability concept and SDGs, ii) Ecological Footprint and its implication and application to sustainability debates, and iii) the link between sustainability and HEIs. The module was intended to teach sustainability in the context of everyday life rather than through an abstract teaching of intangible theories by considering two core aspects: i) sustainability as a multi- and trans-disciplinary topic spanning across all fields of education, all spheres of life, and all sectors of economy; and ii)

highly interactive teaching in which students experience firsthand the crosscutting nature of sustainability. As such, the EF in both implication and application aspects was used as a tool to foster the concept of sustainability with the students. The module was intended to enforce certain learning outcomes and competences considered critical for sustainability learning that are detailed in Table 2.

The developed module was incorporated in existing university courses, not in a new, stand-alone, course. Also, based on the maternal language of participants from different universities, the module was developed in multiple languages (English, Greek, Portugues, and Italian). The length of the module was from 6 to 12 hours frontal lesson, followed by 20 to 25 hours of homework, and included several class exercises and homework assignments, summing up to a total of 1-1.5 ECTS of workload, depending on University rules. The module was primarily intended for undergraduate students (all course and degree types) and postgraduate students with no specific environmental science background.

Table 2. Module's description

Unit Name	Unit lenght	Expected Learning Outcomes (ELO)	Competences	Pedagogies	Class exercises and activities
Understanding Sustainability: from theory to practice...and back	1 academic hour	- Entry level of understanding of the sustainability concept and related issues - Module overview and objectives	- Personal involvement - Empaty and change of perspective	- Mind, Cognitive and Conceptual Maps - Lecturing	- C-map
Ecological Overshoot	1 academic hour	- Realize the concept of planetary limits and how they affect, and are affected by, human activities, - Realize the importance of knowledge and cooperation in avoiding ecological overshoot.	- Empathy and change of perspective, to be able to develop their self-awareness and awareness of others' perspective	- Lecturing - Supply chain/Life Cycle Thinking	- "Fisher for a day" Game
Sustainability and Sustainable Development Goals (SDGs)	1 academic hour	- Realize the definition of sustainability and its main aspect (Environment, Economy, Society), - What SDGs are & which is their role.	- Systems-thinking and handling of complexity - Normative competences and knowledge of SDGs: context and specificities	- Lecturing	- Videos - Presentation
Introduction to Ecological Footprint	2 academic hours	- What EF is, - The unit of measure of EF, - Factors	- Normative competences - Critical thinking and analysis	- Lecturing	- Presentation

		constituting EF, - The usefulness of EF, - EF and other types of footprints and their respective calculation methods and calculators, - The usefulness of EF as a sustainability indicator - The relationship of SDGs with EF.	- Resource Accounting skills - Assessment and valuation		
Your Personal Ecological Footprint	2 academic hours	- Realize their personal EF, - Realize the gap between personal EF and resources availability, - Identify possible solutions for reducing their personal EF, - Implement these solutions and alternative choices and assess their impact on the planet, - Consider why EF is an evaluation tool and how it differs from other evaluation tools regarding its specific advantages.	- Critical thinking and analysis - Assessment and evaluation - Personal involvement - Empathy and change of perspective - Justice, responsibility, and ethics.	- Supply chain/Life Cycle Analysis (LCA) - Lecturing	- EF Calculator
Higher Education Institutions (HEIs) and Sustainability	2 academic hours	- Realize the many ways in which HEIs can and are dealing with sustainability issues, - Understand the different aspects of HEIs' sustainability, - Be aware of the various tools assessing	- Normative competences - Assessment and valuation - Critical thinking and analysis - Personal involvement (Site-visit) - Interpersonal competences (Site-visit)	- Case studies - Lecturing	- Site Visit - Data search and analysis

		universities sustainability.			
EUSTEPs module closure	1 academic hour	- Realize what they have learned during the module, - Learn about existing sustainability solutions and debate about them with the class, - Be willing to be engaged in sustainability action in their daily life and their University.	- Strategic competences - Critical thinking and analysis - Anticipatory thinking or futures thinking - Interpersonal competences	- Mind, Cognitive and Conceptual Maps - Lecturing	- C-map

The first unit includes the building of a conceptual map (C-map), to assess how students understand sustainability in their daily activities, alongside an introductory presentation of the course. Sustainable Development Goals (SDGs) are also approached, being one of the key notions of sustainability nowadays. After this initial approach, during the second unit, students are invited to join the “Fisher a day” game, which provides greater insight on how to perceive the boundaries of planet earth and ecosystems, while employing the cooperation concepts, connecting to Ecological Overshoot. The third unit provides an introduction to the concept of sustainability, to the SDGs and offers the opportunity for a class reflection on university opportunities to deal with SDGs. The fourth unit works on the concept and methodology of Ecological Footprint as a tool to fostering sustainability and the fifth unit centers on how to use and what is the Ecological Footprint Calculator. In fact, the Footprint Calculator offers the opportunity to calculate one’s personal EF and stimulates debate on the topic among students, comparing and discussing results as a mean to create awareness about personal behavior. This idea follows as they reflect on ways to lower the impact on EF, realistically and feasibly, and recalculate their results. Assessment and evaluation, along with critical thinking are key competences developed through these lessons since learners are called to outlook their own actions and reassess personal choices. The sixth unit deals specifically with HEIs’ context and takes into consideration social justice and intergeneration equity, asking students to provide examples of similar situations in their day to day behavior, so they reflect and make suggestions to improve those scenarios. To consolidate and connect all concepts approached, the final unit relates to concrete examples of HEIs and sustainability and a collective revision of the C-map developed in the first unit also takes place.

Different pedagogies were also used, from more traditional, as lecturing, to more interactive, as the use of C-maps and games, used as ice breakers and collaborative ways to create awareness on sustainability. Videos, worksheets and supplementary material were also used. Another resource used was homework assignments, so the worked initiated in the class could also be continued outside of it, along with further reflection. All classroom and homework activities and assignments were performed by working group of students, further supporting in this way their learning effect.

Once the preparation of the contents was complete, the implementation of the EUSTEPs module started. The module’s first test took place at University of Aveiro, starting from 18th February 2020, and then followed by the remaining universities, all beginning in March 2020, involving in total 52 students throughout all universities. The assessment of the effectiveness of the module was considered extremely important to improve the module for the next steps of

the EUSTEPs project. To this aim, a feedback questionnaire was developed to assess students' perceptions of the strengths and weaknesses of the module. The questionnaire covered closed and open-ended questions concerning two main areas: i) general information on students' characteristics, e.g. gender, nationality, and degree, as well as course characteristics, e.g. name and type of the course and the applied semester and year of study, ii) specific questions on the effectiveness of the module, covering module characteristics, educational materials and resources, homework assignments, knowledge and intentions' development, personal Involvement, and overall satisfaction.
A five-point Likert scale was applied (from "very low" to "very high" or "not at all" to "very much" or "very satisfied" to "very unsatisfied") for the closed-form questions (Olsson et al., 2020). Since some educational materials and homework assignments were not taught / applicable to all target universities (mainly due the COVID19 restriction measures), an additional answer option was added in the questionnaire indicating if the educational materials or homework assignments was not applied.
The validity of the questionnaire was assessed through its review from a panel of experts already engaged in the project (Habidin et al., 2015). Subsequently, two methodologies were applied to analyse the survey data: i) for close-ended questions, a descriptive data analysis was performed; and ii) for open-ended questions, line-by-line content analysis was applied by labeling and grouping responses into new categories (Ghahramani, 2016).

5. Results and Discussions

Among the 52 participating students, 41 filled the online version of the questionnaire, representing a response rate of 79%. Gender distribution was almost equal, with 44% male and 56% female students, while the majority of participants (66%) was enrolled in a graduate degree, and 34% was enrolled in an undergraduate degree.
Based on students' perceptions, the most useful educational material was the EF online calculator (Figure 2), closely followed by the "Fisher for a day" game. The field visit reached a low score in comparison with other educational materials, since only the University of Aveiro (UA) had the chance to conduct field visit before the COVID-19 outbreack. However, by considering the results of the open-ended questions, UA students enjoyed the field visit and asked for the possibility of having more.

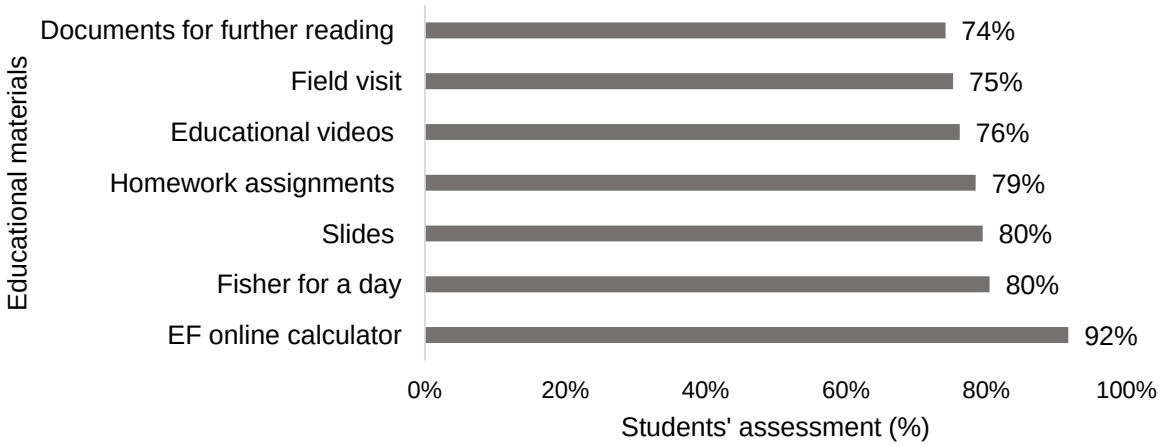

Figure 2. Students' perception on the usefulness of educational materials applied in the module

Also, the majority of the students conveyed that the homework assignment entitled “The link between EF and daily activities” was the most useful among others (Figure 3). Moreover, the C-map tool, although that in comparison with the other homework assignments gained the lowest level, it still reached a high level of usefulness (76%). Based on the students' statements on the open-ended questions, there was no time in the module in which students could discuss the results of their C-map in the group, and thus realize what to learn from that exercise. So, this point was later considered in the refinement of the module.

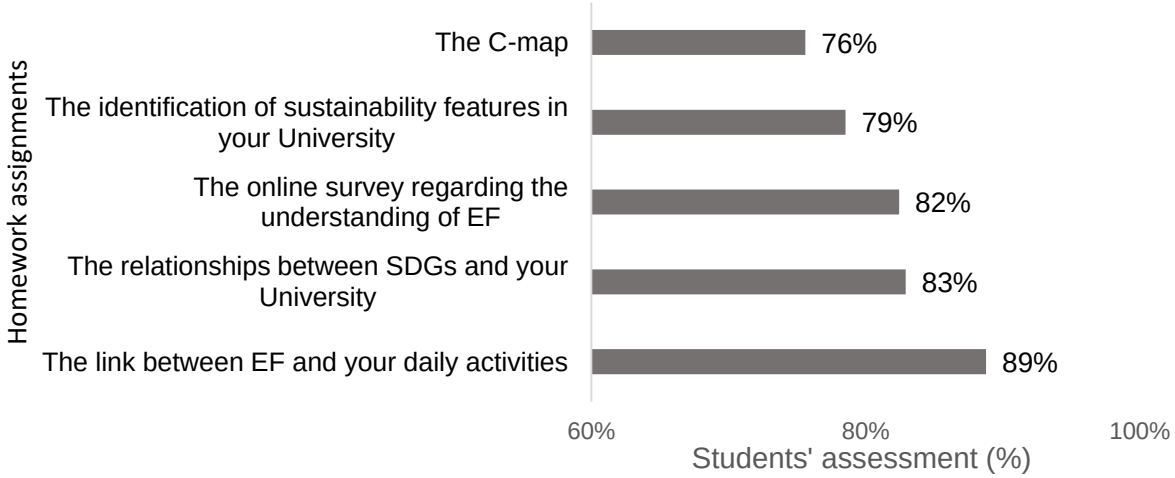

Figure 3. Students’ perception on the usefulness of homework assignments

Figure 4 shows the intentions of students after being familiarized with the sustainability concept. A high rate of responses (92%) considered to try to reduce their EF, closely followed by change of personal way of living towards sustainability (89%). Therefore, personal intentions increased more than the collective and social commitment.

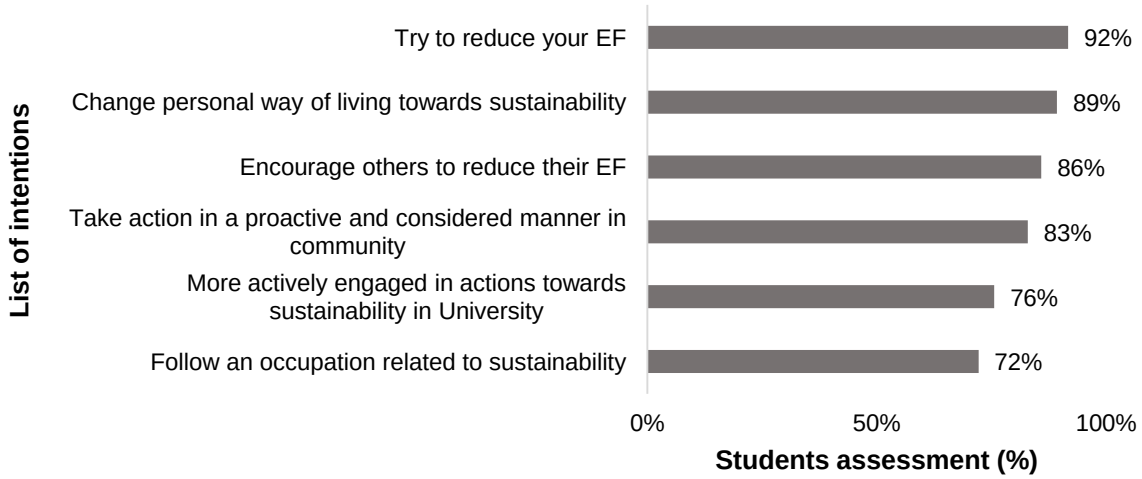

Figure 4. Students’ intentions to take future action on sustainability paths

Also, the very high scores on all topics in focus (>82%) indicates that the module helped students to increase their understanding on these issues (Figure 5).

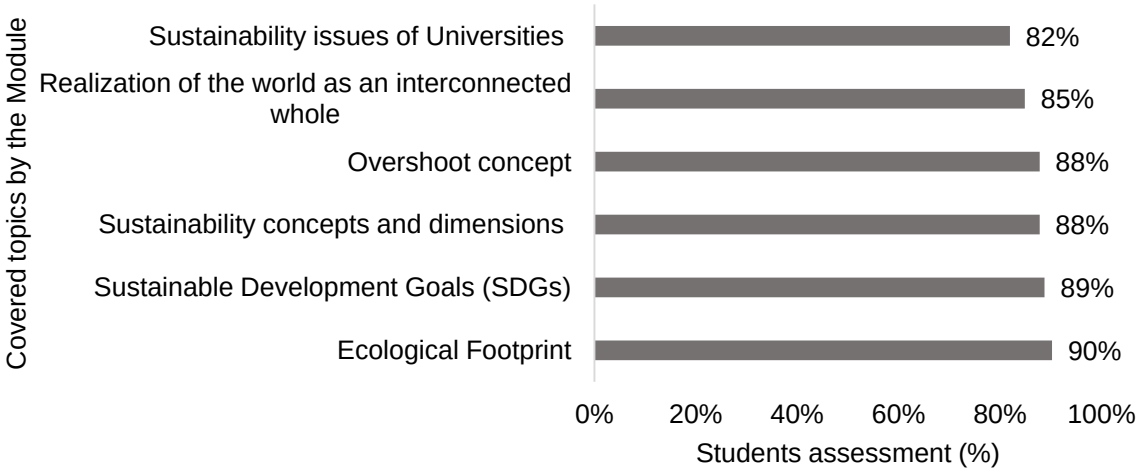

Figure 5. Students' understanding of the covered topics

In addition, as shown in Figure 6, the module is overall satisfying, since more than 90% of the students conveyed that feedback.

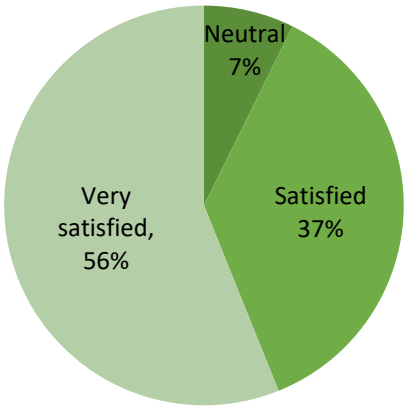

Figure 6. Overall students' satisfaction with the Module

Overall, students were very pleased with the lessons' course and the module's characteristics. They also appreciated the educational materials and resources, as well as the overall knowledge acquired as summarized in Figure 7.

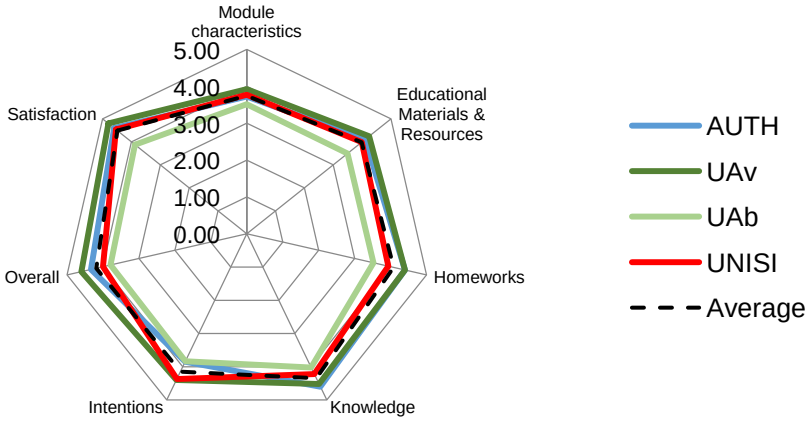

Figure 7. Module feedback from students (% of scoring scale)

Students were also invited to point positive aspects and drawbacks of the module. As strengths, the most indicated was the use of the EF Calculator and its connection to daily activities, thus somehow supporting previous findings from Collins et al. (2018). Some mentioned likewise the applied games during the module (i.e. the “Fisher for a day” game) – the combination of theory with practice – and the awareness raised on the topic. Some weaknesses were also highlited, namely the lack of classroom interaction, which was mainly due to the corona virus outbreak; an external factor that strongly affected the implementation of the module. Few students mentioned the content’s difficulty level, and some proposed increasing the time devoted to the module to allow deepening the topics further.
Finally, the professors’ assessment was based on a qualitative approach, pointing the high and lows throughout the module, the students’ perceived interest on the topic, the materials and the functioning of the overall lessons. In general, the application of the module worked smoothly. The need to incorporate further supporting material and interactive approaches to captivate more the students was empahised. The UA was the only partner that was able to implement the module in a face-to-face setting, easier to get a deeper insight into the students' reaction and evolution to the topics addressed. It was possible to observe that the interest of UA students grew throughout the module, but in the other Universities students’ motivation was already high from the begining. Another important aspect is the amount of work currently proposed by the module, which, as indicated by some professors, may lead to a low adherence of students and future participating teachers. Reducing or aggregating some of the work may transform the module in a more attractive and dynamic course. The end note is very positive, and professors highlighted students’ increased level of engagement, turning the first module’s application into a good and successful starting point.

6. Conclusions

The world is facing today extraordinary challenges that require unprecedented measures. A new approach on the way mankind looks at, and manages, the planet resources is urgently necessary. The first step to promote a more sustainable living and, therefore, a more balanced planet, is to educate present and future generations to prevent the same previous mistakes. EUSTEPs project proposes a groundbreaking approach on Higher Education Institutions, teaching sustainability via a learning-by-doing approach realized through the Ecological Footprint.
Developed in the initial phase of the project’s implementation, the students’ module was developed and tested with 52 students across four European universities, and fine-tuned on the basis of both students’ evaluations and educators’ own teaching experience. The present work features the results of this application, along with the description of the unit delivered to students.
The module’s feedback is overall satisfying as students were receptive and collaborative and helped enhancing the final outcomes. The Ecological Footprint is one of the most appraised tools used and the interactive materials were very successful, although it is suggested to expand its use. Educators were pleased as well, even though there is room to improve some aspects, like the increasement of the incorporation of appealing materials and reducing the amount of homework proposed throughout the module. One should bear in mind that the limitations created by the COVID-19 outbreak, constrained the originally planned implementation of the module. Nonetheless, as the results demonstrate, the educators’ team successfully managed to adapt the content to the new situation.
On the basis of the feedback received, the module has been already improved and is now ready for its use in the Fall 2020 semester, with a plan to ease adoption in a variety of courses, reaching more students from different discipline areas. Future research may feature a larger number of learners, hence provide more robust and representative results on how much impact this project has on tomorrow’s leaders. But HEIs are not only formed by students: professors, administrative and management staff influence every day the overall performance of HEIs’ campuses. Going forward, the project aims to ease a transition towards more sustainable campus by training and engaging with the wider university community.

More training, specialization and awareness are indispensable tools to thrive. Present teaching methods implemented within HEIs still need to build bridges regarding subjects of global interest, such as sustainability, as well as to foster new pedagogies and competences for a transformative learning. EUSTEPs emerges as a pioneer project for European universities, aiming for a more sustainable future and more conscious generation of citizens.

Aknowledgement

This study was supported by ERASMUS+ Project ***"EUSTEPs: Enhancing Universities' Sustainability Teaching and Practices through Ecological Footprint"***, KA 203, Strategic Partnership in Higher Education 2019-2022, Agreement No. 2019-1-EL01-KA203-062941.

References

Assembly, United. "A/RES/57/254 - United Nations Decade Of Education For Sustainable Development - UN Documents: Gathering A Body Of Global Agreements". Un-Documents.Net, 2002. http://www.un-documents.net/a57r254.htm.

Ávila, Lucas Veiga, Walter Leal Filho, Luciana Brandli, Colin J. Macgregor, Petra Molthan-Hill, Pinar Gökçin Özuyar, and Rodrigo Martins Moreira. "Barriers to Innovation and Sustainability at Universities around the World." Journal of Cleaner Production, 2017. https://doi.org/10.1016/j.jclepro.2017.07.025.

Barnosky, Anthony D., Paul R. Ehrlich, and Elizabeth A. Hadly. "Avoiding Collapse: Grand Challenges for Science and Society to Solve by 2050." In Elementa, 2016. https://doi.org/10.12952/journal.elementa.000094.

Brandli, Luciana Londero, Walter Leal Filho, Marcos Antonio Leite Frandoloso, Eduardo Pavan Korf, and Denise Daris. "The Environmental Sustainability of Brazilian Universities: Barriers and Pre-Conditions," 2015. https://doi.org/10.1007/978-3-319-09474-8_5.

Ceulemans, K., and M. De Prins. "Teacher's Manual and Method for SD Integration in Curricula." Journal of Cleaner Production, 2010. https://doi.org/10.1016/j.jclepro.2009.09.014.

Collins, Andrea, Alessandro Galli, Tara Hipwood, and Adeline Murthy. "Living within a One Planet Reality: The Contribution of Personal Footprint Calculators." Environmental Research Letters, 2020. https://doi.org/10.1088/1748-9326/ab5f96.

Collins, Andrea, Alessandro Galli, Nicoletta Patrizi, and Federico Maria Pulselli. "Learning and Teaching Sustainability: The Contribution of Ecological Footprint Calculators." Journal of Cleaner Production, 2018. https://doi.org/10.1016/j.jclepro.2017.11.024.

Cortese, Anthony D. "The Critical Role of Higher Education in Creating a Sustainable Future." Planning for Higher Education, 2003.

Décamps, Aurélien, Guillaume Barbat, Jean Christophe Carteron, Victoria Hands, and Carole Parkes. "Sulitest: A Collaborative Initiative to Support and Assess Sustainability Literacy in Higher Education." International Journal of Management Education, 2017. https://doi.org/10.1016/j.ijme.2017.02.006.

Disterheft, Antje, Sandra Caeiro, Ulisses M. Azeiteiro, and Walter Leal Filho. "Sustainable Universities - A Study of Critical Success Factors for Participatory Approaches." In Journal of Cleaner Production, 2015. https://doi.org/10.1016/j.jclepro.2014.01.030.

Ferrer-Balas, D., J. Adachi, S. Banas, C. I. Davidson, A. Hoshikoshi, A. Mishra, Y. Motodoa, M. Onga, and M. Ostwald. "An International Comparative Analysis of Sustainability Transformation across Seven Universities." International Journal of Sustainability in Higher Education, 2008. https://doi.org/10.1108/14676370810885907.

Ghahramani, Abolfazl. "Factors That Influence the Maintenance and Improvement of OHSAS 18001 in Adopting Companies: A Qualitative Study." Journal of Cleaner Production, 2016. https://doi.org/10.1016/j.jclepro.2016.07.087.

Habidin, Nurul Fadly, Anis Fadzlin Mohd Zubir, Nursyazwani Mohd Fuzi, Nor Azrin Md Latip, and Mohamed Nor Azhari Azman. "Sustainable Manufacturing Practices in Malaysian Automotive Industry: Confirmatory Factor Analysis." Journal of Global Entrepreneurship Research, 2015. https://doi.org/10.1186/s40497-015-0033-8.

Handl, Günther. “Declaration of The United Nations Conference on The Human Environment (Stockholm Declaration), 1972 and The Rio Declaration on Environment and Development, 1992.” United Nations Audiovisual Library of International Law, 2012.

Janerio, Rio De. “United Nations Conference on Environment & Development Rio de Janerio , Brazil , 3 to 14 June 1992.” Reproduction, 1992. https://doi.org/10.1007/s11671-008-9208-3.

Janerio, Rio De. “United Nations Conference on Environment & Development Rio de Janerio , Brazil , 3 to 14 June 1992.” Reproduction, 1992. https://doi.org/10.1007/s11671-008-9208-3.

Kanyimba, Alex, Miriam Hamunyela, and Choshi D. Kasanda. “Barriers to the Implementation of Education for Sustainable Development in Namibia’s Higher Education Institutions.” Creative Education, 2014. https://doi.org/10.4236/ce.2014.54033.

Kapitulčinová, Dana, Alan AtKisson, Joanne Perdue, and Markus Will. “Towards Integrated Sustainability in Higher Education – Mapping the Use of the Accelerator Toolset in All Dimensions of University Practice.” Journal of Cleaner Production, 2018. https://doi.org/10.1016/j.jclepro.2017.05.050.

Kaufmann, Nadine, Christoph Sanders, and Julian Wortmann. “Building New Foundations: The Future of Education from a Degrowth Perspective.” Sustainability Science, 2019. https://doi.org/10.1007/s11625-019-00699-4.

Lambrechts, Wim, Ingrid Mulà, Kim Ceulemans, Ingrid Molderez, and Veerle Gaeremynck. “The Integration of Competences for Sustainable Development in Higher Education: An Analysis of Bachelor Programs in Management.” In Journal of Cleaner Production, 2013. https://doi.org/10.1016/j.jclepro.2011.12.034.

Leal Filho, W., E. Pallant, A. Enete, B. Richter, and L. L. Brandli. “Planning and Implementing Sustainability in Higher Education Institutions: An Overview of the Difficulties and Potentials.” International Journal of Sustainable Development and World Ecology, 2018. https://doi.org/10.1080/13504509.2018.1461707.

Leal Filho, W., S. Raath, B. Lazzarini, V. R. Vargas, L. de Souza, R. Anholon, O. L.G. Quelhas, R. Haddad, M. Klavins, and V. L. Orlovic. “The Role of Transformation in Learning and Education for Sustainability.” Journal of Cleaner Production, 2018. https://doi.org/10.1016/j.jclepro.2018.07.017.

Leal Filho, Walter, and Eric Pallant. “Dimensions of Sustainability in Higher Education.” In Encyclopedia of Sustainability in Higher Education, 2019. https://doi.org/10.1007/978-3-319-63951-2_524-1.

Leal Filho, Walter, Chris Shiel, Arminda Paço, Mark Mifsud, Lucas Veiga Ávila, Luciana Londero Brandli, Petra Molthan-Hill, et al. “Sustainable Development Goals and Sustainability Teaching at Universities: Falling behind or Getting Ahead of the Pack?” Journal of Cleaner Production, 2019. https://doi.org/10.1016/j.jclepro.2019.05.309.

Leal Filho, Walter, Yen Chun Jim Wu, Luciana Londero Brandli, Lucas Veiga Avila, Ulisses Miranda Azeiteiro, Sandra Caeiro, and Lucia Rejane da Rosa Gama Madruga. “Identifying and Overcoming Obstacles to the Implementation of Sustainable Development at Universities.” Journal of Integrative Environmental Sciences, 2017. https://doi.org/10.1080/1943815X.2017.1362007.

Lidstone, Lauri, Tarah Wright, and Kate Sherren. “Canadian STARS-Rated Campus Sustainability Plans: Priorities, Plan Creation and Design.” Sustainability (Switzerland), 2015. https://doi.org/10.3390/su7010725.

Lozano, Rodrigo. “Incorporation and Institutionalization of SD into Universities: Breaking through Barriers to Change.” Journal of Cleaner Production, 2006. https://doi.org/10.1016/j.jclepro.2005.12.010.

Lozano, Rodrigo, Maria Barreiro-Gen, Francisco J. Lozano, and Kaisu Sammalisto. “Teaching Sustainability in European Higher Education Institutions: Assessing the Connections between Competences and Pedagogical Approaches.” Sustainability (Switzerland), 2019. https://doi.org/10.3390/su11061602.

Lozano, Rodrigo, Kim Ceulemans, Mar Alonso-Almeida, Donald Huisingh, Francisco J. Lozano, Tom Waas, Wim Lambrechts, Rebeka Lukman, and Jean Hugé. “A Review of

Commitment and Implementation of Sustainable Development in Higher Education: Results from a Worldwide Survey." Journal of Cleaner Production, 2015. https://doi.org/10.1016/j.jclepro.2014.09.048.
Lozano, Rodrigo, Francisco J. Lozano, Karel Mulder, Donald Huisingh, and Tom Waas. "Advancing Higher Education for Sustainable Development: International Insights and Critical Reflections." In Journal of Cleaner Production, 2013. https://doi.org/10.1016/j.jclepro.2013.03.034.
Mendoza, Joan Manuel F., Alejandro Gallego-Schmid, and Adisa Azapagic. "A Methodological Framework for the Implementation of Circular Economy Thinking in Higher Education Institutions: Towards Sustainable Campus Management." Journal of Cleaner Production, 2019. https://doi.org/10.1016/j.jclepro.2019.04.060.
Moore, Janet. "Barriers and Pathways to Creating Sustainability Education Programs: Policy, Rhetoric and Reality." Environmental Education Research, 2005. https://doi.org/10.1080/13504620500169692.
Olsson, Daniel, Niklas Gericke, Wanda Sass, and Jelle Boeve-de Pauw. "Self-Perceived Action Competence for Sustainability: The Theoretical Grounding and Empirical Validation of a Novel Research Instrument." Environmental Education Research, 2020. https://doi.org/10.1080/13504622.2020.1736991.
Orr, David W. "The Effective Shape of Our Future." Conservation Biology, 1994. https://doi.org/10.1046/j.1523-1739.1994.08030622.x.
Ramos, Tomás B., Sandra Caeiro, Bart Van Hoof, Rodrigo Lozano, Donald Huisingh, and Kim Ceulemans. "Experiences from the Implementation of Sustainable Development in Higher Education Institutions: Environmental Management for Sustainable Universities." In Journal of Cleaner Production, 2015. https://doi.org/10.1016/j.jclepro.2015.05.110.
Rieckmann, Marco. "Future-Oriented Higher Education: Which Key Competencies Should Be Fostered through University Teaching and Learning?" Futures, 2012. https://doi.org/10.1016/j.futures.2011.09.005.
Roorda, Niko, and Pim Martens. "Assessment and Certification of Higher Education for Sustainable Development." Sustainability (United States), 2008. https://doi.org/10.1089/SUS.2008.9990.
Sipos, Yona, Bryce Battisti, and Kurt Grimm. "Achieving Transformative Sustainability Learning: Engaging Head, Hands and Heart." International Journal of Sustainability in Higher Education, 2008. https://doi.org/10.1108/14676370810842193.
Spangenberg, Joachim H. "Institutional Sustainability Indicators: An Analysis of the Institutions in Agenda 21 and a Draft Set of Indicators for Monitoring Their Effectivity." Sustainable Development, 2002. https://doi.org/10.1002/sd.184.
Steffen, Will, Johan Rockström, Katherine Richardson, Timothy M. Lenton, Carl Folke, Diana Liverman, Colin P. Summerhayes, et al. "Trajectories of the Earth System in the Anthropocene." Proceedings of the National Academy of Sciences of the United States of America, 2018. https://doi.org/10.1073/pnas.1810141115.
Stough, T., K. Ceulemans, W. Lambrechts, and V. Cappuyns. "Assessing Sustainability in Higher Education Curricula: A Critical Reflection on Validity Issues." Journal of Cleaner Production, 2018. https://doi.org/10.1016/j.jclepro.2017.02.017.
Trencher, Gregory, Xuemei Bai, James Evans, Kes McCormick, and Masaru Yarime. "University Partnerships for Co-Designing and Co-Producing Urban Sustainability." Global Environmental Change, 2014. https://doi.org/10.1016/j.gloenvcha.2014.06.009.
UE4SD. "Leading Practice Publication: Professional Development of University Educators on Education for Sustainable Development in European Countries," no. November (2015): 136. https://doi.org/10.13140/RG.2.1.1303.6888.
UNESCO. "UNESCO Roadmap for Implementing the Global Action Programme on Education for Sustainable Development." Unesco, 2014.
UNESCO, Carolee Buckler, and Heather Creech. "Shaping the Future We Want." United Nations Educational, Scientific and Cultural Organization, 2014. https://doi.org/10.5363/tits.11.4_46.

United Nations. “The Future We Want: Outcome Document of the United Nations Conference on Sustainable Development.” Rio+20 United Nations Conference on Sustainable Development, 2012. https://doi.org/10.1126/science.202.4366.409.

United Nations. General Assembly. “Transforming Our World: The 2030 Agenda for Sustainable Development. Resolution Adopted by the General Assembly on 25 September 2015.” Governing Through Goals: Sustainable Development Goals as Governance Innovation, 2015. https://doi.org/10.7551/mitpress/9780262035620.003.0011.

Vare, Paul, Grete Arro, Andre de Hamer, Giovanna Del Gobbo, Gerben de Vries, Francesca Farioli, Chrysanthi Kadji-Beltran, et al. “Devising a Competence-Based Training Program for Educators of Sustainable Development: Lessons Learned.” Sustainability (Switzerland), 2019. https://doi.org/10.3390/su11071890.

Venetoulis, J. “Assessing the ecological impact of a university: The ecological footprint for the University of Redlands”. International Journal of Sustainability in Higher Education, 2001. https://doi.org/10.1108/14676370110388381.

WCED. Our Common Future (The Brundtland Report). Medicine and War, 1987. https://doi.org/10.1080/07488008808408783.

Wiek, Arnim, Lauren Withycombe, and Charles L. Redman. “Key Competencies in Sustainability: A Reference Framework for Academic Program Development.” Sustainability Science, 2011. https://doi.org/10.1007/s11625-011-0132-6.

Wilson, Maxwell C., and Jianguo Wu. “The Problems of Weak Sustainability and Associated Indicators.” International Journal of Sustainable Development and World Ecology, 2017. https://doi.org/10.1080/13504509.2015.1136360.