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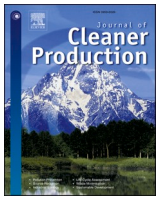

# Transformative organisational learning for sustainability in higher education: A literature review and an international multi-case study

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ABSTRACT

Higher Education Institutions (HEIs) play a critical role in the United Nations (UN) 2030 Agenda for Sustainable Development (SD). However, this contribution requires a significant transformation in HEIs, encompassing all their activities. In this regard, the main objective of this study is to understand the learning processes, paths, and practices that can contribute to this transformation, from the transformative and organisational learning perspectives. Specifically, this study seeks to investigate: (1) what the literature states on transformative and organisational learning for sustainability in higher education; (2) how top sustainable HEIs are embedding sustainability into their activities; and (3) the role of transformative and organisational learning for sustainability in higher education. For that, we combined a bibliometric review of relevant literature on the topic with fifteen case studies from thirteen cities of six different countries, conducted through in-loco observation techniques, in-depth interviews, and document analysis. The findings of this study contribute to the literature by mapping current trends on the topic and, from the experience of the most sustainable HEIs, it provides practical insights and frameworks which can inspire and guide other HEIs on their journey towards sustainability.

## 1. Introduction

As pioneers in education, research, innovation, and social change, higher education institutions (HEIs) can play a key role in advancing sustainable development (SD). In fact, by embracing sustainability initiatives, HEIs can have far-reaching impacts on society at large (Giesenbauer and Müller-Christ, 2020). Therefore, many HEIs around the world have increasingly engaged in global initiatives and expressed their commitment to SD through various declarations and policies (Ferguson and Roofe, 2020; Findler et al., 2019; La De La Poza et al., 2021; Mazon et al., 2020; Osorio et al., 2022; Ruiz-Mallén and Heras, 2020; Vallez et al., 2022).

Nevertheless, a transformation towards sustainability involves new concepts and requirements, which, in turn, depend on a continuous learning process to rethink existing practices and worldviews (König, 2015; Cebrián et al., 2013). Moreover, the institution should see itself as a place of learning and experience for SD and, therefore, focus all its processes on the sustainability principles in order to achieve the 'whole-institution' perspective, that is, education, research, outreach, facilities, and governance (Kapitulčinová et al., 2018; Lozano, 2018). By focusing on sustainability integration into all dimensions of institutional practice, HEIs educate students and staff through a holistic experience that supports more effective and integrated learning (Kapitulčinová et al., 2018). However, a whole-institution approach has proven to be a major governance challenge for most HEIs (Niedlich et al., 2020).

In this regard, the literature has claimed that organisational changes are required in HEIs to face sustainability challenges (Levesque and Wake, 2021; Rieg et al., 2021). Kapitulčinová et al. (2018, p. 4370) state that there is a process of integrating sustainability into an HEI, also called a 'sustainability maturation curve', which involves a 'transformational change' from a 'business-as-usual university' to a 'sustainable university', where sustainability is fully integrated into all the different dimensions. This process ranges from an initiation stage to a transformation or institutionalisation of sustainability into an institution.

Furthermore, on their path to sustainability, Gomera et al. (2020) emphasise that HEIs should consider both individual and organisational dimensions. According to Argyris and Schön (1978), the capacity of organisations to learn depends on the capacity of their individuals to learn. This is the reason why it is necessary to bring the two perspectives

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- individual and organisational - together.

However, by analysing the existing literature, a critical gap is evident in the connections between organisational culture and sustainability governance within the context of higher education (Leal Filho et al., 2021b; Niedlich et al., 2020). Moreover, it is worth noting that empirical research on HEIs as learning organisations has been relatively scarce, as highlighted by Voolaid and Ehrlich (2017). Therefore, by placing transformative and organisational learning at the forefront, this study aims to provide a comprehensive understanding of how these aspects influence HEIs' commitment to sustainability. Thus, this research seeks to bridge this empirical gap and contribute to the existing body of knowledge by providing in-depth insights into the processes and outcomes of HEIs' journey towards sustainable learning organisations.

In this regard, the main objective of this study is to understand the learning processes, paths, and practices that can contribute to HEIs' transformation towards sustainability, from the transformative and organisational learning perspectives. More specifically, the study has the following research objectives: (1) To explore what the literature states on transformative and organisational learning for sustainability in higher education; (2) To investigate how top sustainable HEIs are embedding sustainability into their activities; (3) To understand the role of transformative and organisational learning for sustainability in higher education.

Based on the research objectives outlined above, this study is carried out through a mix of methods. The first part is a bibliometric review of transformative and organisational learning for sustainability in higher education. The second part consists of multi-case studies on top sustainable HEIs through in-loco observation techniques and in-depth interviews. The selection of the HEIs as case studies was made based on the UI GreenMetric World University Rankings.[1] Since these institutions go through a rigid evaluation, scoring, and ranking process, it is pertinent to analyse their learning journey towards sustainability and investigate the role of transformative and organisational learning in their activities' performance.

The findings of this study have both theoretical and practical contributions by offering a bibliometric mapping of the literature on the topic and providing insights into sustainable organisational practices in higher education. To the best of our knowledge, this is the first international empirical multi-case study on the topic. According to Rübenich et al. (2019), the benchmarking process becomes fundamental for HEIs in order to eliminate unnecessary business activities and focus on their priorities, allowing them to achieve better results. Essentially, the contribution of this study ranges from encouraging a holistic approach to sustainability in HEIs to offering practical insights and frameworks derived from top sustainable institutions. It contributes to the broader discourse on sustainability in higher education and can guide institutions on their journey towards sustainability, thus advancing global efforts to achieve the United Nations (UN) 2030 Agenda for SD.

Besides this introduction, the paper is organised as follows. Section 2 presents concepts related to transformative and organisational learning for sustainability. Section 3 describes the methodological procedures adopted in the study. Section 4 presents the results and discussions. Finally, section 5 concludes the study.

## 2. Transformative and organisational learning for sustainability in higher education

This study offers a unique perspective by linking the concept of sustainability with theories of organisational and transformative learning in the context of higher education, based on literature analysis and multiple case studies. Therefore, this theoretical section is divided into three subsections: (1) Sustainability in higher education; (2) Transformative learning for sustainability; and (3) Organisational learning for sustainability.

The theoretical foundation of this study is supported by the authors Peter Senge, regarding the Organisational Learning Theory, and Jack Mezirow, regarding the Transformative Learning Theory. These authors and theories were selected due to their comprehensive and interdisciplinary nature, as well as their empirical support. Their relevance to this study lies in their ability to provide a holistic view of organisational learning, encompassing both collective and individual dimensions and facilitating a deeper understanding of the complex dynamics of learning within organisations. Moreover, both theories are known for their versatility and applicability across different types of organisations and knowledge fields and have already been used by similar studies on the sustainability education topic (e.g., Boström et al., 2018; Cebrián et al., 2013; Jamali, 2006; Sterling, 2011; Trevisan et al., 2023a).

### 2.1. Sustainability in higher education

During the Earth Summit, in 1987, SD was discussed by the World Commission on Environment and Development (WCED), chaired by Gro Harlem Brundtland. Brundtland's seminal report, titled "Our Common Future," offered a defining perspective on SD, asserting that it involves "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 37). The concept of sustainability has since evolved to address a diverse array of challenges, spanning sustainable cities, livelihoods, agriculture, fishing, and the establishment of common corporate standards in initiatives like the UN Global Compact and the World Business Council for SD (Kates et al., 2005).

In essence, sustainability entails transforming our ways of living to optimise the likelihood that environmental and social conditions will continuously support human security, well-being, and health (McMichael et al., 2003). The UN, recognising the imperative of SD, endorsed the 2030 Agenda for SD in 2015, building on the foundation laid by the Millennium Development Goals (MDGs). This comprehensive framework represents a more holistic approach to guiding society towards SD (Prieto-Jiménez et al., 2021). Comprising 17 Sustainable Development Goals (SDGs) to be achieved by 2030, these goals are further delineated into 169 targets, addressing a complex interplay of social, economic, and environmental challenges (Blasco et al., 2021). In this context, HEIs emerge as strategic stakeholders in the implementation of these SDGs, with their potential impact extending across campus operations, outreach, governance, research, and teaching (Vallez et al., 2022).

Sustainability in higher education is a complex and multifaceted concept that involves not only environmental considerations but also ethical and societal dimensions. It requires a holistic approach that integrates various aspects of sustainability, including environmental impact, social responsibility, and long-term effectiveness. It encompasses preparing future professionals to be responsible citizens in a more sustainable society (Leal Filho et al., 2015), formulating strategies to create awareness among students (Manolis and Manoli, 2021; Wang et al., 2022), assessing the global operational footprint of HEIs and emphasising sustainability in their strategic orientation (Motta et al., 2017), contributing to the creation, promotion, and implementation of sustainable paradigms in all HEIs' activities (Terlević et al., 2015), among other activities.

For instance, HEIs can encourage partnerships and collaboration both within the university community and with external stakeholders towards sustainability (Blasco et al., 2021; Leal Filho et al., 2021a; Spee, 2020). HEIs can form valuable partnerships with businesses, government agencies, and non-profit organisations, creating a dynamic ecosystem where knowledge transfer and joint initiatives are established. These collaborations can lead to research funding, internships, employment opportunities for students, and practical solutions for sustainability challenges (Leal Filho et al., 2023). Moreover, a strong commitment to sustainability enhances the reputation of HEIs. It attracts environmentally and socially conscious students, teaching staff,

[1] Available at https://greenmetric.ui.ac.id/.

researchers, and staff, while also appealing to stakeholders and potential donors who are increasingly prioritising sustainability in their decisions (Fuchs et al., 2020). Sustainability initiatives can also lead to substantial cost savings through energy efficiency measures and improved resource management (e.g., Ajiboye et al., 2022; Hashim et al., 2022).

Nevertheless, for HEIs to contribute to sustainability, a substantial transformation encompassing all their activities is essential. However, the absence of clear learning processes, paths, and practices poses a challenge that can hinder HEIs from effectively contributing to this transformation, both from transformative and organisational learning perspectives. Therefore, this study aims to fill this gap by bringing together insights into the processes and outcomes of HEIs' journey towards sustainability in light of the transformative and organisational learning theories.

### 2.2. Transformative learning for sustainability

Transformative education is necessary for preparing individuals to face complex sustainability challenges rather than transmissive ones (Baumber, 2022; Sandri and Holdsworth, 2022; Sewchurran et al., 2022; Sterling, 2011). Consequently, Education for Sustainable Development (ESD) has embraced transformative learning to overcome the conventional approach and support learning that leads to transformation and adopts a paradigm towards sustainability (Balsiger et al., 2017; Sterling et al., 2018). In this sense, the Transformative Learning Theory has been increasingly recognised in the sustainability academic field (Boström et al., 2018).

This theory evolved from the concept of perspective transformation into an established learning theory based on concepts from constructivism, humanistic, and critical social theory (Tisdell, 2012). Mezirow (1981) is recognised as the initial formulator of this theory and was influenced by critical authors such as Paulo Freire and Jurgen Habermas. Freire (1996) stated that teaching is not about transferring knowledge but creating possibilities for its production or construction. Freire distinguished two approaches to learning: 'banking' education, which is based on a specialised model of knowledge transmission centred on the teacher, in which students are understood as empty vessels to be filled by contents of the teacher's exclusive domain; and problematising education, in which the student and teacher work collaboratively, exploring reality, having a dialogue as a key process for social praxis committed to transformative action (Menezes and Santiago, 2014).

According to Mezirow (1981), transformative learning essentially refers to a change in an individual's perception and construction of meaning in a learning experience, such that the actor questions or reformulates his assumptions or habits of thought. For Sterling (2011), it is the learning that reaches our deepest levels of knowledge and meaning and, in so doing, influences our most immediate and concrete levels of knowledge, perception, and action. Taylor (2007) states that it is associated with direct, personally engaging, and thought-provoking learning experiences. Mezirow (2003, p. 58) defines it as:

> […] learning that transforms problematic frames of reference—sets of fixed assumptions and expectations (habits of mind, meaning perspectives, mindsets)—to make them more inclusive, discriminating, open, reflective, and emotionally able to change.

### 2.3. Organisational learning for sustainability

Organisational learning for sustainability is related to the processes of moving the organisation in the desired sustainability direction (Jamali, 2006). This organisational transformation involves reshaping the culture and design elements of the organisation (Henderson, 2002). HEIs, as organisations, often have difficulty learning because they do not have the necessary perspective or external information to help drive new thinking (Bensimon, 2005). In this regard, HEIs can benefit from organisational learning concepts, as they can be used to analyse the external environment, assess organisational capabilities, and develop strategies to increase institutional effectiveness (Dee and Leisyte, 2017).

The literature on organisational change proposes that organisational culture and organisational capabilities are critical for successful change implementation (Aboobaker and Ka, 2021). Furthermore, towards a more holistic and effective approach to sustainability change in organisations, both theories of individual and organisational learning can contribute (Cebrián et al., 2013; Henderson, 2002). Actually, individual learning is stated as a prerequisite for organisational learning (Kim, 1998). Individual learning does not guarantee organisational learning, but without it, no organisational learning occurs, since an organisation cannot create knowledge on its own without individuals (Sita Nirmala Kumaraswamy and Chitale, 2012).

The concept of a learning organisation was introduced by Senge (1990). In his book, he put together five disciplines for a learning organisation: mental models, personal mastery, shared vision, team learning, and systems thinking. Mental models refer to paradigms that interfere with the attitudes of individuals, which are often conflicting and do not allow certain administrative practices. In organisational learning, these models must be challenged and even unlearned if necessary. Personal mastery is about seeing reality objectively, leading people to focus their energies and achieve the results that are most important to them. Regarding the shared vision, there must be a vision that encourages genuine commitment and involvement rather than mere acceptance. Team learning is vital within the organisational environment. If teams cannot learn, the organisation will not either. Finally, the fifth discipline, systems thinking, integrates all the others and helps to see things as part of a whole, not as isolated pieces, but showing that the sum of the parts can exceed the whole (Senge, 2006). Moreover, without a systemic orientation, there is no motivation to look at how the disciplines interrelate, and this can have a great impact on systematic errors in diverse problems of judgment and choice, which highlights the role of concepts such as dynamic decision-making (Senge and Sterman, 1992). According to Senge (2006, p. 12):

> At the heart of a learning organisation is a shift of mind—from seeing ourselves as separated from the world to connected to the world, from seeing problems as caused by someone or something "out there" to seeing how our own actions create the problems we experience. A learning organisation is a place where people are continually discovering how they create their reality. And how they can change it.

In this regard, the literature has emphasised that the integration of systems thinking into education is a critical factor in advancing sustainability education. Systems thinking offers a holistic approach to understanding complex, interconnected systems, which is fundamental to addressing sustainability challenges effectively. By embracing systems thinking, educators can equip learners with dynamic thinking tools to comprehend and evaluate sustainability concepts, fostering a deeper and more interconnected understanding of the complex challenges we face (Dorani et al., 2015; Saxton et al., 2014).

Furthermore, policymakers are increasingly urging educational institutions to transform their organisational learning processes. However, empirical research suggests that campuses must not only embrace this call for change but also establish the necessary infrastructures and a supportive culture to facilitate effective learning (Kezar and Holcombe, 2020; Rübenich et al., 2019). This underscores the intriguing prospect of managing campuses through a systems-thinking lens, embracing transformative organisational learning to adapt and thrive in the evolving educational landscape. Ultimately, the integration of systems thinking and transformative organisational learning can empower institutions to better address sustainability challenges and equip students with the skills and knowledge needed for a more sustainable future.

### 2.4. Intersection of sustainability, transformative learning and organisational learning

Despite the recognition of the interconnection of the concepts presented previously, an analysis of the existing literature reveals a critical gap in the linkages between organisational and transformative learning for sustainability within the higher education context. To address this gap, this study provides a holistic understanding of how these dimensions collectively shape HEIs' commitment to sustainability, with a particular focus on offering in-depth insights into the intricate processes and outcomes of HEIs' journey towards becoming sustainable learning organisations. In doing so, the research aims to present valuable perspectives to the existing knowledge base on sustainable practices in higher education. Thus, this study addresses the following research questions.

**RQ1**: What does the literature state on transformative and organisational learning for sustainability in higher education?
**RQ2**: How are top sustainable HEIs embedding sustainability into their activities?
**RQ3**: What is the role of transformative and organisational learning for sustainability in higher education?

## 3. Methods

This study includes a mixed methods approach that involves both quantitative bibliometric analysis and qualitative case studies in order to: (1) explore what the literature states on transformative and organisational learning for sustainability in higher education; (2) investigate how top sustainable HEIs are embedding sustainability into their activities; and (3) analyse the role of transformative and organisational learning for sustainability in higher education.

The process followed to carry out this research consisted of two approaches: (1) a bibliometric analysis based on keywords co-occurrence technique; and (2) case studies analysis with fifteen top sustainable universities. The integration of both approaches allows for a robust research framework that not only captures the academic landscape but also supplements it with contextualised insights. Relying solely on a literature review, while informative, often falls short of capturing the practical and nuanced aspects of real-world implementation, especially in a complex and multifaceted field such as sustainability. Therefore, the mixed approach adopted in this study enhances the research by bridging the gap between theory and practice, providing a more comprehensive understanding of the processes and outcomes involved in HEIs' journey towards sustainability.

Fig. 1 summarises the methodological procedures adopted in this study, which will be detailed in the following subsections.

### 3.1. Bibliometric analysis

The first approach used in this study consisted of bibliometric analysis. This technique can reduce the complexity involved in searching for a specific research topic and demonstrate the dynamics and trajectory of a specific research domain (Du et al., 2021).

#### 3.1.1. Bibliometric data collection

Data collection for the bibliometric analysis was carried out using the Scopus database. It was performed twice. Firstly, it was conducted in June 2022 to enable the researchers to explore the topic and prepare the interview protocol for the case studies. Afterwards, a new data collection was performed on May 15, 2023 in order to update the findings and include more recent literature on the topic. The results are presented in the following section. The keywords used for data collection covered the research topics: transformative learning, organisational learning, higher education, and sustainability. Therefore, the configured search string was the following:

(TITLE ("transform* learn*" OR "organis* learn*" OR "organiz* learn*" OR "learn* organis*" OR "learn* organiz*") AND TITLE ("higher education" OR "higher education institution*" OR "HEI*" OR "universit*") AND TITLE ("sustain*" OR "sustainable develop*" OR "SDG*" OR ″2030 agenda" OR "sustainable development goal*" OR "global goal*")).

By searching for the mentioned search string, a total of 400 documents were found in the Scopus database, covering all areas and all periods. Then, the search was limited to the English language and the search resulted in 390 documents. Then, it was limited to articles, and as a result, 261 documents were gathered.

#### 3.1.2. Bibliometric data analysis

The bibliometric data analysis was performed with the support of the VOSviewer software, a commonly used software for bibliometric analysis (Van Eck and Waltman, 2021). The documents gathered in the Scopus database were uploaded to the VOSviewer software, and an analysis of the keywords' co-occurrence was conducted in order to identify the popular keywords on the topic. It refers to the proximity relationship of two or more terms in a text unit, allowing for the detection of the main current and future research topics (Arita, 2017). Network analysis, particularly with the support of VOSviewer software, is a powerful methodology that can uncover novel insights, identify emerging trends, and challenge established paradigms in the literature (Van Eck and Waltman, 2021). The analysis returned four main clusters that are described in detail in Section 4.

### 3.2. Case studies

The second approach of this study consisted of case studies on fifteen top sustainable HEIs from thirteen cities in six European countries: Germany, Denmark, Italy, England, Ireland, and the Netherlands (Fig. 2). Case study research can guide the production of new theoretical insights arising from contextualised findings of specific cases (Eisenhardt and Graebner, 2007). Moreover, research based on different case studies can cover a variety of data sources and a range of different methodologies, being an effective technique for compiling a significant amount of data (Miles and Huberman, 1994; Yin, 2009).

The selection of the HEIs as case studies was made based on the UI GreenMetric World University Rankings.[2] The UI GreenMetric measures the performance of HEIs around the world through 39 indicators and six criteria: setting and infrastructure, energy and climate change, waste, water, transportation, and education and research (UI GreenMetric, 2023). This ranking was chosen over existing ones (e.g., Times Higher Education Impact Rankings, QS World University Rankings, Sustainability, People and Planet University League, STARTS) due to its comprehensiveness and use in other studies (Atici et al., 2021; Parvez and Agrawal, 2019; Puertas and Marti, 2019; Sonetti et al., 2016).

#### 3.2.1. Case studies data collection

Case studies data collection was scheduled by contacting the sustainability department/green office of the thirty most sustainable universities ranked by the UI GreenMetric ranking. Due to the managers' agenda and replies, it was possible to schedule visits and interviews with sixteen of them (one HEI was considered as a pre-test and fifteen HEIs were selected as the final sample). Then, data collection was performed through observation techniques (in-loco visits to the HEIs campuses), face-to-face interviews with different actors at the fifteen HEIs, but especially with sustainability managers, and document analysis on the HEIs' sustainability reports. The triangulation technique - a combination of multiple sources of data on the same phenomenon - was used to gather data and enhance the study's validity and reliability (Ridder, 2017).

The interview format was agreed upon with each HEI, according to

[2] Available at https://greenmetric.ui.ac.id/.

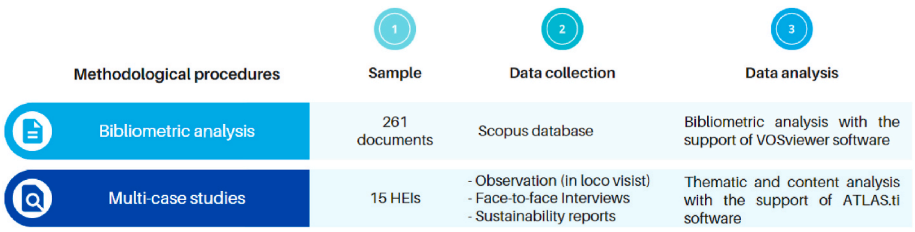


**Fig. 1.** Methodological procedures design.
Source: prepared by the authors based on the study's data.

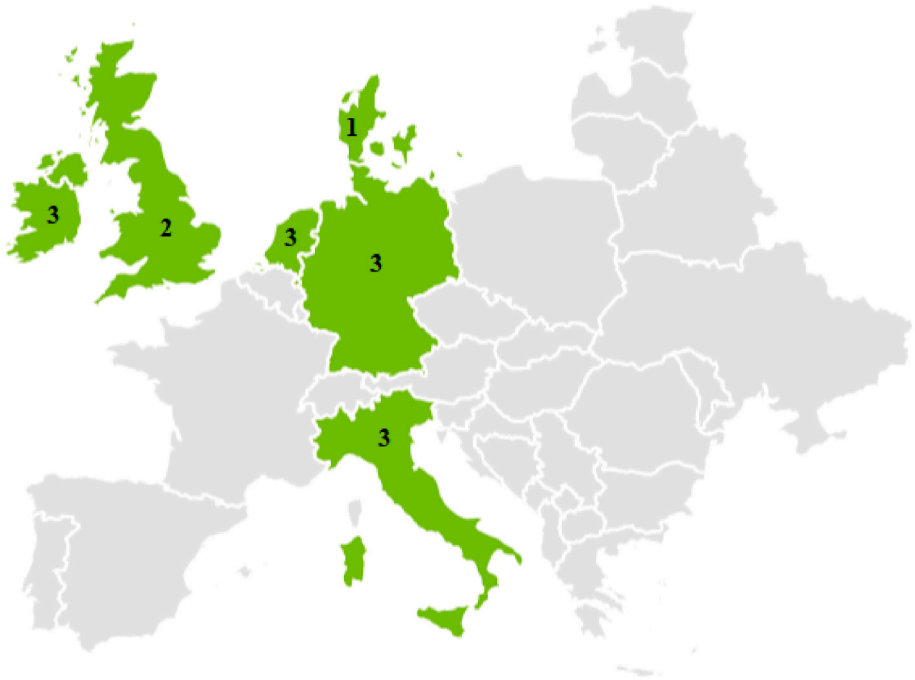


**Fig. 2.** Number of HEIs as case studies by country.
Source: prepared by the authors based on the study's data.

the specificity of each institution. Therefore, some interviews were carried out as a focus group, with the participation of ten academic and administrative staff, and others as individual interviews with sustainability managers. All persons were interviewed once. To ensure the collection of substantial expert knowledge on the sustainability processes of HEIs, the selection criteria encompassed the participants' availability, willingness to participate, as well as their familiarity and direct involvement in their institution's sustainability process. In total, 44 people were interviewed. This exceeds the number of interviews in which data saturation is commonly found in studies of Management, which is twelve in-depth interviews (Boddy, 2016). The meetings occurred between December 2022 and May 2023. They ranged from 35 min to 1 h and 50 min and, in total, the interviews took 15 h and 10 min.

The interview process involved the utilisation of an interview protocol and a form (Appendix A), which were based on the literature and bibliometric review conducted in the previous research stage, mainly based on the authors Peter Senge (Organisational Learning Theory) and Jack Mezirow (Transformative Learning Theory). Therefore, the interview protocol was composed of ten questions that addressed the process of a sustainability structure creation at the institution, the sustainability activities carried out in the different universities' dimensions (curricula, research, facilities, outreach, and governance), and specific questions to approach the role of transformative and organisational learning for sustainability in higher education. Moreover, the administrative form addressed information regarding the HEIs' characterisation, of which the main details are presented in Table 1. Both protocol and form were reviewed by 5 experts, and a pre-test was conducted in one HEI. Afterwards, some improvements were made to them before starting data collection. The pre-test interview was not considered in the data analysis. All necessary ethical procedures were adopted in this study.

#### 3.2.2. *Case studies data analysis*

After data collection, all interviews were recorded, transcribed, and then compiled and analysed with the support of the ATLAS.ti software (version 8.4). For data analysis, a mix of qualitative content analysis (Elo and Kyngäs, 2008) and thematic analysis (Braun and Clarke, 2006) was conducted. The major categories and their respective code groups were prepared based on the literature review (first research stage), as Table 2 shows. Subsequently, the data from all fifteen HEIs case studies were coded and analysed.

## 4. Results and discussions

### 4.1. *Bibliometric analysis*

In order to address the literature issues about the topic, a keywords' co-occurrence analysis on relevant studies was carried out, followed by cluster analysis (Fig. 3). The keywords co-occurrence network was composed of four clusters.

The red cluster refers to topics such as sustainable development,

**Table 1**
Overview of the fifteen HEIs selected as case studies.

| HEI | Nature | Focus[a] | HEI's year of foundation | Number of enrolled students | Year of foundation of the sustainability office | Number of team members[b] | Who is employed in the office |
|---|---|---|---|---|---|---|---|
| I | Public | Universal | 1966 | 26,000 | 2020 | 4 | Staff and students |
| II | Public | Specific | 1918 | 13,678 | 2012 | 5 | Staff and students |
| III | Public | General | 1575 | 34,165 | 2017 | 8 | Staff, students, volunteers |
| IV | Private | Specific | 1974 | 9973 | 2019 | 5 | Staff |
| V | Public | Specific | 1859 | 36,900 | 2022 | 8 | Staff and students |
| VI | Public | General | 1843 | 35,785 | 2013 | 15 | Staff, students, professors, volunteers |
| VII | Public | Universal | 1881 | 44,520 | 2004 | 11 | Staff |
| VIII | Public | Universal | 1404 | 80,000 | 2016 | 4 | Staff, students, professors |
| IX | Public | General | 1971 | 18,502 | 2022 | 2 | Students |
| X | Public | General | 1989 | 18,000 | 2012 | 11 | Staff, students, professors, volunteers |
| XI | Public | General | 1989 | 10,000 | 2000 | 1 | Staff |
| XII | Public | Universal | 1972 | 17,000 | 2022 | 3 | Staff |
| XIII | Public | Universal | 1846 | 21,000 | 2022 | 4 | Staff |
| XIV | Public | Universal | 1614 | 36,681 | 2014 | 9 | Staff, students, volunteers |
| XV | Public | Specific | 1971 | 6231 | 2018 | 7 | Staff, students, professors |

[a] Universal (i.e., it covers all subjects including engineering and medicine); General (i.e., it covers most subjects but not all of them); Specific (i.e., technical university, university of applied sciences, liberal arts college, etc.).
[b] The number of team members refers to fixed people in the office. In addition to this number, there may be volunteers.
Source: prepared by the authors based on the study's data.

**Table 2**
Categories and code groups for the qualitative content and thematic analysis.

| Categories | Code groups | | | | |
|---|---|---|---|---|---|
| Activities (Kapitulčinová et al., 2018; Lozano, 2018). | Curricula | Research | Facilities | Outreach | Governance |
| Stages of the transformative learning process (Henderson, 2002; Mezirow, 1981). | Disruptive Event | Critical Reflection | New Perspective Development | New Perspective Integration | |
| Dimensions of the organisational learning process (Senge, 1990). | Team Learning | Shared Vision | Mental Models | Personal Mastery | Systems Thinking |
| Challenges and drivers for sustainability | Challenges | Drivers | | | |

Source: prepared by the authors.

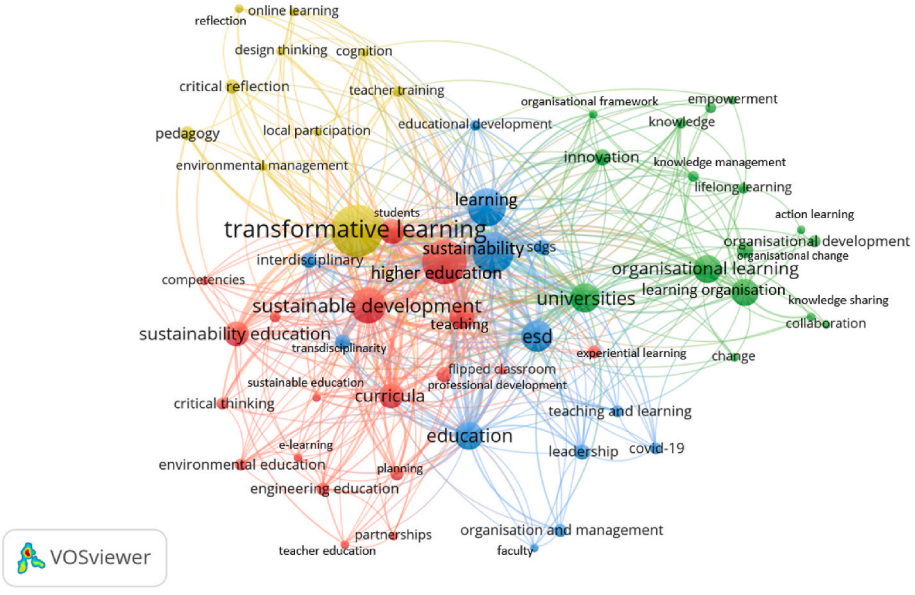


**Fig. 3.** Keywords co-occurrence network.
Source: prepared by the authors based on the study's data.

sustainability education, curricula, flipped classrooms, and critical thinking, among others. Sustainability education encompasses more than just incorporating sustainability issues into the curriculum and empowering learners to contribute to societal change; it also involves adopting effective teaching methods (Howell, 2021). In fact, it requires the promotion of critical thinking, action, and the utilisation of creativity to foster a shift in mindset (Sommier et al., 2022). Therefore, HEIs have a key role in addressing these challenges by bringing together diverse stakeholders and implementing structured learning activities that can facilitate personal and societal transformation (Baumber,

2022). One promising approach in this regard is the flipped classroom, which allows for reflection and active learning during class time by moving content acquisition to pre-class study, thus enabling active and social learning experiences (Howell, 2021; Trevisan et al., 2023a).

The blue cluster focuses on education for sustainable development (ESD), Sustainable Development Goals (SDGs), interdisciplinary, transdisciplinarity, leadership, etc. Environmental education plays a vital role in facilitating profound transformations in people's thinking, behaviour, decision-making, and harmonious connection with the natural environment (Sharma et al., 2023). However, for effective ESD, it is essential to employ pedagogies that actively engage learners in transformative learning processes. These pedagogies encompass reflective and active learning, incorporating experiential, collaborative, and learner-centred activities (Howell, 2021). Equipping students with the ability to approach complex challenges through a systemic perspective can serve as a significant catalyst for interdisciplinary and transdisciplinary practices (Baumber, 2022). Interdisciplinarity involves integrating diverse insights, values, and knowledge from various fields, such as the arts, humanities, and social sciences, as well as science, technology, engineering, mathematics, and medicine (Sommier et al., 2022). On the other hand, transdisciplinarity transcends disciplinary boundaries by integrating knowledge, perspectives, and methodologies from multiple academic disciplines to tackle intricate sustainability issues. It emphasises collaborative processes, dialogue, and the co-creation of knowledge among diverse stakeholders, including academia, government, industry, and civil society. However, implementing transdisciplinary learning encounters challenges within university settings, such as addressing knowledge gaps among teaching staff, securing resources to facilitate extensive collaboration, and overcoming rigid institutional structures that tend to compartmentalise knowledge and prescribe fixed roles for teachers, students, researchers, and external partners (Baumber, 2022).

The green cluster focuses on organisational learning, universities, innovation, organisational development, collaboration, organisational change, etc. Scholars in the field of SD have long stressed the necessity for HEIs to undergo an organisational transformation, which in turn necessitates profound and systemic learning (Niedlich et al., 2020). Achieving these ambitious objectives calls for an education that empowers individuals to reclaim their autonomy and critical citizenship, enabling them to make decisions that challenge prevailing norms and patterns (Varela-Losada et al., 2022). The process of organisational learning plays a crucial role in enabling HEIs to enhance their capabilities, adapt, and effectively respond to the challenges presented by the rapidly changing global environment (Mukhi, 2023). However, many HEIs, often characterised by conservatism, exhibit resistance to change, particularly concerning leadership, management, and governance, which hinders the development of transformative measures (Moreno-Serna, 2022). Therefore, the impetus for change must originate from collective and organisational learning, prompting critical reflection and questioning of established frameworks. It is essential to pay close attention to the social and political context to challenge unsustainable practices and institutions (Boström et al., 2018). By doing so, HEIs can go into a journey of transformation, fostering deep learning and organisational change necessary for SD.

Finally, the yellow cluster refers to topics such as transformative learning, critical reflection, design thinking, pedagogy, and teacher training, among others. Transformative learning, as a constructivist process, inherently cultivates integrative, holistic, and reflexive capacities (Klein, 2022). It is important to recognise that transformative education aligns with the targets of SDG 4, and its impact extends to the achievement of all other SDGs (Janssens et al., 2022). While transformative learning is often portrayed as an individual change, it is crucial to acknowledge that achieving SD requires societal transformation (Varela-Losada et al., 2022). Therefore, universities must explore innovative approaches that enable systemic transformation (Moreno-Serna, 2022). A university learning experience that embraces transformation contributes to the development of sustainability attitudes, skills, and agency among learners (Probst et al., 2019).

### 4.2. Empirical multi-case study

The second stage of this study involved a multi-case study with fifteen HEIs from thirteen cities in six European countries. As already mentioned in the methodology section, the protocol interview (Appendix A) was prepared based on the previous research stage – bibliometric analysis and literature review. Then, visits in-loco were carried out to HEIs' campuses, and interviews were conducted with their sustainability managers. Moreover, HEIs' sustainability documents and reports were analysed. Therefore, this section is divided into two subsections: (1) Embedding sustainability into HEIs' activities and (2) The role of transformative and organisational learning for the institutionalisation of sustainability in higher education. The first one is divided according to the whole-institution approach – curricula, research, facilities, outreach, and governance - and provides a list of drivers and challenges to embedding sustainability into HEIs' activities. The second one reports the analyses of the interviews through the lens of transformative and organisational learning theories and, based on these perspectives, provides a framework for sustainability in higher education.

#### 4.2.1. Embedding sustainability into HEIs' activities

The literature has stated that a whole-institution perspective is essential to drive sustainability in HEIs, that is, curricula, research, outreach, facilities, and governance Kapitulčinová et al. (2018); Lozano (2018) (Fig. 4). This perspective recognises the interconnectedness of all institutional activities and emphasises the need for a holistic approach rather than isolated departmental efforts. It seeks to permeate every aspect of HEIs' operations, including curricula, research, facilities management, outreach, and governance (Gramatakos and Lavau, 2019).

From the curriculum perspective, it should be designed to integrate sustainability principles across all disciplines, acknowledging that each academic field has a role to play in addressing global sustainability challenges. This will equip students with the necessary skills and knowledge to become sustainability leaders in their respective fields (Purcell et al., 2019). HEIs' research capacity can also be leveraged to


**Fig. 4.** The whole-institution approach for sustainability in higher education. Source: prepared by the authors.

find solutions to local sustainability challenges, thereby enhancing their contribution to sustainability beyond their physical boundaries.

Facilities management also forms a vital part of integrating sustainability into HEIs. Green building principles can be applied to new constructions and renovations to reduce institutions' environmental footprint. This includes promoting energy efficiency, water conservation, and responsible waste management practices, among several other initiatives (Udas et al., 2018). Additionally, HEIs should foster a culture of sustainability within their communities, engaging staff, students, and other stakeholders in sustainability initiatives. This can be achieved through educational campaigns, volunteering opportunities, and collaborations with local communities and organisations (Findler et al., 2019).

In terms of governance, adopting sustainability implies embedding it in the institutions' mission statements, strategic plans, and daily practices. Policies should be devised in such a way that they ensure sustainable decisions are taken at every administrative level (Baker-Shelley et al., 2017; Sá and Serpa, 2020). Ultimately, this whole-institution perspective on sustainability requires a paradigm shift within HEIs, where sustainability becomes an inherent characteristic of their identity and activities. As one of the interviewees mentioned:

> If we think about what universities are about, they are about education, they are about betterment, they are about solving global problems. So, actually, it is really important that we do not just chase the money and deliver the research, we actually ensure that what we are doing is aligned to driving down and solving those global problems.

Based on the described whole-institution perspective (Fig. 4), Table 3 presents a comprehensive list of initiatives carried out by the interviewed HEIs to embed sustainability into their activities. In the next subsection, each activity is analysed and described according to each activity (curricula, research, facilities, and governance). It is important to point out that the initiatives are not ordered by importance, since they are all equally important and can be adopted by universities that wish to implement measures towards sustainability.

*4.2.1.1. Curricula.* The interviewed universities are implementing a range of strategies to promote sustainability in education, such as introducing carbon literacy courses, refreshing curricula to include sustainability topics, adopting experience-driven methodologies, and fostering transdisciplinary skills. They also emphasise the autonomy of professors and encourage knowledge exchange among faculty members. Mapping courses to the SDGs and establishing specific departments for education on sustainability are additional measures taken. HEIs also organise events like summer schools, conferences, lectures, and sustainability weeks to promote sustainability awareness and education.

> Besides the promotion of sustainability weeks, events, lectures, and conferences, they collaborate with local municipalities on real-world case studies, such as waste management, where students are sent out to tackle these issues. This encourages students to gain practical experience in addressing sustainability challenges and contributing to their community in the process. One of the interviewees said: "We try to get the students to not only be active at the university but also in the city society".

HEIs are also fostering inter-faculty collaboration, challenging students to work on complex, experience-driven tasks that cross traditional academic boundaries. This approach disrupts the traditional university model of specialist and isolated faculties, emphasising the importance of cross-disciplinary work without diminishing the value of deep expertise.

The integration of sustainability into courses is another focus, but it is done in a way that does not isolate the subject from other academic disciplines. Rather than mandating a separate sustainability module, which risks compartmentalising the topic, they embed sustainability-

**Table 3**
Initiatives carried out by top sustainable HEIs to embed sustainability into their activities.

| Activity | Initiative | |
|---|---|---|
| Curricula | • Carbon literacy course<br>• Curriculum refresh<br>• Experience-driven methodologies<br>• Foster transdisciplinary skills<br>• Professors' autonomy<br>• Professors' knowledge exchange<br>• SDGs courses mapping<br>• Specific department on education for sustainability<br>• Summer school for sustainability<br>• Sustainability conferences<br>• Sustainability courses<br>• Sustainability events<br>• Sustainability lectures<br>• Sustainability week | |
| Research | • Research Centres on Sustainability<br>• Research projects on sustainability<br>• Researchers Collaboration Forum<br>• SDGs funding opportunities mapping<br>• SDGs research projects mapping<br>• Sustainable lab technician network | |
| Facilities | • Air quality monitoring<br>• Automatic tabs<br>• Bicycle maintenance class<br>• Bicycle repair office<br>• Bicycle-sharing system<br>• Bus app<br>• Car-sharing system<br>• Climate garden<br>• CO2 sensors<br>• Community garden<br>• Cycling routes<br>• Electric bicycles for rent<br>• Electric cars for rent<br>• Energy consumption monitoring<br>• Energy production monitoring<br>• Geothermal energy<br>• Green canteen system<br>• Green roof<br>• LED lighting<br>• Light sensors | • Mobility sensors<br>• Online teaching/learning<br>• Presence detection sensors<br>• Reverse vending machine bin<br>• Scooters for rent<br>• Second-hand resources<br>• Single-use plastic-free policy<br>• Smart buildings<br>• Smart classrooms<br>• Solar panels<br>• Sustainable labs<br>• Temperature management system<br>• Timetabling system<br>• Towards a CO2 neutral university<br>• Vegetable garden<br>• Walking routes<br>• Waste management system<br>• Water management system<br>• Water source heat pump system |
| Outreach | • Collaboration with companies<br>• Collaboration with NGOs<br>• Collaboration with other HEIs<br>• International networks<br>• International volunteer programme<br>• Leisure activities related to sustainability<br>• National networks<br>• Partnership with charities<br>• Partnership with city municipalities<br>• SDGs events mapping<br>• Sustainability communication<br>• University-Community partnership | |
| Governance | • Climate action roadmap<br>• Climate emergency declaration<br>• Climate plan<br>• Committee to support delivering sustainability within the curriculum<br>• Digital twin<br>• Energy policies<br>• Facility management system<br>• Food policies<br>• Green Committee<br>• Green Office<br>• Green procurement system<br>• Performance measurement system<br>• Strategic delivery plan<br>• Sustainability management structure<br>• Sustainability leadership<br>• Sustainability policies | |

(*continued on next page*)

**Table 3** (*continued*)

| Activity | Initiative |
|---|---|
| | • Sustainability reports<br>• Sustainability roadmap<br>• Sustainability senior manager<br>• Top-down and bottom-up approaches<br>• Travel policies |

Source: prepared by the authors based on the study's data.

related content across all courses. This strategy also prevents the responsibility of teaching sustainability from falling solely on faculty already specialised in the area.

These universities are also working on mapping the SDGs into curricula, which involves analysing course descriptions to identify mentions of SDG keywords, creating a list of sustainability-related courses, and regularly monitoring courses for SDG alignment. The list of courses is then made available to students on the universities' websites, enabling them to choose courses aligned with their interests. They also provide a wealth of resources for students interested in specific sustainability goals, both from their own institution and external sources. These resources also assist students in conducting research, such as writing their thesis or a paper.

In addition, HEIs have identified their most important and strategic SDGs and offer related courses, applications, research projects, and internal projects. They have developed databases where each faculty member labels the appropriate SDGs for their courses, creating a useful toolkit for self-assessment of SDG integration within a module or programme. The ultimate goal is to associate all SDGs with all faculties and the research conducted within.

*4.2.1.2. Research.* HEIs are actively engaged in sustainability-focused research. They are building research facilities dedicated to sustainability and encouraging research around these topics. One of the interviewed universities has established a dedicated centre for climate and society, to foster interdisciplinary research on sustainability. This centre brings together diverse fields from communication to engineering, and even primary education, promoting a holistic approach to sustainability. Another university has established the 'SDG Collaboratorium', a forum that encourages knowledge sharing, discussion, and collaboration among researchers across all 17 SDGs. The Collaboratorium began as an internal forum but has expanded to share best practices and even failures with other organisations internationally. It serves as a platform to promote interdisciplinary collaboration on local and global sustainability challenges in research, innovation, and teaching activities.

The universities are also proactively monitoring and communicating funding opportunities related to sustainability to encourage faculties and researchers to apply for it. They identify these opportunities and provide a soft push for researchers to engage in sustainability-focused projects. However, they respect academic freedom, and the final decision on application for grants rests with the faculty or researchers themselves. To support this, universities have set up research coordination offices that scan for available programmes, provide advice on calls from different entities, such as the European Union or German Ministry, and assist with formal aspects of grant applications. These offices also conduct onboarding processes for new professors and administrative staff, providing them with information on how to organise and apply for research projects.

The universities also track their sustainability efforts. They monitor all projects that can be linked to any of the SDGs, keeping records of these projects in databases. Furthermore, universities are working on digital tools like dashboards to map how all their research connects to the SDGs, aiming to make their research efforts more visible and better connected. Researchers are encouraged to consider how their work relates to the SDGs when applying for funding. These research efforts are then tagged by the relevant SDGs. By linking digital transformation and sustainability activities, HEIs can maximise their collaboration in facing global challenges. For that, many types of technologies, approaches, and strategies can be employed (Trevisan et al., 2023b).

*4.2.1.3. Facilities.* In terms of facilities, HEIs are implementing various measures to promote sustainability on their campuses. This includes monitoring air quality, using automatic taps and LED lighting, providing bicycle maintenance classes and repair offices, implementing bicycle-sharing and car-sharing systems, and developing cycling and walking routes. They also adopt technologies like presence detection sensors and temperature management systems to optimise energy consumption. The installation of renewable energy sources such as solar panels and geothermal energy, along with waste and water management systems, further enhances sustainability efforts. The use of green canteen systems, green roofs, and sustainable labs also contribute to creating environmentally friendly campuses.

The several strategies being employed by the top HEIs can be categorised as follows.

- Transportation and Mobility: Many universities are investing in making their campuses bicycle-friendly by setting up bicycle-sharing services and bicycle routes across the campuses. They are conducting initiatives such as bike maintenance classes and offering bicycle repair services. They are also encouraging students and staff to use electric bikes and cars, and some have established a 'share space' concept where everyone is equal, regardless of their mode of transportation.
- Energy Management and Efficiency: Many HEIs are implementing technologies like solar panels, ground source heat pumps, lake source heat pumps, and combined heat and power systems. An 'energy-saving' programme was established at some universities, where any energy reduction in their most energy-consuming buildings resulted in financial savings that could be used to fund other projects.
- Digital Solutions: There is a growing use of digital solutions to support sustainability efforts in universities. They have built smart classrooms and buildings, where the management of light and heat is automatic, and environmental variables inside the buildings and classes are constantly monitored. One university has an app that not only allows the booking of buses but also informs users about the nutritional aspects of food served in the canteen, helping reduce food waste.
- Waste Management: Universities have reduced the usage of single-use plastics, implemented recycling programmes, and used technology to track waste. One university launched an app for their catering companies to eliminate the use of single-use cups. Others have implemented a single-use plastic-free policy in their canteens and are promoting the use of second-hand resources.
- Food and Health: Efforts are being made to improve the quality of food and health within universities. This includes offering a lot of vegetarian and vegan options in cafeterias and canteens.
- Sustainable Laboratories: Universities are also focusing on making their labs more sustainable. They have set up initiatives to reduce the usage of chemicals, energy, and plastics in labs. In one case, lab managers are brought together to work on making the labs more sustainable with regard to waste management.
- Green Spaces: Universities are cultivating green spaces for both education and leisure. Besides that, these green spaces often include beekeeping projects and vegetable gardens managed by student groups.

*4.2.1.4. Outreach.* In terms of outreach, HEIs have been establishing partnerships with companies, Non-Governmental Organisations (NGOs), other HEIs, and municipal authorities to work collectively towards sustainability goals. Moreover, international networks and volunteer programmes have provided global perspectives and

opportunities for students and faculty to engage in sustainability-related activities. Collaboration with charities, participation in national networks, and organising sustainability events have helped raise awareness and engage the broader community. Furthermore, effective sustainability communication and university-community partnerships have strengthened the impact of these initiatives. Therefore, the key actions undertaken by top sustainable universities are.

- Collaborations: Universities are partnering with local and international entities including other universities, companies, municipal actors, NGOs, and research institutes. This collaboration fosters a sharing of resources, knowledge, and experiences by including various initiatives, such as developing sustainability competencies in small and medium enterprises, offering internships and research funding opportunities for students, and working with industries in fields like renewable energy and water management, among others. In addition, some universities are offering double degrees and courses in collaboration with other institutions, with a strong focus on sustainability. They are also organising international volunteer programmes and extra-curricular activities focused on sustainability for students to get hands-on experience and contribute to the topic.
- Inter-University Networking: Universities are networking on a local, national, and international level. They are part of communities of practice and various networks, in which they share and exchange knowledge and best practices. Moreover, they are conducting sustainability teaching weeks, and sharing best practices among staff and professors through networks.
- Communication and Outreach: HEIs are investing heavily in communications, utilising channels like social media, newsletters, websites, coffee machine screens, and press offices to spread sustainability.

*4.2.1.5. Governance.* In terms of governance, the top sustainable HEIs have developed climate action roadmaps, declared a climate emergency, and formulated climate plans to address environmental challenges. They have also established committees to support sustainability within the curriculum and developed energy, food, and travel policies, as well as facility management and green procurement systems, aligned with sustainability principles. Other initiatives taken by HEIs include sustainability management structures, leadership positions, policies, reports, sustainability roadmaps, and the adoption of top-down and bottom-up approaches. Moreover, performance measurement systems and strategic delivery plans have enabled HEIs to monitor and evaluate their sustainability initiatives. The main strategies and measures adopted by HEIs can be categorised as follows.

- Stakeholder Involvement: A significant emphasis is placed on the engagement and participation of all stakeholders, particularly students and staff. From recognising a climate emergency to proposing sustainability measures, their role is essential. Moreover, the development of digital twins on campuses allows stakeholders to better understand sustainability issues and potentially help contribute to the challenges, since it allows them to monitor and manage energy usage, air quality, and occupancy, for instance.
- Leadership and Governance: Strong leadership plays a crucial role in driving sustainability initiatives. Organisational structures such as green committees, Green Offices, sustainability councils, and dedicated offices for sustainability have been established to manage and drive universities' initiatives towards sustainability. Leadership also takes into account feedback from various stakeholders to ensure policies are relevant and widely supported.
- Top-Down and Bottom-Up Approaches: Universities are combining top-down and bottom-up approaches to drive sustainability. On one hand, leadership is setting high-level strategic goals. On the other hand, these institutions are encouraging initiatives from students and staff, recognising that both are necessary for successful outcomes. One of the interviewees said: "There is a need for both elements, an institutional structure that allows this to exist and continue existing and, at the same time, the bottom-up approach of people who are interested in it".
- Green Procurement and Sustainable Facilities Management: Universities are making efforts to improve their procurement policies, opting for more sustainable options. This includes strategies like choosing laptops with lower carbon emissions and ensuring food providers have green certifications. The idea is to not only manage waste better but also to reduce consumption. Furthermore, universities are using facility management systems to optimise the use of existing resources and facilities, potentially reducing the need for new constructions.

*4.2.1.6. Drivers and challenges for sustainability in higher education.* As previously detailed, transforming HEIs into 'whole-institution' sustainable institutions requires substantial organisational change, demanding a shift from conventional practices to a holistic approach, which encompasses teaching, research, outreach, facilities, and governance. However, the journey presents both drivers and challenges crucial to their transformation. Table 4 summarises the main drivers and challenges faced by the interviewed HEIs. Subsequently, some of these aspects are described in detail.

All the initiatives previously listed in this article collaborate on universities' paths towards sustainability. However, there are some strategies/drivers that should be highlighted since they are common among the universities interviewed in this study, such as.

- Academic Freedom and Autonomy: Top sustainable universities emphasise the importance of academic freedom, and rather than forcing professors to incorporate sustainability into their work, they encourage and equip them with knowledge and skills. This freedom stimulates innovation and helps integrate sustainable practices across diverse fields of study.

**Table 4**
Drivers and challenges for sustainability in higher education.

| Drivers | Challenges |
|---|---|
| • Academic freedom<br>• Collaboration with companies<br>• Collaboration with other HEIs<br>• Cross-departmental collaboration<br>• Effective personnel management<br>• Financial support<br>• Government laws and regulations<br>• Green Office structure<br>• GreenMetric ranking<br>• International and national networks<br>• Long-term vision statement for a sustainable future<br>• National and international standards<br>• Partnership with the cities' municipalities<br>• Pros of technology<br>• Societal pressure<br>• Strategic delivery plan<br>• Sustainability management structure<br>• Sustainability communication<br>• Sustainability courses<br>• Sustainability leadership<br>• Sustainability policies<br>• Sustainability rankings<br>• Sustainability senior manager<br>• University-Community partnership | • Assess how sustainability is being embedded into curricula<br>• Assess how sustainability is being embedded into research<br>• Cons of technology<br>• Culture change<br>• Formally accredit sustainability in the curriculum<br>• Gender equality<br>• Student engagement<br>• University-community engagement |

Source: prepared by the authors based on the study's data.

- Collaborative Partnerships and Networks: Universities form partnerships and networks with local businesses, government entities, other universities, and NGOs to collaborate on sustainability initiatives. These relationships facilitate the exchange of ideas and best practices and provide a support network to face shared challenges. This is evident from their collaborations on projects, engagement in communities of practice, and participation in networks.
- Leadership Support: The support of decision-makers within the university, such as vice-rectors and directors, is crucial for driving sustainability initiatives. This extends to decisions on green procurement policies and broader governance issues.
- Funding and Financial Support: The interviewed universities often support applications for funds to pursue sustainability-related research and projects. They also leverage the skills and knowledge of their staff and students to conduct sustainability-focused projects and activities, which is an example of using internal resources wisely and creating projects with little financial investment. Moreover, by understanding the importance of the sustainability topic within their spaces, there is strong support from the institutions' leadership on allocating budget to the sustainability offices, providing facilities, resources, and staff, and supporting sustainability decisions.
- Green Office Structure or Sustainability Management Structure: Green Offices or sustainability departments in universities have been proven to be an important driver towards sustainability since they are institutional structures entirely dedicated to the topic. One of the interviewees said:

  Students come and go and then, you know, they graduate, and they are gone and maybe a student initiative does not survive because the people are gone. And this is a safe place where you always have people working here on this exact issue.

- Legislation: Legislation and government mandates also drive universities to incorporate sustainability into their activities. These mandates can include requirements for universities to develop climate action roadmaps, reach specific carbon reduction targets, and address waste and water management.
- University Strategic Plans and Policies: Many universities have made sustainability a key part of their strategic plans, setting specific goals and trajectories for sustainability within their institutions.
- Ranking and Benchmarking: Participation in rankings like the GreenMetric ranking provides a framework for universities to evaluate and improve their sustainability performance. These rankings also provide an opportunity to compare against and learn from other institutions around the world. It helps universities keep their sustainability efforts on track and improve their international reputation.
- Futures Thinking and Visioning: Universities are increasingly considering what a sustainable future could look like and are using this vision to drive their current actions. These efforts include envisioning what a regenerative university might look like and developing plans to move towards that future.
- Societal Pressure: Universities also respond to societal expectations and demands for sustainability, driving them to take more tangible actions.
- Technological Advancements: Efficiency in the use of resources is key for sustainability, and this is facilitated by advancements in technology. One of the interviewees said:

  There is a kind of data transparency requirement in sustainability where the data sets need to be made visible so that people can, one, understand them, two, connect them, and three, have the opportunity to begin to change behaviours (…). This is why we are on the journey of developing the digital twin because we know that large data sets can be visualised.

  From another perspective, another interviewee said:

  I do not think technology is a solution. I think we need to be very careful that we do not see simple technology as the fix. So we will have to use as much technology as we can. But it is not a fix for climate change. We are going to have to adapt how we do things rather than just going to bring heat pumps and changing all of our heating systems out to heat pumps.

On the other hand, there are many challenges to integrating sustainability into university activities, such as.

- Data Mapping and Management: Identifying the extent of sustainability-related activities can be challenging due to poor data management systems. It is difficult to accurately gauge the reach and effectiveness of sustainability efforts, including research and courses when data is poorly tracked. An upgrade or refresh of the system might be necessary to facilitate a better analysis of outcomes.
- Cultural Shift: Achieving sustainability requires shared understanding and responsibility from all members of the university community. Technological interventions such as energy-efficient lighting or temperature controls can help, but ultimately, sustainable behaviours cannot be mandated. This requires a cultural shift towards shared understanding and responsibility, which can be challenging to foster.
- Integration into the Curriculum: While many courses and modules may touch on sustainability, fully integrating this concept into the curriculum remains a challenge, suggesting the need for a more structured and systematic approach.
- Gender Equality: Addressing issues of gender equality and female empowerment is another key challenge, particularly in leadership roles where there is often a gender imbalance. From the interviews, it was observed that most of the teaching staff and managerial positions are still held by men. When women are underrepresented in leadership roles, their unique insights and experiences are not adequately considered, leading to a lack of diverse perspectives in sustainability initiatives (Martínez et al., 2019). Furthermore, gender inequality in HEIs can perpetuate a culture that belittles leadership skills and discourages women from engaging in leadership development (Lukwago et al., 2023). In this regard, one of the universities has some interesting strategies in order to improve gender equality, such as a course focused on integrating, developing, and spreading cultural gender equality and female empowerment, as well as some rules for events and conferences: 1/3 of the speakers should be women and the order of intervention should be balanced between women and men. Moreover, they published a gender report on it, in which photographs are balanced between women and men. According to Martínez et al. (2019), increasing the representation of women in leadership positions and decision-making roles can bring diverse perspectives and insights to sustainability efforts. This can lead to more comprehensive and inclusive approaches to sustainability that consider the needs and experiences of all stakeholders.
- Engagement and Participation: It can be challenging to keep engagement and participation in sustainability activities across different groups within the university.
- Lack of a Clear Vision and Metrics: One of the most significant challenges is defining what it means to be a 'sustainable university'. This involves creating a clear vision, establishing metrics for success, and communicating this vision to the university community. The use of 'speculative artefacts' is mentioned as a way to help people imagine a sustainable future and to provoke conversation about it. This approach underscores the need for clear goals and a shared understanding of sustainability.

#### *4.2.2. The role of transformative and organisational learning for the institutionalisation of sustainability in higher education*

The transformative learning process can play a crucial role in

promoting sustainability in universities. Based on the conducted interviews and the literature on the topic (Henderson (2002, p. 203), we provided a framework for universities to embrace sustainability by going through four key stages of transformative learning: disruptive event, critical reflection, new perspective development, and new perspective integration (Fig. 5). These four stages were established by Henderson (2002, p. 203) when analysing the studies of Jack Mezirow, Stephen Brookfield, and Paulo Freire. However, the significance of this study remains in the context of higher education towards SD.

1. Disruptive Event: The first stage of transformative learning is characterised by a disruptive or disorienting dilemma. In the context of the interviewed universities, the Agenda 21 and 2030 Agenda, the urgent need for sustainable practices in the face of climate change, the energy crisis in Europe, societal pressures, and students' instigation are some examples of disruptive events. These events serve as catalysts that stimulate change by highlighting the severity of environmental issues and the urgent need to incorporate sustainability into the universities' activities.
2. Critical Reflection: The second stage, critical reflection, involves critically examining their existing beliefs, assumptions, and practices. The Green Office structure or sustainable department plays a significant role in promoting critical reflection. By encouraging stakeholders to explore sustainability from different angles, providing training opportunities, and offering platforms for students to engage in sustainability activities and reflect on environmental issues, these structures foster an environment of self-assessment. Additionally, the office's willingness to assess and revise its approach, as well as its emphasis on stakeholder feedback and sustainability rankings, further demonstrates the importance of critical reflection in transformative learning. Regarding the participation in the UI GreenMetric ranking, one of the interviewees said:

   I think it gives us a rather important status on how well we do, but also where we can do better. The method they [GreenMetric ranking] use is very fortunate for us […] I would say that it gives us some insights. I have learned a lot about the university since I started […] So, I think we get a good picture of the different areas where we can react and where we can do better. So, it is like a temperature measurement and it is very interesting to see the other universities […] how they work with it and what they do. […] So, it is both a temperature internally to see what we do, but also we can get some inspiration from others.

3. New Perspective Development: The third stage is the development of a new perspective or understanding based on critical reflection. It involves aligning values and goals with sustainability initiatives. The interviews highlighted the universities' commitment to the 2030 Agenda, the integration of sustainability across different aspects of the institution, and the development of comprehensive sustainability plans. These actions indicate the development of a new perspective on sustainability, where stakeholder engagement, technology support, training, benchmarking, and a whole-institution commitment play a crucial role in a new organisational perspective aligned with sustainability. Regarding benchmarking, one of the interviewees said:

   We select a set of universities chosen from the best rankings […] and we look at them and we provide a benchmarking on some topics, which could be courses or different projects or research projects and so on, and we share it with academic leaders to say: just take a look at what other universities are doing.

4. New Perspective Integration: The final stage is the integration of the new perspective into one's life and actions. In the university context, the interviewees demonstrate this stage by integrating sustainability into their roles at the university, emphasising its importance in different areas. They write policies, implement plans, obtain knowledge and skills, build competence and self-confidence, and continually improve their sustainability efforts. Furthermore, the ongoing commitment to learning, adaptation, and engagement with stakeholders ensures the continuous integration of sustainability practices into the campus culture and operations. Regarding this topic, one of the interviewees said:

   This is something we have learned. We should never stand still. We should always improve and recognise that we have to improve. Because if we do not do this, we will fall behind. It is the same in the green metric ranking. We always have to try to get more points in the next round, because if not, we will lose our position.

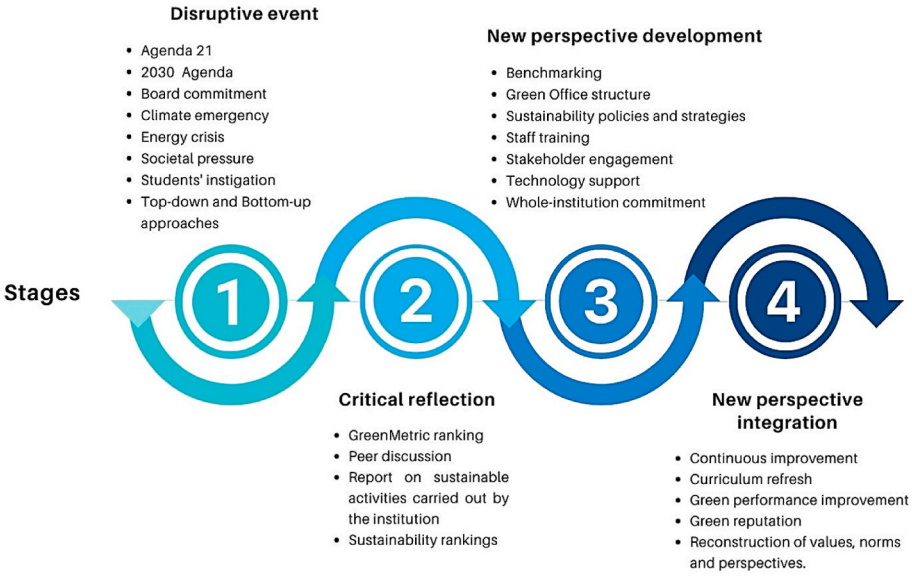


**Fig. 5.** Stages of transformative learning for sustainability in higher education.
Source: prepared by the authors based on the study's data and the four stages of transformative learning proposed by Henderson (2002).

In addition to the transformative learning perspective, this study analysed the initiatives promoted by the most sustainable universities through the lens of organisational learning. More specifically, it examined how the five dimensions of organisational learning (team learning, shared vision, mental models, personal mastery, and systems thinking) are presented in the interviewees' responses and how they can contribute to sustainability in higher education.

1. Team Learning: Team learning emphasises collaboration and knowledge exchange within and outside the university. The exchange of ideas and experiences among team members enhances the collective learning capacity of the organisation. The interviewees highlighted the importance of cooperation between different departments and engagement with external communities and organisations. Universities have created opportunities for networking, symposia, and collaborative projects to promote team learning. Team learning can be observed in various other collaborative efforts, such as creating a road map for sustainability, developing a functioning digital twin, or a waste management system. It is also apparent in the collaborative efforts of student organisations, like the Green Office, and in the coordination with external entities, such as local municipalities and industries.
2. Shared Vision: A shared vision is essential for aligning stakeholders towards sustainability goals. The interviewed universities have cultivated a shared vision by communicating their commitment to sustainability through various channels and platforms such as social media, newsletters, and websites to share updates, events, and information related to sustainability with the wider university community. Moreover, they involve different stakeholders, including students, staff, partners, and local communities, in the decision-making process to ensure a collective understanding of sustainability goals. This shared vision unites the university community, fostering a sense of purpose and direction in sustainability efforts. Regarding this dimension, one of the interviewees said:

   > [Sustainability] is something that we are trying to spread. And they [other employees] will not all live in my office. I do not want them to. So, we would have expertise in all units because if it [sustainability] is a driver of everything we do, then everybody needs to have some understanding of what it means and the impacts not just from the legislation, but also from a moral and ethical responsibility perspective. As educational institutions, we have a responsibility to ensure that the message is heard as to the scale of change and the urgency with which change is needed.

3. Mental Models: Mental models are the deep assumptions that influence how individuals understand the world and take action. The interviewees emphasise the need to challenge traditional practices and mindsets to foster sustainability by reframing it as a shared responsibility and an integral part of the university's culture, rather than being the sole responsibility of a dedicated office. They also emphasise the need for a broader perspective to overcome isolated efforts and create a comprehensive sustainability strategy. This can be seen in the integration of sustainability through the different initiatives listed in Table 3. Moreover, regarding how HEIs engage the university community towards a sustainability mental model, one of the interviewees mentioned they do that:

   > By leaning into futures and strategic foresight. […] We do that not to predict the future, but to bring a community of people together around a shared understanding of the type of future they would like to have because that is what drives action today. So I would make the argument that most organisations do not have visions of the future. They may have strategies, but if you stop somebody, they probably would have no idea what the organisational strategy is. And even if they did, they probably would not be able to articulate what the future actually looks like. So that is why we have included futures as part of our sustainability function so that we can bring people together that can create forward momentum. And so that we can have those hard conversations around what types of futures people would like for our region, for our community, for our university, etc., which is challenging. It challenges a lot of people. Most people are used to thinking three to five years out the maximum and that is seen as a long. […] So when you start to stretch that out 10–20 years, there is a level of discomfort, but then once people have been on the journey, there is a realisation that comes that we have to actively hold these images in our heads if we are going to consider all the steps are towards them in the future.

4. Personal Mastery: This dimension is demonstrated through the commitment of individuals to continuous learning and improvement in sustainability. The interviewees' active involvement in sustainability initiatives, their pursuit of benchmarking opportunities, and their dedication to staying updated with sustainability practices in other universities showcase personal mastery. The interviewed universities recognise the importance of equipping students and staff with the needed knowledge and skills to contribute to SD.
5. Systems Thinking: Systems thinking involves understanding the interconnectedness of various aspects and the broader impact of sustainability initiatives. The universities adopt a holistic approach, recognising the interdependencies within the university system and its interactions with the external environment. The various programmes and projects related to sustainability are not isolated, but interconnected, with the campus often serving as a laboratory for sustainable projects. This approach acknowledges the complexity and interconnectedness of sustainability, seeing it as an ongoing process of improvement and adaptation. They integrate sustainability practices across different areas, usually involve all stakeholders in decision-making, and seek synergies among resources, projects, and departments. They also discuss the importance of networking and collaborations across various entities, recognising that universities are not isolated systems but are part of a larger, interconnected global system. One of the interviewees highlighted:

   > [a connected approach] challenges the fundamentals of how universities are set up because we are set up to be experts in reductionists or niche areas, and I think sustainability calls us to work across those areas. It does not diminish the importance of expertise and deep expertise, but I think it also requires us to work across disciplines.

In summary, through the case studies analysis, it was observed that the collaboration among teams, the alignment towards a common vision, the commitment to continuous learning, and the understanding of interconnectedness demonstrate the universities' dedication to organisational learning for sustainability. By embracing these dimensions, universities can create a culture of sustainability and contribute to global efforts towards a more sustainable future. Fig. 6 synthesises the initiatives conducted by the studied HEIs to promote organisational learning for sustainability.

Based on the study's findings and the literature on the topic, a framework for organisational learning and transformative learning for sustainability in higher education was proposed (Fig. 7). The five main phases towards the institutionalisation of sustainability in HEIs through the lens of these two theories can be described as follows.

1. Awareness and Understanding: In this phase, the institution recognises the need for sustainability and identifies existing sustainability practices within its spaces. Moreover, it fosters critical thinking, self-

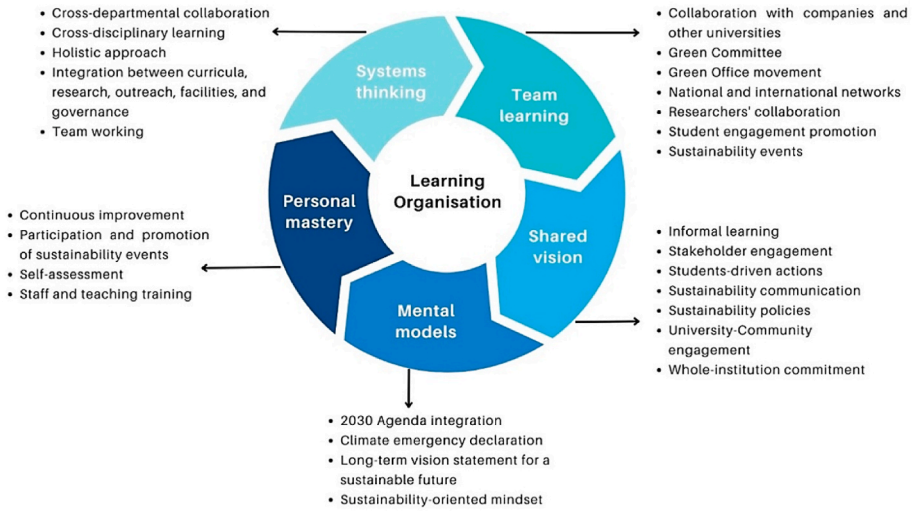


**Fig. 6.** Initiatives to promote organisational learning for sustainability in higher education.
Source: prepared by the authors based on the study's data and the five dimensions of organisational learning proposed by Senge (2006).

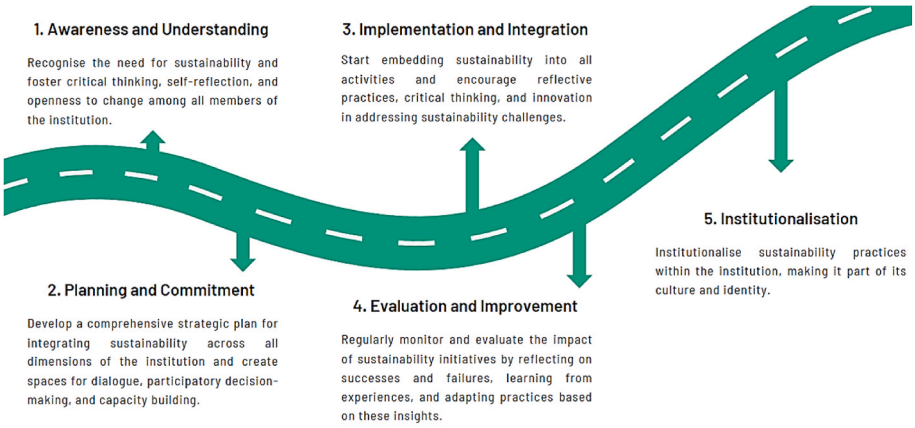


**Fig. 7.** Roadmap for embedding sustainability in higher education through transformative and organisational learning.
Source: prepared by the authors based on the study's data.

reflection, and openness to change among all members of the institution (faculty, students, staff, and managers).

2. Planning and Commitment: In this phase, the HEI develops a comprehensive strategic plan for integrating sustainability across all dimensions of the institution (teaching, research, outreach, facilities, governance). This may involve commitments, sustainability policies, and a dedicated team for sustainability efforts. Furthermore, it creates spaces for dialogue, participatory decision-making, and capacity building to empower the university community to embrace the sustainability agenda.
3. Implementation and Integration: The institution starts embedding sustainability into its activities and continues fostering a sustainability culture through ongoing dialogue, reflective practices, training, stakeholder engagement, benchmarking, and partnerships with other institutions.
4. Evaluation and Improvement: This phase refers to regularly monitoring and evaluating the impact of sustainability initiatives. This could involve developing sustainability indicators, conducting sustainability audits, participating in sustainability rankings, and obtaining feedback from stakeholders. Through these initiatives, the institution has the opportunity to reflect on its successes and failures, learn from experiences, and adapt itself, promoting continuous learning and improvement.
5. Institutionalisation: This stage refers to the last one in the 'sustainability maturation curve' stated by Kapitulčinová et al. (2018), where sustainability is part of the institution's culture and deeply embedded in all policies, structures, and processes. Moreover, sustainability is a shared value and a normative expectation for all members of the institution. However, the process does not end at this stage, since the journey towards sustainability is a continuous process that requires ongoing learning, adaptation, and improvement.

The roadmap should be analysed together with the stages of transformative learning for sustainability in higher education (Fig. 5) and the initiatives to promote organisational learning for sustainability in higher education (Fig. 6) since they are complementary. For instance, disruptive events can lead to the universities' awareness and understanding of sustainability issues. Then, a critical reflection supports the institutions' planning and commitment and a new perspective development, the implementation and integration of initiatives. Finally, the new perspective integration enhances sustainability institutionalisation. The organisational learning dimensions should permeate all the roadmap stages to develop a sustainability culture in the university community.

The presented framework provides a roadmap for HEIs seeking to integrate sustainability into their activities and culture through transformative and organisational learning. However, each HEI has its specificities, and there is no universal model of practices (Jamali, 2006).

Therefore, it should be adapted to the unique context and needs of each institution, which should discover its own solutions by choosing the tools that best match its particular situations and contexts (Kapitulčinová et al., 2018). Moreover, the implementation of transformative and organisational learning for sustainability needs to be perceived as an ongoing process, and one that requires commitment, creativity, and willingness to change. It also demands the alignment of sustainability goals with the institution's core educational mission. By deploying transformative organisational learning in their sustainability efforts, HEIs can significantly contribute to the development of a more sustainable global society.

## 5. Conclusions

This study aimed at understanding the learning processes, paths, and practices that can contribute to HEIs' transformation towards sustainability, from the transformative and organisational learning perspectives. Our specific goals were: (1) to map the literature on the topic; (2) to investigate how sustainability is embedded into top sustainable HEIs' activities; and (3) to understand the role of transformative and organisational learning for sustainability in higher education.

Regarding the first objective, the findings from the bibliometric and literature review on the topic provided a comprehensive analysis of transformative and organisational learning for sustainability in higher education, pointing out current trends in the field. Moreover, it essentially supported the second research stage (multi-case studies) by providing theoretical guidance for the interview protocol and qualitative analysis.

To address the second objective of the study, a multi-case study with fifteen top sustainable HEIs was conducted. Data collection was performed through observation techniques (in-loco visits to the HEIs campuses), face-to-face interviews with different stakeholders at the fifteen HEIs, but especially with sustainability managers, and document analysis on the HEIs' sustainability reports. The main initiatives carried out by the interviewed HEIs to embed sustainability into their activities were then categorised and detailed in agreement with the 'whole-institution' approach, that is: education, research, outreach, facilities, and governance. The findings illustrated that, despite the governance challenges this approach requires, it is possible for HEIs to fully integrate sustainability into their main activities. Based on a detailed description of the activities carried out by the interviewed universities, the study shed light on how universities are capable of significant transformation and change towards sustainability. Furthermore, drawing from the thematic and content analysis of the interviews, drivers and challenges for sustainability in higher education were highlighted.

Finally, to address the third objective of this study, the role of transformative and organisational learning was investigated. Both the individual and organisational dimensions were found to be essential, aligning with Argyris and Schön's (1978) statement that an organisation's capacity to learn is directly linked to the learning capacities of its individuals. This study thereby not only expanded the theoretical understanding of transformative and organisational learning for sustainability but also offered practical insights into how these theories are operationalised within top sustainable HEIs. As main contributions of this analysis, we provided three frameworks for sustainability in higher education which can help HEIs to (1) embrace sustainability by going through the key stages of transformative learning, (2) promote organisational learning for sustainability in higher education, and (3) embed sustainability in higher education through transformative and organisational learning. However, it is essential to recognise that transformation towards sustainability is an ongoing process and requires continuous learning and re-evaluation.

Nevertheless, in conclusion, through the lens of the transformative and organisational learning perspectives and from the experience of the most sustainable HEIs, this study provides theoretical and practical insights into the various pathways to sustainability, illustrating its applications under real and international contexts. It is hoped that these insights will inspire and guide other HEIs on their journey toward sustainability, thus advancing global efforts to achieve the UN 2030 Agenda for SD. The idea is that universities and colleges should lead by example, demonstrating sustainability in action and preparing students to be agents of change in a world facing critical environmental and social challenges.

### 5.1. Limitations of the study

There are limitations of this study that should be mentioned, such as (1) Sample Selection: The study focused on the top sustainable HEIs based on the UI GreenMetric ranking. While this offered valuable insights into best practices, it may limit the generalisability of the findings. Universities that participate in different rankings might exhibit different paths to sustainability or face unique challenges that were not captured in this study. One of them, for instance, is related to funding resources, which were not considered a challenge for the interviewed HEIs, but a driver for the development of their activities - mainly due to the commitment and support provided by their institutions' administrations. However, it can be a challenge faced by other HEIs around the world (Leal Filho et al., 2017); (2) Geographic Limitation: Although the study examined HEIs from six different countries, the global variability in higher education systems, cultures, and political-economic contexts is vast. As a result, the findings may not be representative or applicable to HEIs in all countries or regions; (3) Focus on Successful Cases: By focusing on the top-ranking institutions, the study might have overlooked the struggles and challenges faced by institutions at different stages of the 'sustainability maturation curve'; (4) Data Collection Methods: The study relied on observation techniques, interviews with sustainability managers, and document analysis. While these methods are robust, they inherently contain some degree of subjectivity, especially if respondents provide socially desirable responses; and (5) Timing of the Study: This study was conducted at a specific point in time. Given that sustainability integration is an ongoing process, the findings may evolve or change over time. The study is also a picture of a dynamic process that might have different outcomes under different conditions or time frames.

### 5.2. Future research insights

Although the study presents a promising framework on the topic, it is crucial to continually assess and refine the strategies and practices employed in this transformation journey. Furthermore, future research should explore potential barriers to this transformation, identify opportunities for enhanced learning processes, and evaluate the effectiveness of existing strategies to ensure the transition to sustainability within HEIs. In addition, exploring other geographical contexts, considering other University Rankings, interviewing other HEIs' stakeholders (students, local community), conducting different methodological approaches, and using different theoretical foundations could enhance the discussion on the topic, bring new perspectives to the field, and foster innovative solutions to the sustainability challenges.

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## CRediT authorship contribution statement

**Laís Viera Trevisan:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Walter Leal Filho:** Writing – review & editing, Writing – original draft, Supervision, Data curation. **Eugênio**

**Ávila Pedrozo:** Writing – original draft, Supervision, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2024.141634.

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