UNIVERSIDADE CATÓLICA PORTUGUESA

Sustainability in Higher Education Institutions: What is it and how to quantify it?

Beatriz Neves Vieira Silva

Católica Porto Business School

2025

UNIVERSIDADE CATÓLICA PORTUGUESA

Sustainability in Higher Education Institutions: What is it and how to quantify it?

Final Work in Academic Context
presented to Universidade Católica Portuguesa
in order to obtain the master's degree in Management
with specialisation in Business Analytics

by

Beatriz Neves Vieira Silva

Under the guidance of
Professora Doutora Maria da Conceição Andrade Silva

Católica Porto Business School, Universidade Católica Portuguesa
Maio 2025

Acknowledgements

The elaboration of this master's thesis represented the greatest challenge I have ever faced academically and, at the same time, symbolizes an immense achievement. It was months of intense commitment and dedication, balancing studies with the beginning of my professional life. This work is not only the fruit of my personal effort, but above all, of the support and commitment of those around me.

I want to dedicate my deepest thanks to my parents, Orlando Silva and Sara Silva. Your unconditional support, tireless effort, love and dedication were fundamental. Without your investment in me, this master's degree would not have been possible.

To my boyfriend, for being my right-hand man, my partner and for supporting me throughout these intense months of work.

To my sister, for supporting me in every choice and for always being the voice of reason in my decisions.

To my brother-in-law, for your wise advice and motivation throughout this journey.

To my godson, for brightening my days with your laughter and, in your own unique way, inspiring me to see the world anew.

To my grandfather Hélder, for your constant presence, care, and support.

To my godmother Claúdia, for being a constant support from the very beginning of this journey.

To the rest of my family, my boyfriend's family, my best friends, who believed in me and contributed to making this journey so special.

Finally, a very special acknowledgment to Professor Maria Conceição Andrade Silva, whose dedication, commitment, and kindness were essential to the development of this dissertation. Without your support and guidance, this work would not have been achieved in the same way.

Resumo

Esta dissertação investiga e avalia a literacia em sustentabilidade de estudantes e professores universitários portugueses, bem como o papel atual e o contributo futuro das instituições de ensino superior (IES). Após uma revisão bibliográfica completa, selecionaram-se e adaptaram-se itens de estudos anteriores (Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018) Leal et al. (2024), Aleixo et al. (2021)) para construir um questionário centrado em três principais construtos - **conhecimento, comportamento e atitude**. A amostra final incluiu 163 respostas válidas (117 estudantes e 46 professores). Os dados foram submetidos a análises estatísticas - incluindo correlações e α de Cronbach - e ao cálculo de índices para cada construto, seguidos da interpretação dos resultados e criação de dois dashboards interaticos relativos a cada grupo. Os resultados revelaram uma lacuna entre o índice de conhecimento e os índice de atitude e comportamento e apontam para a necessidade das instituições de ensino superior assumirem um papel mais ativo no fomento da literacia em sustentabilidade em Portugal.

Palavras-chave: Sustentabilidade, Desenvolvimento Sustentável, Instituições de Ensino Superior, Literacia, Conhecimento, Atitude, Comportamento, Indices, Medição, Construto, Análise

Nº de palavras: 9300

Abstract

This dissertation investigates and assesses sustainability literacy among Portuguese university students and teachers, as well as the current role and future contribution of higher education institutions (HEIs). After a comprehensive literature review, items from previous studies were selected and adapted (Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018)Leal et al. (2024), Aleixo et al. (2021)) to construct a questionnaire focused on three main constructs - **knowledge, behaviour and attitude**. The final sample included 163 valid responses (117 students and 46 teachers). The data were subjected to statistical analysis - including correlations and Cronbach's α - and the calculation of indexes for each construct, followed by the interpretation of the results and the creation of two interactive dashboards for each group. The results revealed a gap between the knowledge index and the attitude and behaviour indexes and point to the need for higher education institutions to take a more active role in promoting sustainability literacy in Portugal.

Keywords: Sustainability, Sustainable Development, Higher Education Institutions, Literacy, Knowledge, Attitude, Behaviour, Indices, Measurement, Construct, Analysis

Word Count: 9300

Contents

List of Figures

List of Tables

1 Introduction

In a world where sustainability has become a defining global challenge, Higher Education Institutions (HEIs) are uniquely positioned to lead the way.

The dual role that universities must adopt involves taking responsibility for teaching, educating and promoting sustainability literacy to various groups within the institution, as well as implementing sustainable management practices within organisations.

It is essential to understand the level of sustainability literacy among higher education students – future professionals – and teachers. By integrating sustainability into strategic planning, daily operations, curricula and research, HEIs would promote innovation, competitiveness and development in the area of sustainability.

However, there are clear challenges for HEIs—fragmentation of initiatives, lack of financial and human resources, organisational resistance and leadership, lack of standardisation and impact assessment—that hinder the integration of sustainability, as addressed by Abad-Segura and González-Zamar (2021), Alhazmi et al. (2023), Abo-Khalil (2024) and Alberti et al. (2023)

This raises three essential research questions to be studied throughout this dissertation:

- **RQ1:** What is the level of sustainability literacy among portuguese students attending higher education?
- **RQ2:** What is the level of sustainability literacy among university teachers?
- **RQ3:** How does Higher Education Institutions (HEIs) contribute or can contribute to sustainability literacy and sustainable management practices?

To this end, an extensive literature review was conducted, focusing on the role of universities and the measurement of sustainability literacy. With this, a questionnaire was developed with items extracted from studies - developed by the authors Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018), Leal et al. (2024) and Aleixo et al. (2021). It focused on three main constructs to measure literacy - **knowledge, behaviour and attitude** - and some items related to the current and future role of institutions. The questionnaire was applied only to portuguese students and teachers and had a total sample of 170 respondents, 163 of whom were eligible.

With this in mind, this thesis aims to measure the level of sustainability literacy among Portuguese students and teachers. The items were analysed for internal consistency (Cronbach's alpha), correlation, and indexes were constructed for these three constructs. In addition, the current role of each respondent's institution and their suggestions for the future will be investigated. Furthermore, detailed analyses and graphs were developed for both fields in order to highlight the results obtained.

2 Previous Literature

2.1 Sustainability

Sustainability is generally defined as the ability to maintain a balance between economic growth, social equity and environmental preservation, through practices that ensure the well-being of current and future generations, (Abad-Segura and González-Zamar, 2021). With this, the concept of sustainable development (SD) grew and gained international prominence after the Brundtland Report in 1987, which defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In addition, it addressed education as a way of helping to realise sustainability initiatives and as a propagation tool, (Nolet, 2015).

At this point, several global initiatives attempted to address the issue of sustainability and education. The publication of the Brundtland report gave rise to a conference known as the Earth Summit, held in Rio de Janeiro in 1992, which led to the creation of Agenda 21 - represented by more than 178 countries. Subsequently, in 2000, the member countries, at UN headquarters, developed the Millennium Development Goals (MDGs) by 2015. Given the growing importance of sustainable development, in 2015 the United Nations (UN) established 17 Sustainable Development Goals (SDGs) to tackle global challenges such as poverty, inequality, climate change and environmental degradation - which have recently been adopted into the 2030 Agenda (Karimi and Hakim, 2024). These goals require global collaboration between governments, the private sector and society, (BCSD, 2025).

According to UNESCO (2017), 'the goal of the 17 SDGs is to ensure a sustainable, peaceful, prosperous and equitable life on Earth for all, now and in the future'. The report about Sustainable Development Goals of 2024, published by the UnitedNations (2024), presents a detailed analysis based on data from more than 50 international organisations. The research reveals that only 17% of the goals are on track, while almost half show minimal or moderate progress and more than a third have stagnated or regressed. The consequences of the COVID-19 pandemic, geopolitical conflicts, trade tensions and climate change are some of the main obstacles to progress on the SDGs.

2.1.1 Dimensions of Sustainability

The good path to sustainable development is defined by the balance between three pillars (Abad-Segura and González-Zamar, 2021). Maintaining the link between the different dimensions of SD is important in order to have a holistic and complete view between environmental, social and economic aspects - as described in Figure 1, (Karimi and Hakim, 2024):

1. Environmental: It concerns the preservation of the environment, ensuring its capacity to support human life. This involves protecting biodiversity, fighting climate change, access to clean water and seeking to reduce waste and maximise the use of renewable resources;

2. Social: it aims to create conditions that enable all people to fully exercise their rights and fulfil their needs freely and fairly. Issues such as human rights and gender equality are fundamental to promoting peace and social stability;

3. Economic: it emphasises the need to meet current demand without compromising future resources. Since resources are finite or irrenewable, and excessive economic expansion has led to unsustainable use of resources - hence the need for inclusive, efficient, and equitable growth, always in line with environmental limitations.

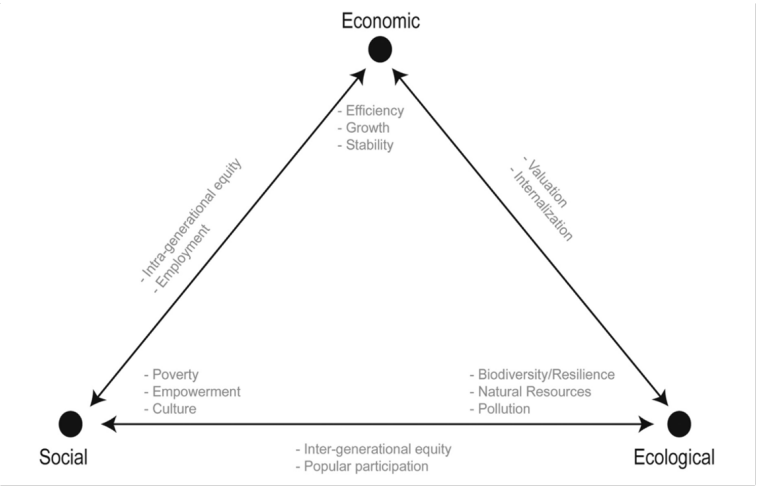

Figure 1: Graphical representation of sustainable development
Source: Ruggerio (2021)

2.1.2 Sustainability and Development in Portugal

Sustainability has become one of the central elements of public and business policies in Portugal, reflecting both international commitments and growing social awareness. Studies and initiatives show that this issue is decisive for economic development, competitiveness and the population's quality of life. An example of this impact is the study carried out by the EIB (2023), which analysed young Portuguese people's perceptions of sustainability in the labour market. The results show that 80% of young people attach great importance to a company's sustainability strategy when choosing a job - a figure that exceeds the European Union average of 76%. In addition, 67% say that the organisation's environmental reputation directly influences their decision to accept a job offer, demonstrating that sustainability is no longer just a differentiating factor but an essential criterion in retaining talent. Interestingly, more than half of young Portuguese are willing to accept a lower salary to work for a company with a strong environmental

commitment, showing a cultural shift in which sustainable purpose and values are increasingly prioritised.

This concern for sustainability also extends to public policies, as demonstrated by the Sustainable Development Goals (SDG) indicators for Portugal, published by INE (2024). The analysis of 179 indicators from 2015 to 2023 points to significant progress in 11 of the 17 SDGs, reframing the country's commitment to a sustainable development agenda. At the same time, the 'Sustainable 2030' programme - financed with 3.1 billion euros from the European Union's Cohesion Fund - directs support efforts on several fronts (GOV, 2025). In addition, to make it easier to monitor this progress, the ODSLocal (2025), platform was created, which assesses the performance of Portugal's 308 municipalities in relation to the SDGs, providing tools for citizens to analyse information on each city, municipality, projects involved, good practices, among others. For example, the city of Porto has made positive progress in SDG9 (Innovation and Infrastructure), but its performance in eradicating hunger (SDG2) is not as positive.

At a global level, Portugal has made significant progress. Lafortune et al. (2024), indicates that the country has risen two places in the global sustainability ranking, reaching 16th position. However, the report also warns that none of the 17 SDGs are on track to be fully achieved by 2030, emphasising the need for continuous and collaborative efforts to consolidate these advances.

Universities, within the framework of social and environmental responsibility, cannot remain outside the SDGs. Sustainability, together with integrity, are the central axes of what the university's contribution should be to direct society towards a future that guarantees the well-being of those who are and those who have not yet arrived. Hence, sustainability, in its three dimensions (social, environmental, and economic), should be the key that defines the university's strategy, along with a series of actions, activities, and proposals, (Schank and Rieckmann, 2019).

2.2 Sustainability in Higher Education

To respond to the urgent challenges facing our planet, since the early 2000s, UNESCO has been integrating programmes aimed at encouraging changes in knowledge, values and attitudes in education. It has now launched the Education for Sustainable Development (ESD) programme for 2030, aligned with the Sustainable Development Goals of the 2030 Agenda: 'Encourage people to make smart and responsible choices that help create a better future for all, (UNESCO, 2017). In addition, the SDGS (2025), together with the higher education community, has also launched the Higher Education Sustainability Initiative (HESI), which 'aims to strengthen the role of the higher education sector in promoting sustainable development by

facilitating debate among various stakeholders, actions and the dissemination of best practices.'

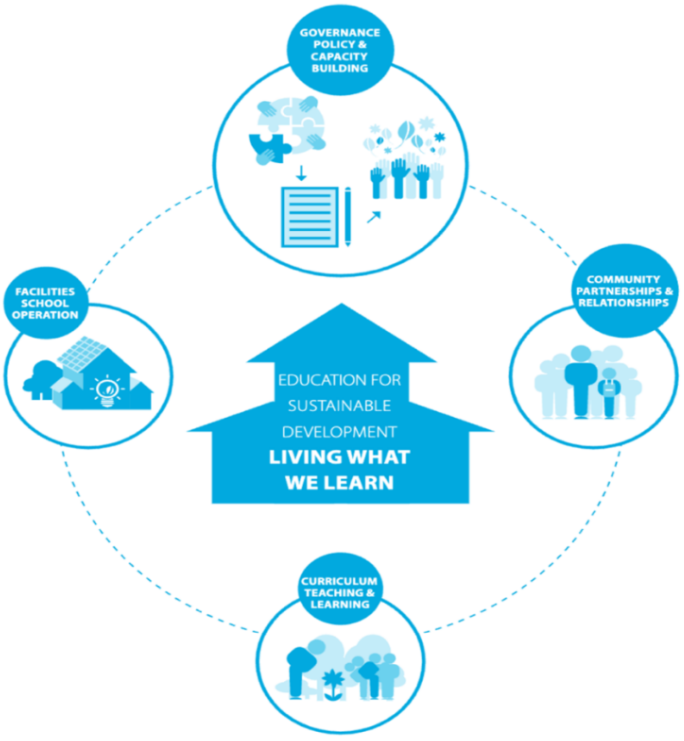

Figure 2: Recreation of the UNESCO ESD circle
Source: Karimi and Hakim (2024)

Figure 2 represents the concept of 'Living what we learn', indicating the idea of living according to the principles we learn. Around it, we have the five fundamental areas for implementing ESD:

1. Governance, Policy and Capacity Building: the importance of having solid policies that support sustainability.

2. Facilities and School Operation: the importance of adopting daily actions in schools

3. Community Partnerships and Relationships: the importance of involving the community and establishing partnerships that promote sustainable practices

4. Curriculum, Teaching Learning: the importance of integrating sustainability into the curriculum and adopting sustainable teaching practices.

Higher Education Institutions (HEIs) are increasingly playing a crucial role in sustainable development and, consequently, in economic and social growth. Hassan et al. (2024), argues that recent global crises, the COVID-19 pandemic, climate change and economic instability, demonstrate the urgency of restructuring HEIs so that they act as active agents of global transformation. This not only involves adopting sustainable practices in institutional management, but also integrating these principles into teaching, research and extension.

Sanchez-Carrillo et al. (2021), argues that HEIs are essential agents for training qualified individuals to implement the Sustainable Development Goals. The author divides his study into five main axes:

1. Economic Impacts: HEIs boost economic growth by promoting an increase in living standards and the development of students' and teachers' technical and analytical skills.
2. Social Issues: they contribute to the formation of individuals who are increasingly aware of and aware of society's needs, promoting equity and social justice.
3. Pedagogical aspects: the research reinforces that pedagogical innovation is essential for transforming teaching into an even more powerful tool for sustainable development.
4. Structural Challenges: Internal obstacles, the author argues that institutional barriers hinder the adoption of sustainable practices

In addition to these aspects, Iqbal and Piwowar-Sulej (2022) state that sustainable leaders create an environment that stimulates creativity, organizational training, and innovation. The study emphasizes the importance of social innovation as a mechanism that connects sustainable management with sustainable performance. Therefore, HEIs can lead by implementing sustainable management policies, reducing their environmental footprint, and promoting responsible management practices. This includes adopting renewable energies, energy efficiency in university centers, encouraging sustainable mobility, recycling programs, and waste management.

According to Alberti et al. (2023), universities are increasingly coming together to share good practices, develop assessment methodologies and promote institutional policies in line with the SDGs. Indicators such as environmental certifications (like ISO 14001), adherence to international initiatives like the Sustainable Campus Network (SCN) and rankings like the Green Metric Ranking are some of the strategies adopted to measure the impact of sustainable actions in higher education.

Complementing this view, Trevisan et al. (2024), carried out a study of 15 universities globally recognised for their sustainability practices and identified five main dimensions in which universities have integrated their sustainable practices:

1. Curriculum: sustainability is incorporated into subjects in various areas
2. Research: projects oriented towards the SDGs;
3. Infrastructure: implementation of green technologies;
4. Extension: government, business and organisational partnerships geared towards sustainability;

5. Management: integration of strategic plans and sustainable development departments.

2.2.1 Challenges in Implementing Sustainability in Higher Education

Despite the growing importance of sustainability in higher education, there are a number of barriers that prevent the wider and more effective adoption of sustainable measures. The main obstacles identified in the literature include:

1. Fragmentation of initiatives

   According to Abad-Segura and González-Zamar (2021), one of the biggest challenges is the fragmentation of initiatives within universities. Many institutions treat sustainability in isolation, applying it to specific disciplines, research projects or administrative operations, without a unified strategy that integrates all sectors of the university.

2. Lack of financial and human resources

   Alhazmi et al. (2023) and Abo-Khalil (2024), state that many universities face difficulties in obtaining funding for sustainable projects, green infrastructure and teacher training programmes.

3. Organisational resistance and leadership

   Abo-Khalil (2024), also mentions that academic managers and teachers resist curricular and structural changes, avoiding new pedagogical approaches and investments in innovation. This resistance is related to a lack of knowledge about sustainability, insecurity about the effectiveness of new methodologies and an institutional culture still focused on traditional teaching models - which do not always integrate sustainability as an intrinsic value in institutional management.

4. Lack of Standardization and Impact Assessment

   According to Alberti et al. (2023), the lack of standardisation in assessment makes it difficult to compare institutions and formulate effective strategies for improvement. Many universities approach sustainability as a theoretical or secondary concept, without integrating it in a positive and meaningful way.

2.2.2 Opportunities and Strategies for Implementing Sustainability in Higher Education

Faced with the challenges mentioned above, several opportunities arise to consolidate the role of HEIs in the sustainable transition.

According to Trevisan et al. (2024), emerging technologies and growing social pressure for sustainable practices create a favourable environment for innovation in higher education. Tools

such as digital teaching platforms, artificial intelligence applied to resource management and the use of big data for environmental monitoring can facilitate the implementation of sustainability in universities.

Another promising aspect pointed out by Nogueiro et al. (2022) is the adoption of sustainability as a quality criterion in higher education. Universities that incorporate sustainable practices into their institutional metrics are better able to attract students and obtain international funding. In addition, transparency in actions and accountability through sustainability reports are also effective strategies for strengthening the credibility of HEIs and boosting their commitment to the SDGs.

Furthermore, Abo-Khalil (2024), states that although the challenges of integrating sustainability into higher education are substantial, universities have a unique opportunity to lead the transition to more sustainable societies and to become living laboratories.

According to Sanchez-Carrillo et al. (2021) and Wang et al. (2022), five main strategies are proposed to overcome the challenges that still exist in HEIs:

1. Transform institutional identity: reformulate academic, curricular and administrative practices to align them with sustainable principles. This involves creating objective assessment systems to measure the environmental, social and economic impact of institutions. In addition to integrating sustainability into different disciplines.

2. Structural openness and dissemination of information: promote transparency and the sharing of good sustainable practices from different sectors of the academic community - adopt sustainability reports.

3. Training and education: train and educate teachers, managers and staff in areas of sustainability.

4. Academic Community: create a link with students and communities by participating in local initiatives.

5. International collaboration: encourage partnerships between higher education institutions, promoting knowledge and the implementation of sustainable practices in different contexts.

2.3 Sustainability Literacy

The framing of the term environmental literacy was first defined by Roth (1992), who defined environmental literacy as: ”Environmental literacy is the ability to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore

and improve the health of systems". With this, over the years, the author Décamps et al. (2017) together with the Sulitest - a platform designed to measure sustainability knowledge - defined sustainability literacy " as the knowledge, skills, and mindsets that help compel an individual to become deeply committed to building a sustainable future and allow him or her to make informed and effective decisions to this end".

The authors Michel and Zwickle (2021), analysed how different sources of information influence university students' knowledge and attitudes towards sustainability, namely social media, news, academic courses, among others (Figure 3). The authors developed the study and, among their conclusions, highlighted that, in relation to formal sources of education, students who attended courses on the subject had higher levels of knowledge about sustainability. In addition, traditional sources of communication, such as television, radio and newspapers, did not have a significant impact on students' knowledge. This contrasted with the use of social media, which was associated with higher levels of knowledge.

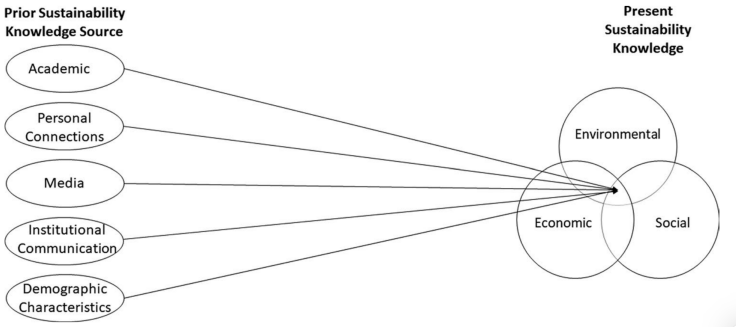

Figure 3: Conceptual model developed by Michel and Zwickle (2021)

2.3.1 Empirical Studies on Sustainable Literacy

The study developed by Ajzen et al. (2011), addresses the Theory of Planned Behavior (TPB), according to which human behavior is shaped by attitudes, social norms, and behavioral control. The author defines attitude as a state of mind that leads a person to react either positively or negatively, whereas behavior corresponds to the observable actions of an individual and knowledge as the awareness or understanding acquired through experience or study. Thus, Figure 4 shows the proposed theoretical model that has proven useful in predicting different types of behavior among individuals. In this case, knowledge about sustainability, often addressed by universities, influences students' attitudes. In turn, these attitudes have a direct impact on the sustainable behaviors adopted. Furthermore, knowledge can directly influence behavior, regardless of attitude (Rafael et al., 2022).

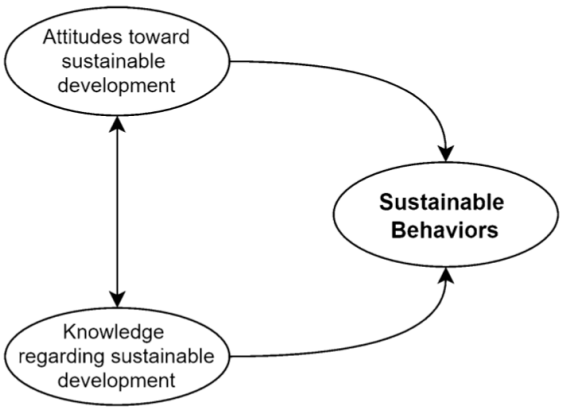

Figure 4: Proposed theoretical framework based on Ajzen et al. (2011)
Source: Rafael et al. (2022)

Over the years, the variety of studies on sustainability in higher education and literacy has been increasing. Table 1 presents some research studies on sustainability literacy in various contexts around the world, highlighting the types of scale used in each, the country where it was developed, the authors, and whether they address the three main factors: knowledge, attitude, and behaviour. The analyses target two different groups of participants, ranging from teachers to students. In addition, some studies consider various dimensions, from the environment to society, the economy and educational institutions, among others.

Reference	Country	Type of Scale	Knowledge	Attitude	Behaviors
Sulitest (2025)	France	Multiple Choice	X		
GapMinder (2025)	Sweden	Multiple Choice	X		
Karimi and Hakim (2024)	German	Likert scale / GREEN scale	X	X	X
Olsson et al. (2015)	Sweden	Likert scale	X	X	X
Michalos et al. (2011), Michalos et al. (2015)	Canada	True or False / Likert scale	X	X	X
Sekhar and Raina (2021)	India	Likert scale	X	X	X
Rafael et al. (2022)	Mexico	Likert scale	X	X	X
Erguvan (2024)	Kuwait	Multiple Choice / Likert scale	X	X	X
Zwickle and Jones (2018)	EUA	Multiple Choice	X	X	
Makri et al. (2022)	Spain	Multiple Choice	X	X	
Aleixo et al. (2021)	Portugal	Likert scale			X
Campos et al. (2024)	Portugal	Multiple Choice / Likert scale			X
Leal et al. (2024)	Portugal	Likert scale			X
Nguyen and Bui (2022)	Vietnam	Likert scale	X		

Table 1: Scales and Empirical Studies to Measure Sustainable Literacy

One of the measurement tools developed is Sulitest, a platform designed to promote, enhance, certify, and measure the sustainability knowledge of individuals and organizations. Provides assessments covering social, environmental and economic issues. These assessments are designed to measure the level of knowledge in sustainable responsibility and are applicable worldwide to any higher education institution and its students. Sulitest is currently used by more than 650 universities and companies in more than 60 countries. One of Sulitest's most prominent tools is TASK™, the first international certification of sustainability knowledge. TASK™ 'offers a comprehensive psychometric assessment covering a wide range of sustainability-related topics, allowing universities, companies, and individuals to measure and demonstrate their knowledge in the field', Sulitest (2025).

In the same logic, there is GapMinder (2025) - an educational platform with the main aim of promoting knowledge by using reliable data and presenting it in an accessible way through interactive dashboards and games. The platform offers games and visualizations that address in detail, but in a clear and accessible way, each of the 17 Sustainable Development Goals (SDGs), allowing users to explore these goals in both specific and global terms.

In addition, studies have been conducted to measure sustainability literacy, such as that by Karimi and Hakim (2024). The authors developed a quantitative survey consisting of 47 questions that investigated individual preferences and knowledge related to sustainability, based on three main dimensions: knowledge about sustainability, attitudes towards sustainability, and sustainable behaviours. The survey obtained a total of 258 responses, of which 172 were complete and suitable for Exploratory Factor Analysis (EFA). The study developed by Olsson et al. (2015) aims to assess 'sustainability awareness'. It consisted of 50 questions covering three dimensions of sustainable development: environmental (17 items), economic (13 items) and social (20 items). The aim of the questionnaire was to assess students' knowledge, attitudes and behaviours in relation to these three aspects.

Similarly, Michalos et al. (2011), sought to assess the same concepts in relation to Education for Sustainable Development (ESD). The questionnaire was sent to 5,000 families in Canada and resulted in 506 responses. The questionnaire consisted of three main sections: 17 questions on sustainability knowledge, 15 questions on attitudes and 15 on sustainable behaviour. Years later, Michalos et al. (2015) developed and complemented the study by testing the hypothesis that knowledge and attitudes favourable to sustainability lead to favourable behaviours. They used a sample of 1,108 students from Manitoba, Canada, and developed three indices. They analysed the Knowledge, Favourable Attitudes and Favourable Behaviours indices. About 25% of the variation in the Behaviour Index score can be explained by the Knowledge Index and Attitude Index scores, with knowledge exerting a relatively greater influence than attitudes.

In addition, Sekhar and Raina (2021), also assessed the sustainability literacy of students from Management Education Institutions (MEIs) in the social, environmental and economic domains. The questions to measure sustainability literacy were developed within the Sulitest and UNDESD frameworks. The study reached 409 respondents and revealed a difference in sustainability literacy levels among postgraduate students in the three cities. Another relevant study was conducted by Rafael et al. (2022), which also analysed the levels of knowledge, attitudes and sustainable behaviours among university students in Mexico. The survey involved a sample of 350 students and revealed that although students have a moderate level of knowledge and positive attitudes towards sustainability, their sustainable behaviours are still limited. Similarly, Erguvan (2024), investigated sustainability literacy among university students, with the aim of assessing the same three concepts in a quantitative phase involving 221 students.

Additionally, the study conducted by Zwickle and Jones (2018), contributes significantly to the field of sustainability research, as they developed a robust tool for assessing knowledge, integrating environmental, social and economic dimensions - the ASK (Assessing Sustainability Knowledge) scale. Along the same lines, Makri et al. (2022), analysed university students' perceptions of the Sustainable Development Goals (SDGs) and their sustainability literacy. The study obtained 321 responses and adopted Zwickle and Jones' ASK scale to assess the level of knowledge. It revealed that only 15.9% of students were familiar with all SDGs.

In the national context, Aleixo et al. (2021) developed, based on previous studies, a study for students from public higher education institutions in Portugal, with the aim of measuring their habits, experiences and behaviours in relation to sustainability. The study, which was descriptive and exploratory in nature, involved 1,257 students from various public institutions and assessed their perceptions of the promotion of sustainability in institutions, integration into courses, the impact of teaching on environmental awareness, knowledge and involvement in sustainable practices. The results showed that, although students recognise the importance of sustainability, 16% had never heard of the SDGs and believe that higher education institutions should offer more training on the subject. In addition, the study by Campos et al. (2024), also contributed to measuring environmental literacy among university students in Portugal. A survey was conducted with a sample of 451 respondents, suggesting that students demonstrated moderate environmental knowledge, positive attitudes towards the environment and moderately positive environmental behaviours.

Years later, Leal et al. (2024), conducted a study focusing on teachers' perceptions, using an online questionnaire applied to teachers from Portuguese public higher education institutions, including polytechnics and universities. The sample consisted of 444 participants and the data were analysed using Exploratory Factor Analysis. Essentially, it assessed the incorporation of

sustainability in institutions, the integration of sustainable development in the curriculum, the training offered in SD, agreement with statements on climate change and the involvement of teachers in sustainability actions. The results indicated that, although most teachers believe that institutions promote sustainability, only 16% believe that it is truly integrated into all their actions. In an international context, Nguyen and Bui (2022), also conducted a study with 392 participants, in which they analysed the critical contextualisation of primary school teachers' knowledge, sustainable use of resources, participation in community processes, and ethics. The results of the study suggested a lack of perspectives on sustainable development among trainee teachers and gaps in teacher training curricula in relation to sustainable development.

Based on the studies and tools analysed above, although not all of them cover the three main dimensions — **knowledge, attitude and behaviour** — they constitute a complex and interrelated research system. Thus, the study developed in this article also aims to investigate these three dimensions, in order to provide a more comprehensive and integrated analysis of the factors that measure sustainability literacy.

3 Framework and Methods

A quantitative research method will be used to answer the researchs questions. In this section we explain the process of developing the questions for the questionnaire and the process of collecting and analysing the data. It is significant to highlight that the research will involve two distinct target groups — **university students and teachers** — with the aim of developing a comprehensive study on sustainability in higher education.

3.1 Framework to be employed

Table 2 presents the final structure of the questionnaire, which is the result of a lengthy analysis of the literature and a detailed investigation of the questionnaires developed by the authors and platforms. It includes the type of scale used, the number of items per construct, and the reference.

Nr	Construct	Type of Scale	Number of Questions	Reference
1	Target Identification	Multiple Choice	1 (Both target)	
2	Sociodemographic Questions	Multiple Choice / Open-ended	8 (Teachers), 7 (Students)	
3	Sustainability Knowledge Questions	Multiple Choice	8 (Both target)	GapMinder (2025)
4	Sustainability Behavior Questions	Likert scale / Multiple Choice	11 (Both target)	Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018)
5	Sustainability Attitude Questions	Likert scale	10 (Both target)	Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018)
6	Incorporation and Promotion of Sustainability in the Institution	Multiple Choice / Likert scale	3 (Teachers), 1 (Students)	Leal et al. (2024), Aleixo et al. (2021)
7	Future: Actions of HEI	Open-ended	1 (Both target)	Leal et al. (2024)

Table 2: Questionnaire Framework

The questionnaire is divided into two versions: one for students and one for teachers - the response to the **first item** - *"Are you a university student or a university teacher?"* - influences the version of the questionnaire. The versions are practically identical since the objective is to measure the same aspect for both groups - the only differences are in some items in constructs 2 and 6.

To adjust the clarity of the items, a pilot test was conducted with ten participants before the final version available in subsection 7.1 (students) and subsection 7.2 (teachers) was consolidated. It should be noted that references to items in each construct are made using the legend provided in these subsections and will be used throughout the document.

The second construct consists of sociodemographic items: ten items for each group (some of which differ) - Q2 to Q11. For the remaining constructs, the items were taken from the studies referenced in Table 2 and adapted when necessary. For the **knowledge construct**, the eight items (Q12-Q19), with three multiple-choice options, were extracted from GapMinder (2025) and are in line with the UN goals. Regarding the **behaviour construct**, we started with a group of 15 items extracted from articles by Karimi and Hakim (2024), Olsson et al. (2015), Michalos et al. (2011), Zwickle and Jones (2018). After eliminating redundancy and reformulating items for our context - namely converting some questions to negative - the final version contains nine items (Q20-Q28) on a Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly agree) and two multiple-choice items (Q29-Q30) with 'yes' or 'no' answers. The **attitude construct** followed the same line as the previous one: we started with twelve items in the pilot test and arrived at ten (Q31-Q40) in the final version using the same Likert scale. The **Incorporation and Promotion items** differs for both groups and were extracted from the study of the authors Leal et al. (2024), Aleixo et al. (2021). In the case of teachers, it consists of three items (Q41-Q43): two of them with five multiple-choice options (with the possibility of selecting more than one option) and the other on a Likert scale (1 = Not at all, 2 = Very little integrated, 3 = Neutral, 4 = Integrated and 5 = Completely integrated). In the case of students, it consists of only one multiple-choice item (Q41) - the same for teachers. Finally, the **future item** consists of an open-ended item, extracted from the Leal et al. (2024) study, for both groups (Q42 for students and Q44 for teachers).

The final questionnaire was made available on Google Forms and remained active for three weeks, receiving a total of 170 responses, which were disseminated through social media and word of mouth. Python was used to process and analyse the data, which allowed the database to be cleaned and structured efficiently. After this process, 163 responses were eligible, of which 46 belonged to teachers and 117 to students. To organise this analysis, four separate scripts were developed and analysed in subsection 3.2. In addition, graphs were generated in Python to facilitate data interpretation. After this processing, dashboards were created in PowerBi to provide a more dynamic and accessible visualisation of some results obtained.

3.2 Data Analysis

The quantitative analysis of our survey data was studied in Python 3.1. We organised our workflow into four standalone scripts:

- `DataProcessing.py`: The first script's main purpose is to clean and normalise the collected data. Initially, all responses from foreign universities are removed to ensure a national sample. Next, in the data normalisation process, the names of universities, fac-

ulties, bachelor's degrees and master's degrees are organised and cleaned up to resolve inconsistencies in how respondents wrote their answers. A small summary analysis of the data was also performed. Finally, a new version of the CSV file is saved with the processed data, which will serve as the basis for '*DataAnalysis_Tests.py*' - it is important to note that a numerical Likert scale is used. In addition, it also generates two csv files, one with student data and the other with teacher data, converting the numerical Likert scale to text.

- `DataAnalysis_Tests.py`: This script integrates the document generated in *'DataProcessing.py'* with information from both groups. First, an analysis of the internal quality of each item is performed using Cronbach's internal consistency coefficient (β) for both students and teachers and the correlation. After the analysis, questions that promoted inconsistencies were eliminated, and an index was developed for each construct. In this case, the knowledge index corresponds to the average number of correct answers that each participant obtained in response to factual questions, on a scale of 0 to 8 — one point is awarded for each correct answer and 0 for each incorrect or blank answer. The behaviour and attitude indexes are calculated on a scale of 0 to 5, applying scale inversions to statements with negative polarity to ensure consistency. For each construct and group, the overall average of each index is detailed, as well as statistical tests (Student's t-test and Mann-Whitney U test) to compare the two groups.

- `DataAnalysis_Students.py`: The students script performs an in-depth analysis of the students' responses. The student CSV file created in *'DataProcessing.py'* is loaded, items considered inconsistent in *'DataAnalysis_Tests.py'* are deleted, and then a general demographic analysis is performed. After that, the level of knowledge about sustainability was measured by checking the percentage of correct answers for each item, as well as the distribution of answers by option. Behaviour and attitude were also analysed to observe trends in students' habits and choices regarding sustainability. In addition, the script investigates students' perceptions, in percentage terms, of the degree of integration of sustainability in their institutions. Finally, graphs were constructed to analyse the analysis - shown in subsection 4.2.

- `DataAnalysis_Teachers.py`: The third script follows a similar structure but is adapted to the particularities of the teachers. As in the previous case, demographic statistics are generated and each construct is analysed in the same way, as well as the institutional perception of teachers on the promotion of sustainability in their universities. Finally, as with the students, graphs were created and can be found in subsection 4.2.

4 Results

This chapter presents the main results, organised into three main sections. First, the sample is characterised in demographic terms, subsection 4.1. Next, subsection 4.2, an overall analysis is presented of the correlations and the α coefficient between the items of the main constructs and, in addition, the respective evaluation indexes are created. Finally, the results obtained among students and teacher are in subsection 4.3.

4.1 Demographic Characterisation

As previously mentioned, the final sample consists of 163 respondents - 117 students and 46 teachers. In terms of age, as can be seen in Table 3, more than half of the respondents (50.6%) are between 18 and 24 years old, followed by 23.5% between 25 and 34 years old. This distribution reveals that the student group is considerably younger (70.7% in the 18–24 age group and 26.7% in the 25–34 age group), while teachers are concentrated in older age groups - 39.1% between 35–44 and 34.8% between 45–54.

Group	18–24	25–34	35–44	45–54	55+
Overall	50.6%	23.5%	11.1%	10.5%	3.7%
Students	70.7%	26.7%	–	0.9%	0.9%
Teachers	–	15.2%	39.1%	34.8%	10.9%

Table 3: Age Distribution

In terms of gender composition, Table 4, the overall sample is predominantly female (62.3%), with 37.0% of participants being male and 0.6% preferring not to state their gender. Again, there are internal differences: among students, 65.5% are women and 34.5% are men, while among teachers these percentages are 54.3% and 43.5%, respectively, with 2.2% choosing not to disclose their gender.

Group	Female	Male	Prefer not to say
Overall	62.3%	37.0%	0.6%
Students	65.5%	34.5%	–
Teachers	54.3%	43.5%	2.2%

Table 4: Gender Distribution

In terms of universities, most of the overall sample came from the UMinho (24.2%), followed by UCP Porto (20.4%) and the UPorto (15.3%). When analysed separately, students were mainly concentrated at UMinho (25.0%) and UPorto (16.1%), while lecturers were more represented at UCP Porto (37.8%) and UMinho (22.2%) - as shown in Table 5.

Group	U. Minho	UCP Porto	U. Porto	U. Coimbra	U. Europeia	Others
Overall	24.2%	20.4%	15.3%	7.0%	5.1%	28.0%
Students	25.0%	13.4%	16.1%	7.1%	6.2%	32.2%
Teachers	22.2%	37.8%	13.3%	6.7%	2.2%	17.8%

Table 5: University Distribution (Top 5 + Others)

Analysing the school within the university Table 6, shows that CPBS (Católica Porto Business School) stands out the most with 21.2%, followed by the Faculty of Engineering with 15.2% and EEG (School of Economics and Management of UMinho) (9,8%). When we separate the groups, we see that, among students, 19.5% belong to the School of Engineering and 16.1% to CPBS. In contrast, 31.1% of teachers belong to CPBS, 20.0% to EEG, and only 6.7% to the Faculty of Engineering.

Group	CPBS	School of Eng.	EEG	FEP	Law	Others
Overall	21.2%	15.2%	9.8%	9.1%	6.1%	38.6%
Students	16.1%	19.5%	4.6%	10.3%	8.0%	41.5%
Teachers	31.1%	6.7%	20.0%	6.7%	2.2%	33.3%

Table 6: Faculty Distribution (Top 5 + Others)

With regard to teachers, as can be seen in Table 7b, the overwhelming majority of teachers (93.5%) have a PhD, with the remaining 6.5% holding a master's degree. In addition, most of the sample are assistant professors (37.0%), followed by full professors (26.1%) and associate professors (23.9%) - Table 7a. Furthermore, another relevant fact is that almost half of the teachers (47.8%) stated that they hold an academic leadership position.

(a) Academic Position Distribution

Academic Position	Percentage
Assistant professor	37.0%
Full professor	26.1%
Associate professor	23.9%
Teaching assistant	8.7%
Other	4.3%

(b) Highest Level of Education

Level of Education	Percentage
PhD	93.5%
Master's degree	6.5%

Table 7: Distribution of teachers by academic position and highest level of education

When we analyse the students, around 61.5% stand out for attending master's degrees, followed by 29.9% of bachelor's degree students - Table 8a. Among those doing master's degrees, 17.1% study Management, 12.9% Computer Engineering, among others - Table 8b.

(a) Degree Pursuing

Degree	Percentage
Master's degree	61.5%
Bachelor's degree	29.9%
Postgraduate studies	4.3%
PhD	4.3%

(b) Most Frequent Master's Degrees

Master's Degree	Percentage
Gestão	17.1%
Engenharia Informática	12.9%
Gestão de Marketing	8.6%
Marketing	7.1%
Engenharia e Gestão Industrial	5.7%
Psicologia Clínica e da Saúde	4.3%
Faculdade de Psicologia	4.3%
Economia	2.9%
Ciências da Comunicação	2.9%
Finance	2.9%
Contabilidade e Controlo de Gestão	2.9%
Others	28.0%

Table 8: Distribution of students by degree level and type of master's degree

4.2 Overall Results

In this chapter, several tests were developed to validate the questionnaire. In addition, three indexes were created — knowledge, behaviour and attitude — for both students and teachers.

Table 17 on subsection 7.3 shows the correlation of each item (indicating how well each item follows the overall construct), the total Cronbach's α for each construct for each group (students and teachers) and Cronbach's α without each item.

Regarding **knowledge construct**, both groups show high values, which demonstrates that the eight items form a cohesive construct - students 0.811 and teachers 0.783. Among students, items Q12 and Q13 stand out the most (r=0.750 and r=0.691). On the other hand, Q19 shows less alignment with the total construct, although it is still significant. In the case of teachers, Q17 is one of the pillars of the construct, r=0.830. However, Q18 is the least relevant, r=0.472. In the case of teachers, Q17 is one of the pillars of the construct, and its removal would lower the α from 0.783 to 0.713. However, Q18 is the one that contributes least to the construct - it has the lowest correlation (0.472).

Regarding the **behaviour construct**, students achieve an overall α of 0.613 and teachers 0.538 (which is acceptable but low). In the case of students, Q24 stands out most positively in the construct (r=0.609). However, both Q25 and Q26 contribute negatively (r=0.296 and r=0.331, respectively). For teachers, Q24 contributes most to the construction (r=0.620). In contrast, both Q20 and Q25 have correlation levels of 0.221 and 0.260. After some testing, Q25 and Q26 will be eliminated since, together, they would increase the overall α of the group the most.

Regarding the **attitude construct**, students achieved an overall α of 0.755 and teachers 0.412 (considerably low, less than 0,5). For students, Q32 contributes most positively to construction,

r=0.683. On the other hand, Q40 with r= 0.331 stands out negatively. For teachers, Q31 stands out for contributing to greater alignment with r=0.549. Items Q35, Q36 and Q37 contribute negatively and since teachers's alpha is low, these questions were eliminated.

Table 9 shows the resulting Cronbach's Alfa for each construct in each questionnaire after the elimination of unreliable items. Note that there was a reduction of the general α of the students of the attitude construct, however, it remains significant.

Construct	**Group**	**Cronbach's α**
Knowledge Index	Students	0.8108
	Teachers	0.7830
Behavior Index	Students	0.6663
	Teachers	0.5856
Attitude Index	Students	0.7106
	Teachers	0.5292

Table 9: Cronbach's α coefficient by construct and group after elimination some questions

As a result, after eliminating the items, a comparison index between constructs was created - Table 10 - revealing a consistent pattern: teachers have a more aligned and pro-environmental level of knowledge, behaviour, and attitude than the students.

Construct	**Group**	**Mean**	**SD**	**n**	**t**	**p (t-test)**	**U**	**p (M–W)**
Knowledge Index	Students	1.71	2.12	117	-3.552	0.0007	1625.500	0.0001
	Teachers	3.15	2.41	46				
Behavior Index	Students	3.62	0.61	117	-3.639	0.0004	1829.000	0.0014
	Teachers	3.95	0.49	46				
Attitude Index	Students	4.18	0.52	116	-5.090	<0.0001	1598.000	0.0001
	Teachers	4.53	0.33	46				

Table 10: Descriptive statistics and comparison indices, by group and Construct

A detailed analysis of the **knowledge index**, on a scale of 0 to 8, shows that the average score of 1.71 means that, on average, students answered 1.71 of the 8 knowledge questions correctly (the same reasoning applies to teachers). The difference in average scores between groups reveals a higher level of knowledge among teachers (although not by much).

The **behaviour index**, on a scale of 1 to 5, again reveals a higher average for teachers - 3.95.

Finally, in the **attitude index**, on a scale of 1 to 5, both report high levels, although the highlight is again for teachers. Furthermore, as in the t-test, 0.0061 < 0.05, we reject the null hypothesis and conclude that the difference in means is statistically significant (the Mann-Whitney test also reinforces these data).

4.3 Results by group

4.3.1 Sustentability Knowledge Construct

Analysing the students' knowledge, Figure 5 and Table 18 in subsection 7.4 reveal that the students performed poorly on the eight items related to sustainability, with an average score of 1.71, Table 10. Q15, how many countries create laws against racism, had the highest success rate, 32.5%. Q19, change in global forest area over the last 30 years, only achieved 15.4% correct answers. Additionally, a more detailed analysis of Table 18 shows that option B was the most frequently chosen in most questions.

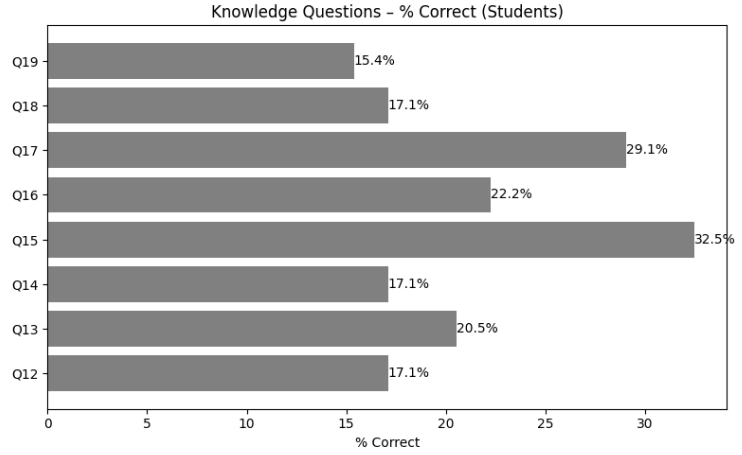

Figure 5: Quiz Students's Response by % of Correct Anwser

As for teachers, they have an average of 3.15. Figure 6 and Table 19 in subsection 7.4 reveal that Q12 - the percentage of the global refugee population - was the question with the highest rate of correct answers, 63.0%. In contrast, Q14 - access to drinking water within 30 minutes - was the question with the lowest percentage of correct answers, only 23.9%. However, teachers revealed an average of 3.15 in Table 10 - higher than students.

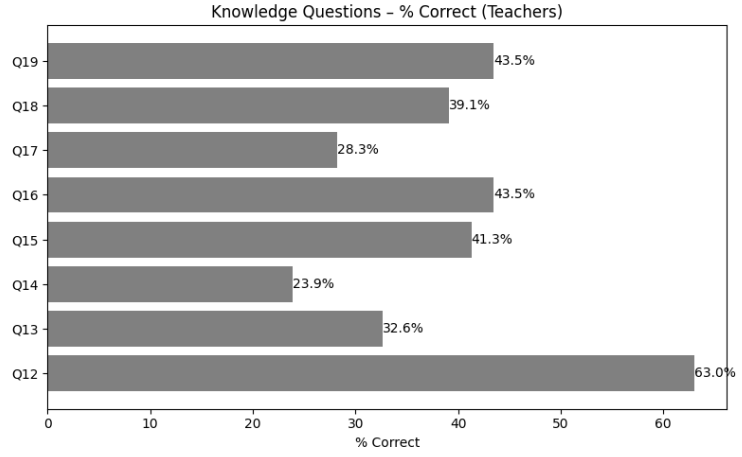

Figure 6: Knowledge Questions per Correct Answer by Teachers

4.3.2 Sustentability Behavior Construct

With regard to students, the study showed an average behaviour score of 3.62—reflecting a generally neutral but positive stance toward sustainability—while teachers scored higher, with an average of 3.95 indicating even more positive behaviour (Table 10).

Figure 7 shows that 67,5% disagree with the item 'I don't recycle much' (Q20), which shows that most participants recycle whenever possible. 50,4% is neutral with the need to buy from responsible companies - Q23. About half of the students agree with adopting habits to minimise waste (Q24). The majority, 91,5% agree that they respect people of different ages and genders, Q21. On the other hand, in Q22, around 37,6% disagree that they do not prioritise cycling or walking. Meanwhile, 62,4% disagree with Q28, revealing that most students are aware of their actions and choices.

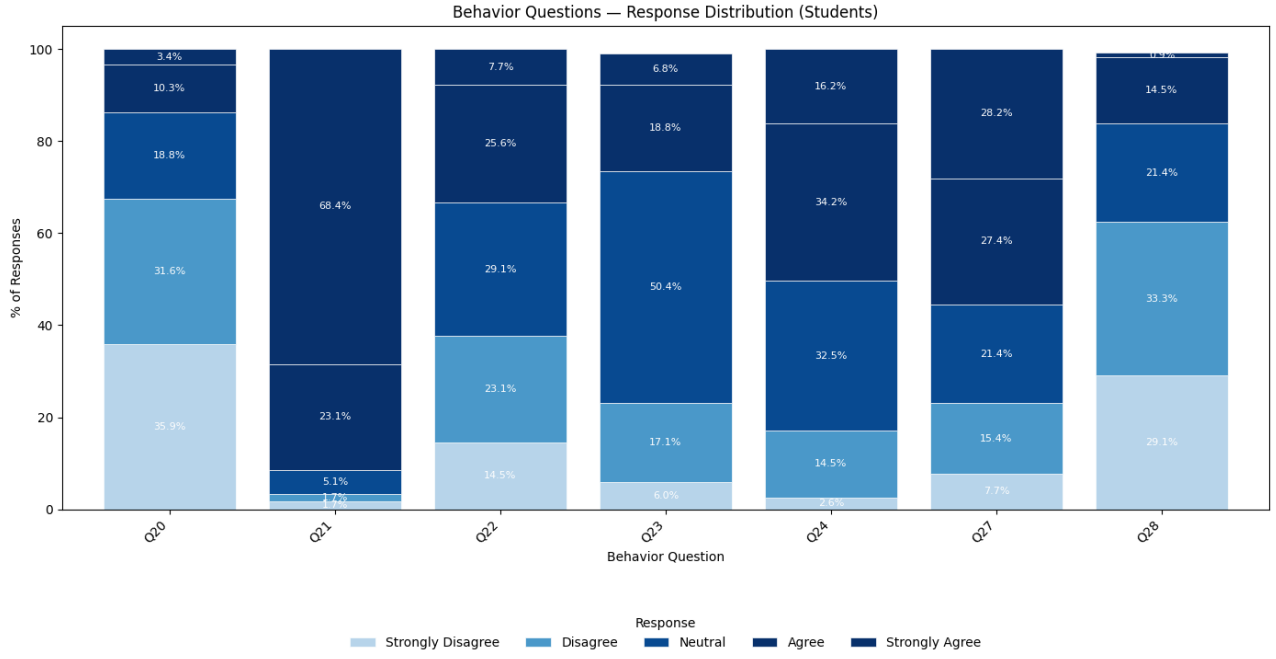

Figure 7: Behavior Questions – Response Distribution (Students)

As for teachers, Figure 8 shows that 97.8% disagree with 'I don't recycle much, even when I can' - Q20. Everyone agreed that it treats everyone equally - Q21. However, 45.7% remained neutral about buying second-hand - Q23. 60,9% agrees that adapted their lifestyle to minimise waste (Q24) and 69.6% repairs food waste whenever possible - Q27. Also, 43,5% of teachers do not prioritise cycling or walking (Q22). Even so, in Q28, more than half disagree in 'not thinking that their actions affect the environment' (58.7%).

In contrast, when analysed in Python, neither group shows strong involvement in sustainability organisations or projects (Q29–Q30): 71.8% of students do not belong to any sustainable organisation and 82.9% are not actively involved in projects, while among teachers these figures are 82.6% and 73.9%, respectively.

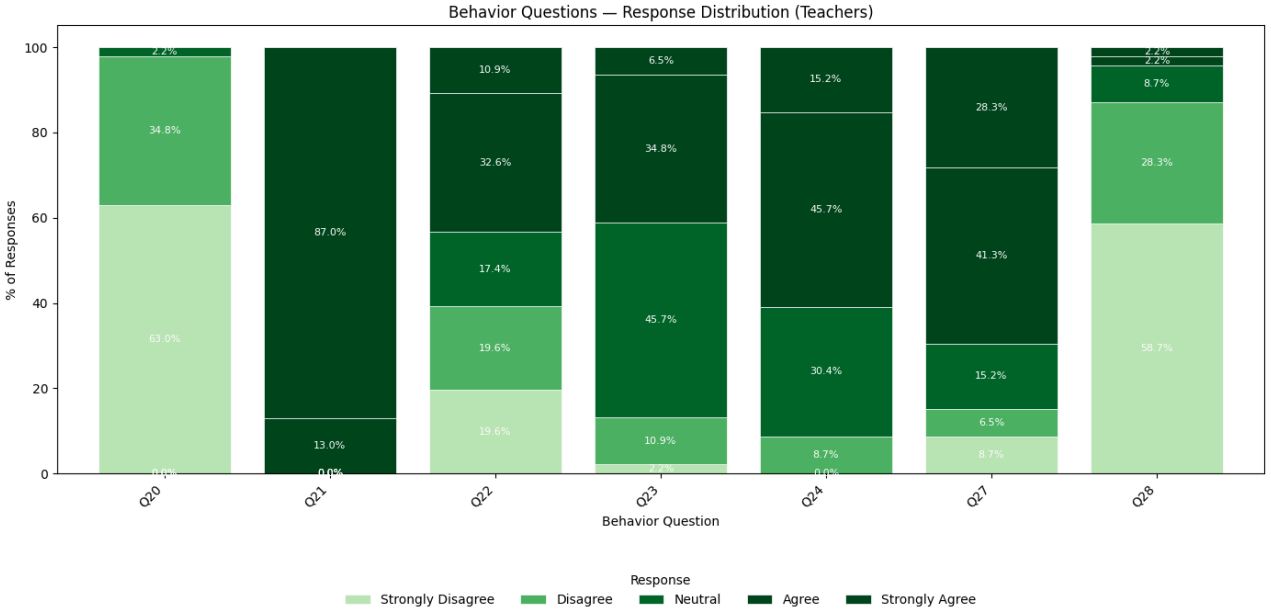

Figure 8: Behavior Questions – Response Distribution Teachers

4.3.3 Sustentability Attitude Construct

With regard to students, the study showed an average attitude of 4.18 while teachers scored 4.53, which indicates a positive average for both groups (Table 10).

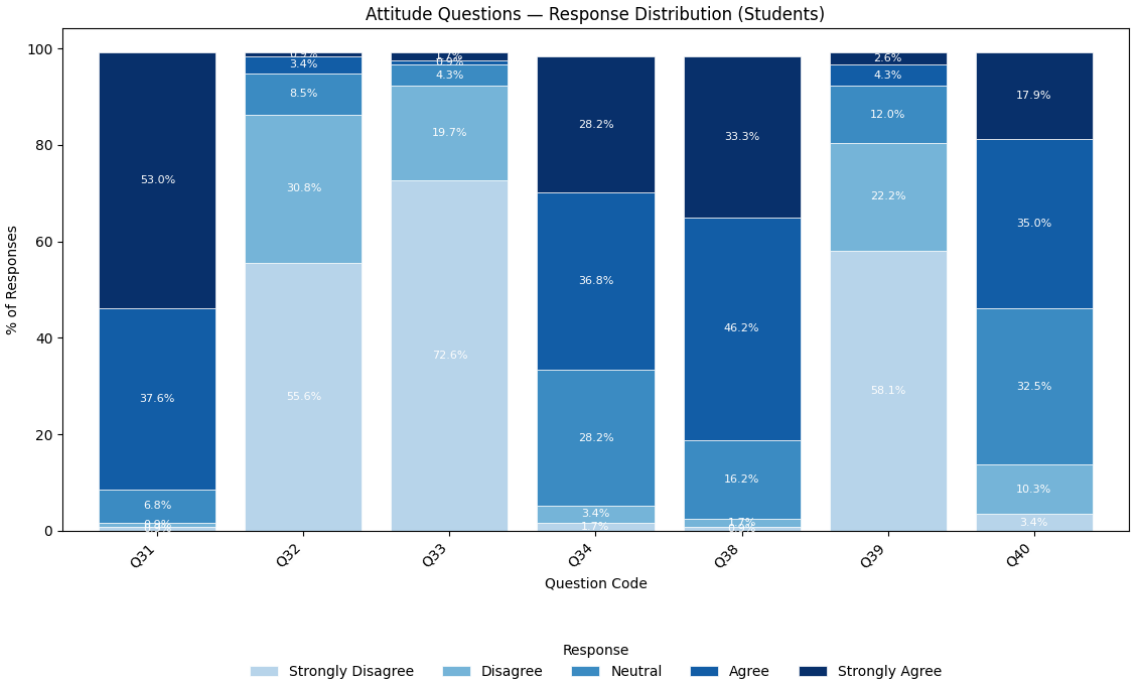

Figure 9: Attitude Questions – Response Distribution (Students)

Figure 9 shows that more than 90,6% of students agree with Q31 - companies have a responsibility to reduce disposable items. In Q39, 80% disagree with the idea that governments do not need to make sustainable development a national priority. At the same time, almost 90% disagree with Q32 and Q33, the ideas that stricter environmental laws and measures to combat

climate change are not necessary. In addition, more than half of students agree with the idea that the government should financially support the transition to eco-friendly cars (64%) - Q34. Furthermore, 52% of students agree that it is possible to protect the environment and create jobs even with a weak economy (Q40), and around 80% agree with the idea of making an extra effort to reduce environmental impact - Q38.

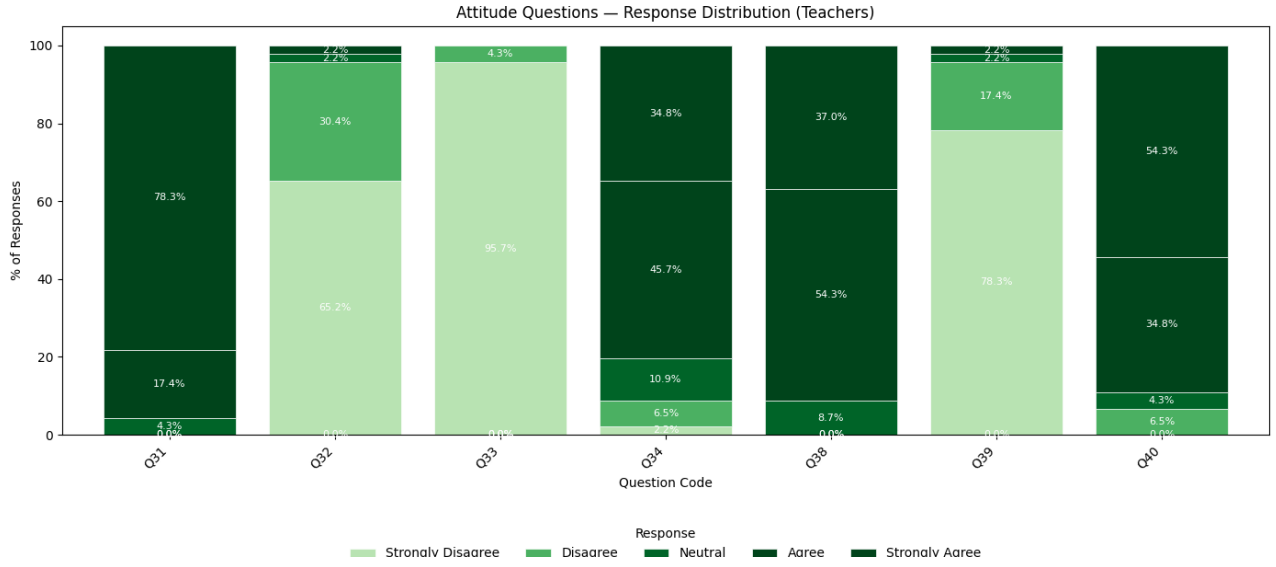

Figure 10: Attitude Questions – Response Distribution (Teachers)

Figure 10 shows data on teachers' attitudes, revealing that 90% are in favour of corporate responsibility in reducing disposable products - Q31. Questions Q34, Q38 and Q40 reveal very high percentages of agreement: that the government should support the transition to eco-friendly cars; that people should be willing to make an effort in their daily lives to reduce their impact; and that it is possible to protect the environment and create jobs, even in times of crisis.

In contrast, in questions Q32, Q33 and Q39, teachers almost unanimously disagreed that we do not need environmental laws or actions and that governments do not need to prioritise sustainable development. In other words, disagreements in favour of sustainability.

4.3.4 Incorporation and Promotion of Sustainability in the Institution and Actions of HEI

Figure 11 and Figure 12 shows how **students** and **teachers** perceive their institutions' efforts to promote sustainability - it is important to note that they could choose more than one option.

It is noteworthy, in Figure 11, that 45.3%, with almost half of the students stating that they do not know or are not aware of any institutional sustainability actions. In addition, about a third of students recognise that the institution adopts sustainability issues as part of its strategy and 27% recognise that the institution promotes research in this area and daily campus operations (23.9%).

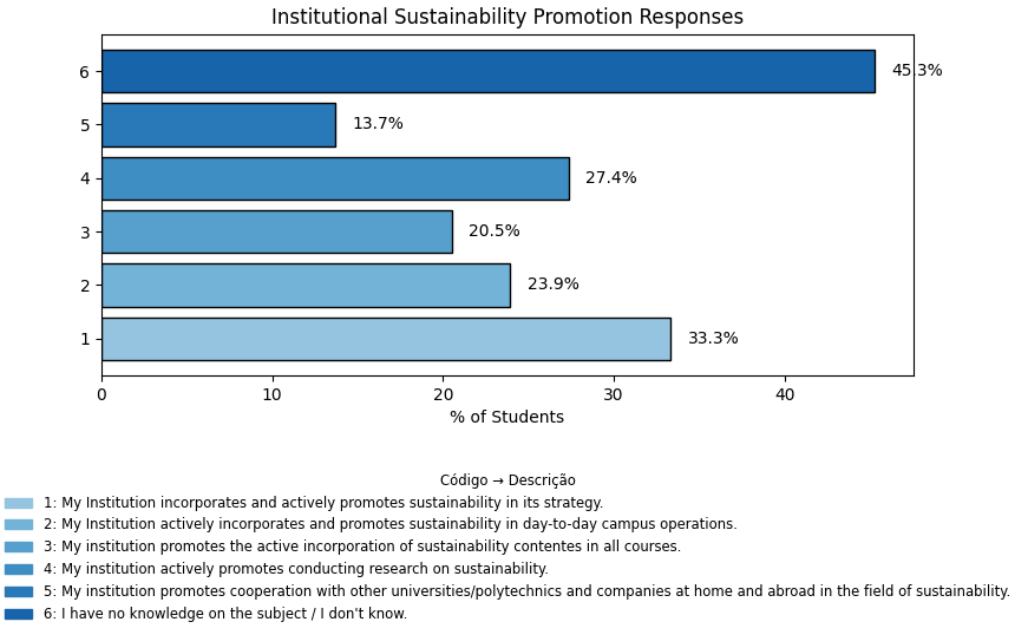

Figure 11: Institutions Questions of Students – Response Distribution

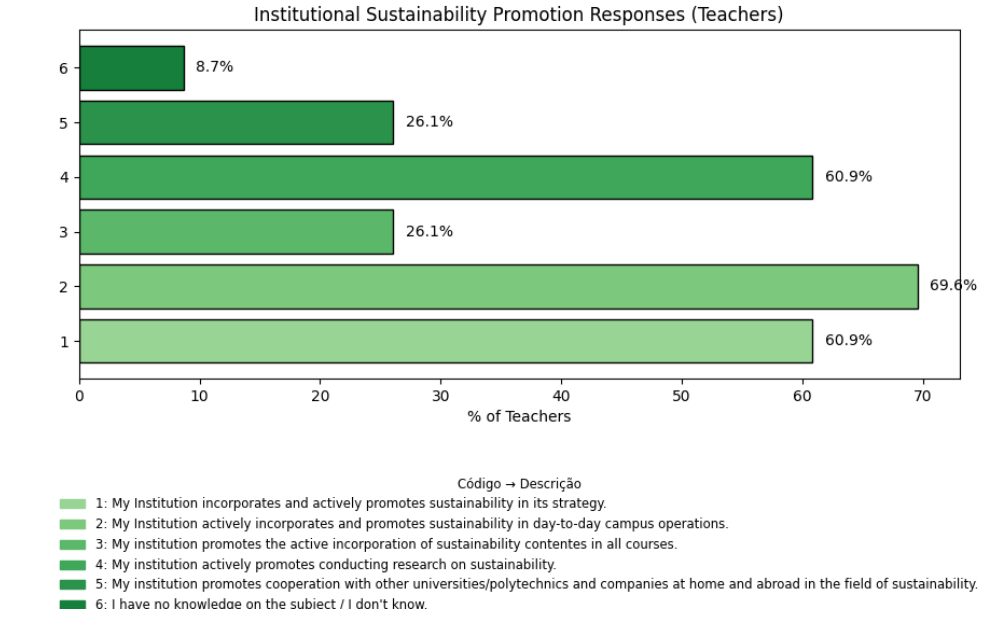

Figure 12: Institutional Questions of Teachers – Response Distribution

Figure 12 shows the three options most selected by teachers: the institution promotes sustainability in its strategy (69.6%), incorporates it into daily campus operations (60.9%) and promotes research (60.9%). In addition, only 8.7% admitted to being unaware of any institutional action. This is a very different scenario from that of the students.

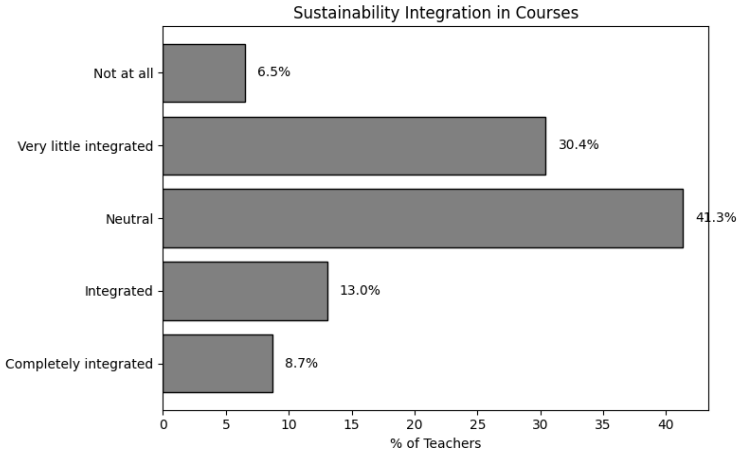

Figure 13: Sustainability in Courses by Teachers – Response Distribution

Figure 13, the view is even more moderate, with most teachers remaining neutral about how integrated sustainability is in their courses. However, 30.4% consider that this integration is very poor.

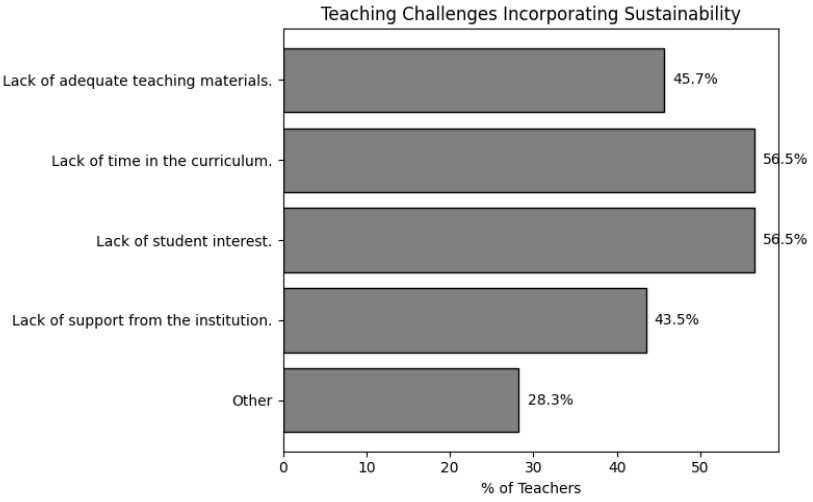

Figure 14: Sustainability Challenges Incorporation by Teachers – Response Distribution

Furthermore, Figure 14 reveals that, in the opinion of teachers, all the options given are obstacles to the integration of the topic. However, the main ones selected were lack of time in the curriculum (56.5%) and lack of interest among students (56.5%).

To complement the analysis, Table 11 was prepared to summarise the results and suggestions given by students and teachers to the last item in the questionnaire, *"What can higher education institutions (HEIs) do to ensure that their students receive better training in the area of sustainability?"*.

It highlights different priorities. Students focus on training and awareness: more lectures, workshops, integration into the curriculum, teacher curriculum development, strengthening internal communication and partnerships. Teachers, on the other hand, suggest involving students in real projects, developing curricula, providing ongoing training for teaching staff, offering specialised events, and conducting sustainable performance evaluations, among other things.

Group	**Theme**	**Recommendations**
Students	Lectures & Events	Offer more lectures on sustainability; organize fairs and themed events; promote conferences and campus posters.
	Workshops & Practical Activities	Provide certified workshops; community and field–based activities; hands-on project demonstrations; interactive discussion forums.
	Curriculum Integration	Introduce short mandatory modules; create dedicated sustainability courses; embed topics in existing subjects; foster interdisciplinary programmes.
	Faculty Development	Offer continuous training for faculty; dynamic and practical educator workshops on sustainability.
	Communication & Culture	Increase internal communication of sustainability initiatives; build student sustainability communities.
	Partnerships & Incentives	Partner with companies; establish internships and research awards; provide grants for sustainable projects.
Teachers	Practical Experience	Start with hands-on practice; guide by example in campus operations; involve students in real-world SDG projects.
	Curriculum Integration	Integrate sustainability into all courses and units; introduce dedicated modules; adapt syllabi and link to ECTS credits.
	Faculty Development	Provide continuous training for professors and staff; recruit and support faculty dedicated to sustainability research and teaching.
	Workshops & Events	Organize certified workshops, seminars and guest lectures; host interactive forums and community engagement activities.
	Projects & Engagement	Launch sustainability projects (e.g. SDG-based); embed applied, project-based work into assessments and curricula.
	Assessment & Incentives	Link sustainability performance to institutional KPIs; award credits, prizes or recognition for sustainable initiatives.
	Institutional Leadership	HEIs must lead by example: develop clear sustainability policies, set targets, and make the campus a living laboratory.

Table 11: Recommendations for Improving Sustainability Training in HEIs by Students and Teachers

4.3.5 Data Visualization

In order to illustrate some of the key collected from the questionnaire, two dashboards were developed - one for students, Figure 15, summarising the responses of 117 university students on sustainability, and another for teachers, Figure 16, which presents the results from 46 teachers on the same topic.

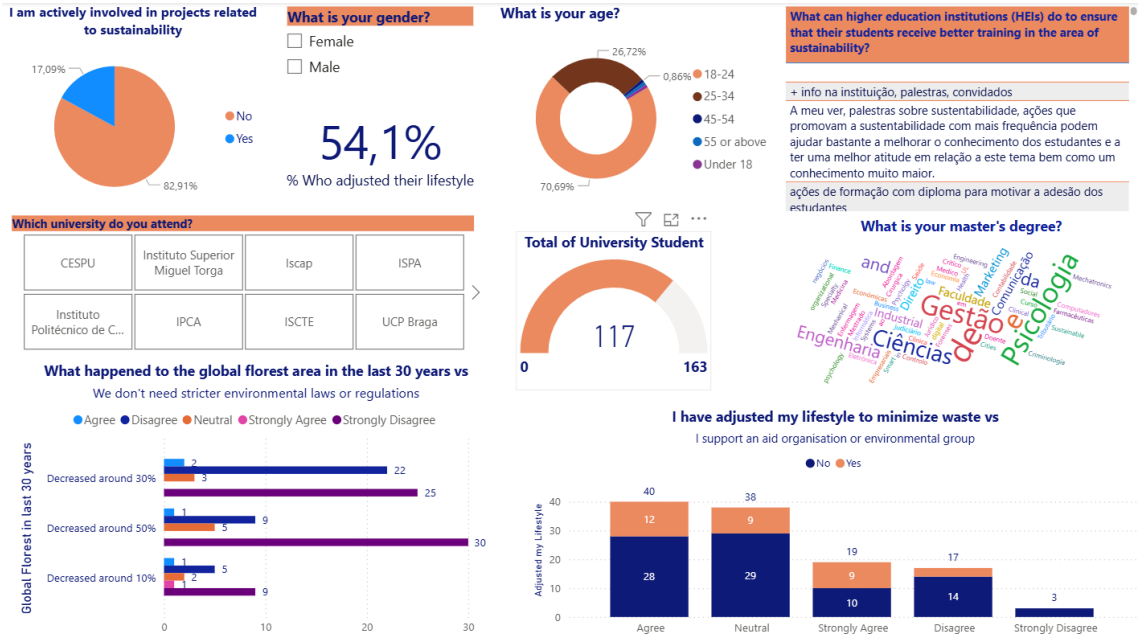

Figure 15: Students Dashboard

In the upper right corner, there is a list of students' suggestions for higher education institutions in response to the last question in the questionnaire, followed by a word cloud that identifies the most frequent areas of master's degree. Below are two types of graphs: on the right, the intersection between support (or lack thereof) for environmental organisations and lifestyle adjustments (or lack thereof); on the left, a relationship between the different options in the knowledge construct item with attitude - which reveals that in all options, even in the correct one (decreased around 10%), students disagree - highlighting strong support for environmental standards regardless of the correct answer.

In the upper right corner: a pie chart showing the percentage of those who participate in sustainability projects; two filters, one in a mosaic related to the university attended and the other to gender; and a card illustrating the percentage of those who have adjusted their lifestyle to minimise waste. Finally, another pie chart showing the percentage of the ages of the respondents.

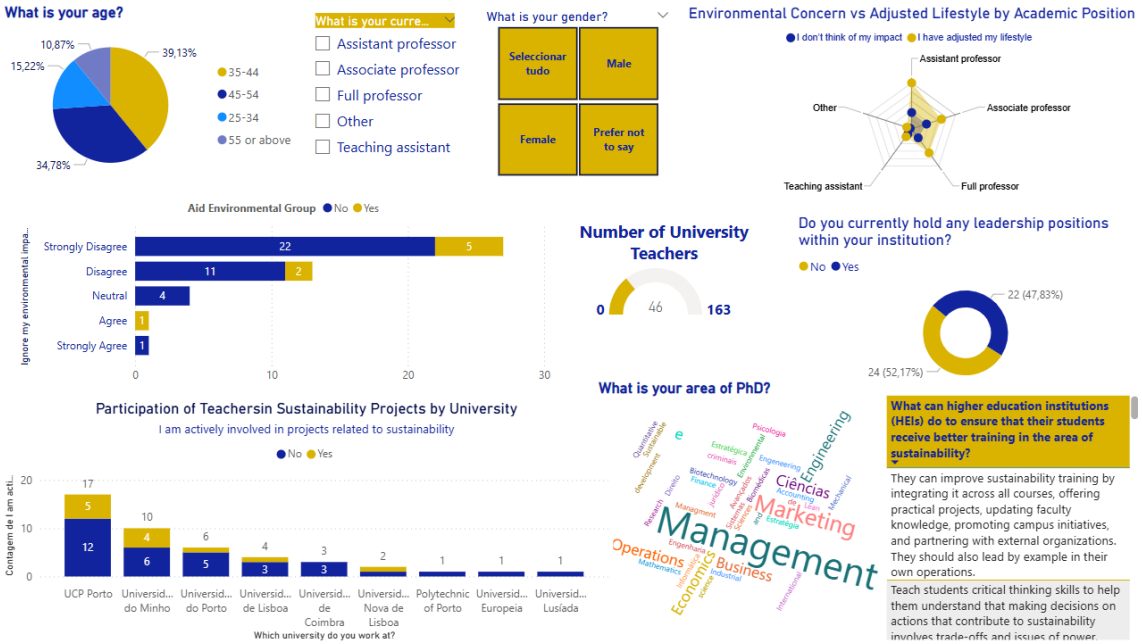

Figure 16: Teachers Dashboard

In the top right-hand corner of Figure 16, a radar crossing 'environmental concern' (Q28) with 'lifestyle adjustment' (Q24) by academic position is shown, revealing that assistant and associate professors have a greater commitment, albeit more moderate. Below, a doughnut reveals the percentage (47.8 per cent) of professors who hold leadership positions at the institution, a table listing suggestions for higher education in relation to sustainability and a word cloud mapping the most common areas of doctoral study.

In the top left-hand corner, a circular graph showing the age distribution (the majority between 35-44) and two filters for academic position (list format) and gender (mosaic format). Below, two graphs: a horizontal bar graph showing how many professors support environmental groups (or not) and ignore their environmental impact (or not); and a vertical bar graph characterising professors' participation in sustainable projects according to the university they work at.

5 Discussion

Through the data collected, it is possible to analyse that there is a clear gap between theoretical knowledge about sustainability and its application in practice – especially among higher education students – as well as a heterogeneity in the initial internal consistency of Cronbach's α between different teachers constructs. These results validate, once again, the theory that literacy and a study in sustainability should consist of more than one construct, since the inequality observed between constructs reflects that if only one were analysed, the data would not present the same degree of comprehensiveness or detail. This three-dimensional structure – knowledge, attitude and behaviour – is mentioned in the literature review by Michalos et al. (2011), Olsson et al. (2015), Zwickle and Jones (2018) and Karimi and Hakim (2024).

Students show good internal consistency in each construct, which ensures the good applicability of the scale. On the other hand, teachers showed high internal consistency in the knowledge construct, but much lower values, in the first phase, in the behaviour and attitude constructs. This discrepancy may be due to the small sample size of teachers (n=46). Even with the elimination of some of the questions that caused internal inconsistency, Cronbach's alpha increased, but not significantly.

Therefore, future studies should include larger and more diverse samples, both in terms of academic profiles and institutions – this one focused mainly on UMinho, UCP Porto, and UPorto. This is in line with Nolet (2015) on the use of digital tools in education to collect richer, more in-depth data and reach more people. Another aspect to note was that the vast majority of students were unaware of the active role of their institutions in promoting sustainable practices. This further reinforces the criticism made by Abad-Segura and González-Zamar (2021) about the fragmentation of initiatives within universities – if these had an active and open role, students would certainly be more aware. Furthermore, as Alberti et al. (2023) argue, sustainability should be made compulsory in the curriculum for teachers, not only to promote real skills but also to pass them on to their students.

Moreover, sustainable practices create a favourable environment for innovation in HEI's: tools such as digital teaching platforms, artificial intelligence applied to resource management, and the use of the big data for environmental monitoring can facilitate the implementation of sustainability in universities. To overcome the challenges that still exist, Sanchez-Carrillo et al. (2021) and Wang et al. (2022), propose five main strategies: transforming institutional identity; structural openness and dissemination of information; training and education; fostering academic community; and international collaboration.

All the recommendations made by students (and even teachers) to institutions in the open response *'What can higher education institutions (HEIs) do to ensure that their students receive better*

training in the area of sustainability?' are in line with this: promote more workshops and events, develop continuing education programmes for both groups, invest in incorporating areas of sustainability into the university itself and into the curriculum. These points precisely express the five dimensions seen in the literature by Trevisan et al. (2024), especially in the points 'Curriculum, Teaching Learning' and 'Capacity Building'.

6 Conclusion

In conclusion, it is important to highlight that the quantitative analysis carried out shows that the level of sustainability literacy varies significantly between the groups studied and reveals clear opportunities for higher education institutions. With this in mind, it is essential to analyse the three initial research questions:

RQ1: What is the level of sustainability literacy among portuguese students attending higher education?

The results showed that most students have moderate levels of sustainability literacy. According to the indexes created, the worst average score was for knowledge, revealing high behaviour and attitude indexes. The best result in an item of the knowledge construct was 32.5% correct answers - on anti-racism laws. In contrast, overall responses to the attitude and behaviour constructs were consistent and in line with positive sustainability practices.

RQ2: What is the level of sustainability literacy among university teachers?

The data collected revealed that all teachers indexes were higher than those of students. The knowledge index is equally low, but the behaviour and attitude indexes are significant. The best result in an item of the knowledge construct was 63% correct answers – on the percentage of the world's refugee population. Nevertheless, they achieved unanimity on almost all items in the attitude construct and revealed, in general, positive practices through the behaviour construct.

RQ3: How does Higher Education Institutions (HEIs) contribute or can contribute to sustainability literacy and sustainable management practices?

This study clearly reveals the crucial role of higher education institutions in the responses given by respondents in the open comments. Although 69.9% of teachers reported that institutions actively promote sustainability in their operations, 45.3% of students are unaware of their institution's role in sustainability, revealing a communication gap. Both groups insist that HEIs should take a more visible and proactive stance. Furthermore, 80% of young people consider a company's sustainability strategy to be an important factor when choosing a job (EIB, 2023), underlining why higher education institutions should align their practices and messages with these expectations. The recommendations given are in line with UNESCO's "ESD Circle" (Education for Sustainable Development).

Finally, given the results among students and teachers, there is a recognised need for higher education institutions to take action to raise the level of sustainability literacy among both groups and promote rigorous changes and more sustainable management practices. It is important to suggest that future research could cross-reference the constructs with other variables (such as type of literacy by gender or faculty) for a more detailed comparative analysis.

7 Appendix

7.1 Students Questionnaire

Nr	Construct	Questions	Scale
1	Target Identification	**Q1:** Are you a university student or a university teacher?	Multiple Choice
2	Sociodemographic	**Q2:** What is you age? **Q3:** What is your gender? **Q4:** Which university do you attend? **Q5:** Which faculty do you belong to within your university? **Q6:** What degree are you pursuing at the moment? **Q7:** What is your current academic year, based on the degree you are pursuing (bachelor's or master's)? **Q8:** What is your bachelor's degree? **Q9:** What is your postgraduate program about? **Q10:** What is your area of PhD? **Q11:** What is your master's degree?	Multiple Choice/ Open-ended
3	Sustentability Knowledge Questions	**Q12:** What share of the world's population are international refugees? **Q13:** What share of the world's population don't have enough food to meet their daily energy needs? **Q14:** What percentage of people in the world have access to basic drinking water within 30 minutes of their home? **Q15:** Of 195 countries, how many have promised to create laws against racism, in accordance with the UN Convention on the Elimination of All Forms of Racial Discrimination? **Q16:** What percentage of the world's 250 richest companies describe climate change as a risk in their annual reports? **Q17:** How much of the excess heat from global warming is captured in the oceans? **Q18:** What share of all plastic waste in the world ends up in the oceans? **Q19:** What happened to the global forest area in the last 30 years?	Multiple Choice
4	Sustainability Behavior Questions	**Q20:** I do not recycle much, even when I have the opportunity. **Q21:** I treat individuals of all genders and ages equally and with respect. **Q22:** I don't usually prioritize walking or cycling over using motor vehicles. **Q23:** I prioritize purchasing goods from companies with ethical labor and environmental practices. **Q24:** I have adjusted my lifestyle to minimize waste, like reducing food waste and conserving materials. **Q25:** When not in use, I often forget to turn off the water. **Q26:** I purchase second-hand goods over the internet or in a shop. **Q27:** I always separate food waste before putting out the rubbish when I have the chance. **Q28:** I don't think about how my actions may damage the natural environment **Q29:** I support an aid organisation or environmental group. **Q30:** I am actively involved in projects related to sustainability.	Likert scale/ Multiple Choice

5	Sustainability Attitude Questions	**Q31:** Companies have a responsibility to reduce the use of packaging and disposable articles. **Q32:** We don't need stricter environmental laws or regulations. **Q33:** There is no need to take measures to address climate change. **Q34:** The government should provide financial aid to encourage more people to make the shift to green cars. **Q35:** People who pollute land, air or water should be held accountable for the damage they cause. **Q36:** Equal opportunities in education and employment for women and men are not important. **Q37:** Access to clean water should not be considered a basic human right. **Q38:** I am willing to put forth a little more effort in my daily life to reduce my environmental impact. **Q39:** Governments do not need to make sustainable development a national priority. **Q40:** It is possible to protect the environment and create jobs even when the economy is doing poorly.	Likert scale
6	Incorporation and Promotion of Sustainability in the Institution	**Q41:** Does my institution incorporate and promote sustainability?	Multiple Choice
7	Future	**Q42:** What can higher education institutions (HEIs) do to ensure that their students receive better training in the area of sustainability?	Open-ended

Table 13: Students Questionnaire

7.2 Teachers Questionnaire

Nr	Construct	Questions	Scale
1	Target Identification	**Q1:** Are you a university student or a university teacher?	Multiple Choice
2	Sociodemographic	**Q2:** What is you age? **Q3:** What is your gender? **Q4:** Which university do you work at? **Q5:** Which faculty do you belong to within your university? **Q6:** What is your current academic position? **Q7:** Do you currently hold any leadership positions within your institution? **Q8:** What is your highest level of education? **Q9:** What is your bachelor's degree? **Q10:** What is your master's degree? **Q11:** What is your area of PhD?	Multiple Choice/ Open-ended
3	Sustentability Knowledge Questions	**Q12:** What share of the world's population are international refugees? **Q13:** What share of the world's population don't have enough food to meet their daily energy needs? **Q14:** What percentage of people in the world have access to basic drinking water within 30 minutes of their home? **Q15:** Of 195 countries, how many have promised to create laws against racism, in accordance with the UN Convention on the Elimination of All Forms of Racial Discrimination? **Q16:** What percentage of the world's 250 richest companies describe climate change as a risk in their annual reports? **Q17:** How much of the excess heat from global warming is captured in the oceans? **Q18:** What share of all plastic waste in the world ends up in the oceans? **Q19:** What happened to the global forest area in the last 30 years?	Multiple Choice
4	Sustainability Behavior Questions	**Q20:** I do not recycle much, even when I have the opportunity. **Q21:** I treat individuals of all genders and ages equally and with respect. **Q22:** I don't usually prioritize walking or cycling over using motor vehicles. **Q23:** I prioritize purchasing goods from companies with ethical labor and environmental practices. **Q24:** I have adjusted my lifestyle to minimize waste, like reducing food waste and conserving materials. **Q25:** When not in use, I often forget to turn off the water. **Q26:** I purchase second-hand goods over the internet or in a shop. **Q27:** I always separate food waste before putting out the rubbish when I have the chance. **Q28:** I don't think about how my actions may damage the natural environment **Q29:** I support an aid organisation or environmental group. **Q30:** I am actively involved in projects related to sustainability.	Likert scale/ Multiple Choice

5	Sustainability Attitude Questions	**Q31:** Companies have a responsibility to reduce the use of packaging and disposable articles. **Q32:** We don't need stricter environmental laws or regulations. **Q33:** There is no need to take measures to address climate change. **Q34:** The government should provide financial aid to encourage more people to make the shift to green cars. **Q35:** People who pollute land, air or water should be held accountable for the damage they cause. **Q36:** Equal opportunities in education and employment for women and men are not important. **Q37:** Access to clean water should not be considered a basic human right. **Q38:** I am willing to put forth a little more effort in my daily life to reduce my environmental impact. **Q39:** Governments do not need to make sustainable development a national priority. **Q40:** It is possible to protect the environment and create jobs even when the economy is doing poorly.	Likert scale
6	Incorporation and Promotion of Sustainability in the Institution	**Q41:** Does my institution incorporate and promote sustainability? **Q42:** What are the main challenges to incorporating sustainability into teaching? **Q43:** What is the extent to which Sustainability has been included in your course?	Multiple Choice/ Likert scale
7	Future	**Q44:** What can higher education institutions (HEIs) do to ensure that their students receive better training in the area of sustainability?	Open-ended

Table 15: Teachers Questionnaire

7.3 Correlation and Cronbach's

Construct	Group	Question	Corr.	α if del.	α_{overall}
Knowledge	Students	**Q12:** What share of the world's population are international refugees?	0.750	0.769	0.811
		Q13: What share of the world's population don't have enough food to meet their daily energy needs?	0.691	0.782	0.811
		Q14: What percentage of people in the world have access to basic drinking water within 30 minutes of their home?	0.687	0.790	0.811
		Q15: Of 195 countries, how many have promised to create laws against racism, in accordance with the UN Convention on the Elimination of All Forms of Racial Discrimination?	0.676	0.789	0.811
		Q16: What percentage of the world's 250 richest companies describe climate change as a risk in their annual reports?	0.643	0.784	0.811
		Q17: How much of the excess heat from global warming is captured in the oceans?	0.642	0.789	0.811
		Q18: What share of all plastic waste in the world ends up in the oceans?	0.600	0.769	0.811
		Q19: What happened to the global forest area in the last 30 years?	0.553	0.789	0.811
Knowledge	Teachers	**Q12:** What share of the world's population are international refugees?	0.596	0.767	0.783
		Q13: What share of the world's population don't have enough food to meet their daily energy needs?	0.636	0.757	0.783
		Q14: What percentage of people in the world have access to basic drinking water within 30 minutes of their home?	0.626	0.757	0.783
		Q15: Of 195 countries, how many have promised to create laws against racism, in accordance with the UN Convention on the Elimination of All Forms of Racial Discrimination?	0.631	0.759	0.783
		Q16: What percentage of the world's 250 richest companies describe climate change as a risk in their annual reports?	0.587	0.769	0.783
		Q17: How much of the excess heat from global warming is captured in the oceans?	0.830	0.713	0.783
		Q18: What share of all plastic waste in the world ends up in the oceans?	0.472	0.791	0.783
		Q19: What happened to the global forest area in the last 30 years?	0.661	0.755	0.783
Behavior	Students	**Q20:** I do not recycle much, even when I have the opportunity.	0.594	0.549	0.613

continues on next page

continued from previous page

Construct	Group	Question	Corr.	α if del.	α_{overall}
		Q21: I treat individuals of all genders and ages equally and with respect.	0.439	0.590	0.613
		Q22: I don't usually prioritize walking or cycling over using motor vehicles.	0.540	0.569	0.613
		Q23: I prioritize purchasing goods from companies with ethical labor and environmental practices.	0.509	0.567	0.613
		Q24: I have adjusted my lifestyle to minimize waste, like reducing food waste and conserving materials.	0.609	0.543	0.613
		Q25: When not in use, I often forget to turn off the water.	0.296	0.646	0.613
		Q26: I purchase second-hand goods over the internet or in a shop.	0.331	0.632	0.613
		Q27: I always separate food waste before putting out the rubbish when I have the chance.	0.491	0.588	0.613
		Q28: I don't think about how my actions may damage the natural environment.	0.563	0.561	0.613
Behavior	Teachers	**Q20:** I do not recycle much, even when I have the opportunity.	0.221	0.539	0.538
		Q21: I treat individuals of all genders and ages equally and with respect.	0.232	0.532	0.538
		Q22: I don't usually prioritize walking or cycling over using motor vehicles.	0.583	0.499	0.538
		Q23: I prioritize purchasing goods from companies with ethical labor and environmental practices.	0.507	0.489	0.538
		Q24: I have adjusted my lifestyle to minimize waste, like reducing food waste and conserving materials.	0.620	0.435	0.538
		Q25: When not in use, I often forget to turn off the water.	0.260	0.577	0.538
		Q26: I purchase second-hand goods over the internet or in a shop.	0.481	0.524	0.538
		Q27: I always separate food waste before putting out the rubbish when I have the chance.	0.502	0.509	0.538
		Q28: I don't think about how my actions may damage the natural environment.	0.628	0.448	0.538
Attitude	Students	**Q31:** Companies have a responsibility to reduce the use of packaging and disposable articles.	0.559	0.727	0.755
		Q32: We don't need stricter environmental laws or regulations.	0.683	0.709	0.755
		Q33: There is no need to take measures to address climate change.	0.603	0.723	0.755

continues on next page

continued from previous page

Construct	Group	Question	Corr.	α if del.	α_{overall}
		Q34: The government should provide financial aid to encourage more people to make the shift to green cars.	0.540	0.737	0.755
		Q35: People who pollute land, air or water should be held accountable for the damage they cause.	0.524	0.733	0.755
		Q36: Equal opportunities in education and employment for women and men are not important.	0.616	0.735	0.755
		Q37: Access to clean water should not be considered a basic human right.	0.543	0.751	0.755
		Q38: I am willing to put forth a little more effort in my daily life to reduce my environmental impact.	0.474	0.741	0.755
		Q39: Governments do not need to make sustainable development a national priority.	0.638	0.723	0.755
		Q40: It is possible to protect the environment and create jobs even when the economy is doing poorly.	0.331	0.767	0.755
Attitude	Teachers	**Q31:** Companies have a responsibility to reduce the use of packaging and disposable articles.	0.549	0.299	0.412
		Q32: We don't need stricter environmental laws or regulations.	0.531	0.311	0.412
		Q33: There is no need to take measures to address climate change.	0.341	0.338	0.412
		Q34: The government should provide financial aid to encourage more people to make the shift to green cars.	0.461	0.362	0.412
		Q35: People who pollute land, air or water should be held accountable for the damage they cause.	0.150	0.440	0.412
		Q36: Equal opportunities in education and employment for women and men are not important.	0.295	0.459	0.412
		Q37: Access to clean water should not be considered a basic human right.	0.449	0.445	0.412
		Q38: I am willing to put forth a little more effort in my daily life to reduce my environmental impact.	0.275	0.399	0.412
		Q39: Governments do not need to make sustainable development a national priority.	0.361	0.386	0.412
		Q40: It is possible to protect the environment and create jobs even when the economy is doing poorly.	0.413	0.392	0.412

Table 17: Question statistics and Cronbach's α, by construct and group

7.4 Other Tables

Nr	Correct Answer	Option A	%A	Option B	%B	Option C	%C
Q12	Around 0,6%	Around 0,6%	17.1%	Around 6%	53.8%	Around 16%	29.1%
Q13	Around 11%	Around 11%	20.5%	Around 23%	47.9%	Around 37%	31.6%
Q14	Around 90%	Around 50%	34.2%	Around 70%	48.7%	Around 90%	17.1%
Q15	180 countries	10 countries	11.1%	80 countries	54.7%	180 countries	32.5%
Q16	About 60%	About 10%	34.2%	About 30%	42.7%	About 60%	22.2%
Q17	Around 89%	Around 9%	13.7%	Around 49%	56.4%	Around 89%	29.1%
Q18	Less than 1%	Less than 1%	17.1%	Around 36%	32.5%	More than 66%	49.6%
Q19	Decreased around 10%	Decreased around 50%	39.3%	Decreased around 30%	45.3%	Decreased around 10%	15.4%

Table 18: Quiz Students's Response Breakdown

Nr	Correct Answer	Option A	%A	Option B	%B	Option C	%C
Q12	Around 0,6%	Around 0,6%	63.0%	Around 6%	23.9%	Around 16%	13.0%
Q13	Around 11%	Around 11%	32.6%	Around 23%	54.3%	Around 37%	13.0%
Q14	Around 90%	Around 50%	32.6%	Around 70%	43.5%	Around 90%	23.9%
Q15	180 countries	10 countries	4.3%	80 countries	54.3%	180 countries	41.3%
Q16	About 60%	About 10%	17.4%	About 30%	39.1%	About 60%	43.5%
Q17	Around 89%	Around 9%	28.3%	Around 49%	43.5%	Around 89%	28.3%
Q18	Less than 1%	Less than 1%	39.1%	Around 36%	32.6%	More than 66%	28.3%
Q19	Decreased around 10%	Decreased around 50%	19.6%	Decreased around 30%	37.0%	Decreased around 10%	43.5%

Table 19: Knowledge Questions — Response Distribution (Teachers)

Acknowledgment of AI Use: During the preparation of this work the author(s) used ChatGPT in order to better structure the text, reorder ideas, help with errors in the Python code. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

Abad-Segura, E. and González-Zamar, M. D. (2021). Sustainable economic development in higher education institutions: A global analysis within the sdgs framework. *Journal of Cleaner Production*, 294:126133.

Abo-Khalil, A. G. (2024). Integrating sustainability into higher education challenges and opportunities for universities worldwide. *Heliyon*, 10:e29946.

Ajzen, I., Joyce, N., Sheikh, S., and Cote, N. G. (2011). Knowledge and the prediction of behavior: The role of information accuracy in the theory of planned behavior. *Basic and Applied Social Psychology*, 33:101–117.

Alberti, M. G., Navarro, J. G., Guerra, F. S., Carlos, J., Feijoo, M., Machado, C. F., and Davim, J. P. (2023). Sustainability in the modernization of higher education: Curricular transformation and sustainable campus-a literature review.

Aleixo, A. M., Leal, S., and Azeiteiro, U. M. (2021). Higher education students' perceptions of sustainable development in portugal. *Journal of Cleaner Production*, 327:129429.

Alhazmi, A. K., Zain, A., Alsakkaf, N., and Othman, Y. (2023). Identification of sustainability barriers in higher education institutions (heis) and the role of technology in improving sustainability in heis. *Journal of Science and Technology*, 28:30–37.

BCSD (2025). Objetivos de desenvolvimento sustentável. `https://ods.pt/ods/` (Accessed: 2025-03-18).

Campos, C., Fernandes, J., Gonçalves, G., Sousa, C., and Spínola, H. (2024). First-year higher education student environmental literacy – the algarve university case. *International Conference on Higher Education Advances*, pages 1159–1166.

Décamps, A., Barbat, G., Carteron, J. C., Hands, V., and Parkes, C. (2017). Sulitest: A collaborative initiative to support and assess sustainability literacy in higher education. *The International Journal of Management Education*, 15:138–152.

EIB (2023). 80% of young portuguese people say the sustainability strategy of prospective employers is an important factor when job hunting. `https://www.eib.org/en/press/all/2023-134-80-of-young-portuguese-people-say-the-sustainability-strategy-of-prospective-employers-is-an-important-factor-when-job-hunting`(Accessed: 2025-03-18).

Erguvan, I. D. (2024). Assessing the sustainability literacy of undergraduate students in a first-year writing course. *Discover Education*, 3:84.

GapMinder (2025). Gapminder. https://www.gapminder.org/ (Accessed: 2025-04-02).

GOV (2025). Sobre o sustentável 2030. https://sustentavel2030.gov.pt/sustentavel-2030/sobre/ (Accessed: 2025-03-18).

Hassan, M. U., Murtaza, A., and Rashid, K. (2024). Redefining higher education institutions (heis) in the era of globalisation and global crises: A proposal for future sustainability. *European Journal of Education*.

INE (2024). Sustainable development goals (sdg) indicators for portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_destaques&DESTAQUESdest_boui=645950952&DESTAQUESmodo=2 (Accessed: 2025-03-18).

Iqbal, Q. and Piwowar-Sulej, K. (2022). Sustainable leadership in higher education institutions: social innovation as a mechanism. *International Journal of Sustainability in Higher Education*, 23.

Karimi and Hakim, A. (2024). Measuring sustainability literacy: Scale development and validation.

Lafortune, G., Fuller, G., and Sachs, J. D. (2024). The sdgs and the un summit of the future-sustainable development report.

Leal, S., Azeiteiro, U. M., and Aleixo, A. M. (2024). Sustainable development in portuguese higher education institutions from the faculty perspective. *Journal of Cleaner Production*, 434:139863.

Makri, A., Leiva-Brondo, M., Lajara-Camilleri, N., Vidal-Meló, A., Atarés, A., and Lull, C. (2022). Spanish university students' awareness and perception of sustainable development goals and sustainability literacy.

Michalos, A. C., Creech, H., McDonald, C., and Kahlke, P. M. H. (2011). Knowledge, attitudes and behaviours. concerning education for sustainable development: Two exploratory studies. *Social Indicators Research*, 100:391–413.

Michalos, A. C., Kahlke, P. M., Rempel, K., Lounatvuori, A., MacDiarmid, A., Creech, H., and Buckler, C. (2015). Progress in measuring knowledge, attitudes and behaviours concerning sustainable development among tenth grade students in manitoba. *Social Indicators Research*, 123:303–336.

Michel, J. O. and Zwickle, A. (2021). The effect of information source on higher education students' sustainability knowledge. *Environmental Education Research*, 27:1080–1098.

Nguyen, L.-H.-P. . and Bui (2022). An investigation into the perspectives of elementary pre-service teachers on sustainable development.

Nogueiro, T., Saraiva, M., and Pires, A. R. (2022). Implementing sustainability as a quality factor in higher education institutions. page 573.

Nolet, V. (2015). Educating for sustainability: Principals and practices for teachers. *Educating for Sustainability: Principles and Practices for Teachers*, pages 1–218.

ODSLocal (2025). Ods local. `https://odslocal.pt/?sdg=1` (Accessed: 2025-03-18).

Olsson, D., Gericke, N., and Rundgren, S.-N. C. (2015). Environmental education research the effect of implementation of education for sustainable development in swedish compulsory schools-assessing pupils' sustainability consciousness.

Rafael, T., Amézaga, W., Camarena, J. L., Roberto, Figueroa, C., Karla, and Realivazquez, A. G. (2022). Measuring sustainable development knowledge, attitudes, and behaviors: evidence from university students in mexico. *Development and Sustainability*, 24:765–788.

Roth, C. E. (1992). Environmental literacy: Its roots, evolution and directions in the 1990s.

Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of The Total Environment*, 786:147481.

Sanchez-Carrillo, J. C., Cadarso, M. A., and Tobarra, M. A. (2021). Embracing higher education leadership in sustainability: A systematic review. *Journal of Cleaner Production*, 298:126675.

Schank, C. and Rieckmann, M. (2019). Socio-economically substantiated education for sustainable development: Development of competencies and value orientations between individual responsibility and structural transformation. *Journal of Education for Sustainable Development*, 13:67–91.

SDGS (2025). Higher education sustainability initiative. `https://sdgs.un.org/HESI` (Accessed: 2025-03-18).

Sekhar, C. and Raina, R. (2021). Towards more sustainable future: assessment of sustainability literacy among the future managers in india. *Environment, Development and Sustainability*, 23:15830–15856.

Sulitest (2025). Sulitest. `https://www.sulitest.org/` (Accessed: 2025-04-02).

Trevisan, L. V., Filho, W. L., and Ávila Pedrozo, E. (2024). Transformative organisational learning for sustainability in higher education: A literature review and an international multi-case study. *Journal of Cleaner Production*, 447:141634.

UNESCO (2017). Education for sustainable development goals. `https://unesdoc.unesco.org/ark:/48223/pf0000247444` (Accessed: 2025-04-02).

UnitedNations (2024). The sustainable development goals report. `https://unstats.un.org/sdgs/report/2024/` (Accessed: 2025-03-18).

Wang, Y., Sommier, M., and Vasques, A. (2022). Sustainability education at higher education institutions: pedagogies and students' competences. *International Journal of Sustainability in Higher Education*, 23:174–193.

Zwickle, A. and Jones, K. (2018). Sustainability knowledge and attitudes—assessing latent constructs. *World Sustainability Series*, pages 435–451.