Type of Contribution (Paper)

Development of Sustainability Awareness Index for European Universities

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Abstract

Institutions of Higher Education (HEIs) are essential agents in shaping the future of our society. They serve as centres of knowledge responsible for equipping individuals with the critical skills, insights, and perspectives needed to address sustainability challenges that continue to plague our communities. However, research indicates a lack of standardised instruments to comprehensively assess sustainability awareness among university staff and students (Salahange et al., 2024). Existing approaches often focus on specific aspects of environmental sustainability, such as the carbon footprint, while neglecting a holistic measure of aspects forming part of the sustainability discourse. This gap in comprehensive assessment tools hinders the ability to effectively measure the impact of implemented sustainability policies, campaigns and teaching and learning activities on the knowledge, competencies, behaviour, and attitudes of the academic community.

The Emission-Free European Universities (EFEU) project, a consortium of four European universities, aims to address this gap in sustainability awareness tools. The project is dedicated to enhancing sustainability competencies and achieving carbon neutrality within engineering disciplines by transforming teaching and learning practices. One of the planned activities of this project is to develop a questionnaire that will serve as the foundation for the Sustainability Awareness Index (SAX). The SAX framework is rooted in a multidisciplinary approach, assessing, to a lesser extent, the social and economic dimensions of sustainability and, to a greater extent, the environmental aspects. Therefore, this framework offers a robust measure of the sustainability awareness of respondents, provides a sound basis for comparison among similar institutions, and provides insights that can guide universities in improving sustainability initiatives and their curricula.

The methodology consists of several steps: First, an extensive literature review is conducted to analyse existing sustainability indices and assessment systems. Particular attention is paid to the criteria and methods used to measure individual sustainability awareness. Subsequently, relevant studies are selected to form the basis for the development of the project's own questionnaire and calculation framework. Based on the gained insights, a questionnaire is designed to capture the sustainability awareness of respondents. The questionnaire will be tested through a pilot implementation at one of the partner universities to ensure its applicability and effectiveness in diverse educational contexts. The final version will be launched once it has been validated by all partners.

The SAX index aims to serve as a critical tool for fostering a culture of sustainability in higher education, encouraging continuous improvement, and contributing to the broader goals

of the 2030 Agenda for Sustainable Development. Positioned as an essential tool for universities aiming to enhance the sustainability agenda, the framework will be made freely available on the EFEU website.

Key Words: Sustainability Awareness, Sustainable Education, Sustainability Awareness Index

1. Introduction

1.1 Context and Significance

Universities play a pivotal role in the sustainable transition of society. As institutions of education and research, they must lead efforts to equip future professionals with both technical competencies and awareness to act as passionate and dedicated change-makers. To meet these demands, universities must adapt their curricula to prioritise sustainability.

In this context, the Emission-Free European Universities (EFEU) Project aims to transform learning and teaching activities so that the campuses of institutions of higher learning within Europe can evolve into true beacons of sustainability. The project unites four European institutions: Duale Hochschule Baden-Württemberg (Stuttgart, Germany), Instituto Politécnico de Leiria (Leiria, Portugal), Metropolia Ammattikorkeakoulu Oy (Helsinki, Finland), and Université Polytechnique Hauts-de-France (Valenciennes, France).

From December 31, 2022, to May 30, 2025, the EFEU consortium is dedicated to ensuring the successful implementation of project activities including the development of the EFEU Carbon Footprint Calculator, Sustainability Awareness and Mobility surveys and reports, Teaching Modules (in-person and online), a Blended Intensive Program, a Carbon Dioxide Emission Prediction Software, and an EFEU Summer School.

Through the development of the EFEU Sustainability Awareness Survey, the EFEU team recognised the need to develop a standardised framework to comprehensively assess the sustainability awareness of students and staff among the partner universities. This tool will provide insights into awareness levels and identify the specific competencies that need further development.

1.2 Problem Statement and Objectives

The SAX framework aims to offer a more vigorous measure of respondents' sustainability awareness, providing a sound basis for adjusting sustainability initiatives and curricula and supporting interoperability among similar institutions.

This study aims to develop a questionnaire and index to assess sustainability awareness, with a particular focus on environmental sustainability, using a methodologically rigorous approach. By reviewing existing studies, it builds on established procedures and explanatory models that have demonstrated effectiveness in related research.

The SAX will also function as a tool for meeting and developing targeted measures. Its application will facilitate the formulation of concrete recommendations to adhere to and advance the educational objectives outlined within universities, regional or global mandates such as the 2030 Agenda for Sustainable Development.

1.3. Current State of Research Field

The term " awareness" varies across disciplines, but a quite relevant definition was provided by Gier (2021). Gier analysed sustainability awareness based on numerous population-representative studies and defined it as a conscious, verbalised attitude, with attitudes being enduring readiness to react to objects, ranging from tangible items to societal issues. According to Rosenberg and Hovland's (1960) three-component theory, attitudes consist of affective (emotional), cognitive (beliefs), and conative (behavioural intent) elements, which interact dynamically to shape overall attitudes toward sustainability.

Academic studies by Preisendörfer (1999), Franzen (2013), and Sonnberger (2024) were more descriptive when discussing the alignment of environmental awareness to psychological model of attitudes. They specified the major aspects of each dimension and summarised that the cognitive dimension requires an understanding of environmental threats, the affective dimension necessitates perceiving threats as undesirable, and the conative dimension involves the willingness to act.

On the issue of measuring awareness, the process remains challenging. Quasi-experiments, like those by Andersen and Mayerl (2022), suggest no clear influence of awareness on behaviour, requiring further causal analysis. The environmental attitude-behaviour gap has also attracted considerable attention among behavioural and cognitive scientists. Although many studies have been undertaken, Gifford & Chen (2017) and Wyss et al. (2022) concluded that the mechanisms causing this discrepancy are not yet fully understood. Additionally, according to several researchers including Preisendörfer (1996), the measurement of cognitive attitudes is complex due to their hierarchical structures.

Competence, a broader concept than cognitive skills, refers to the ability to apply knowledge, literacy, and skills to address recurring problems (Hofer et al., 2011). A key concept of the sustainability competence discourse is literacy. Stibbe (2009) defines sustainability literacy as the knowledge, attitudes, and competencies needed to understand and act on environmental challenges. Interdisciplinary research by Stibbe (2009), Bianci et al. (2022) and Ehlers (2023) have identified a number of key sustainability competencies necessary for the 21st century, which will be explored in Chapter 2, as they form the basis for the development of the questionnaire.

Another consideration is that environmental awareness is influenced by socio-demographic factors, such as age, gender, education, and income (Preisendörfer, 1996). Dabija et al. (2017), therefore, argued that understanding the causes and impacts of key factors such as environmental, education, social, etc. including their linkages should be a focal research area for universities.

The literature reveals a number of existing tools dedicated to measuring environmental awareness. The International Social Survey Programme (ISSP) scale, widely used in international surveys, is based on three dimensions: conative, cognitive, and affective (Franzen, 2021). Empirical analysis, however, suggests a focus on two dimensions with no clear distinction between cognitive and affective elements, but the scale shows high reliability and validity. Comparisons with other scales, such as the New Environmental Paradigm (NEP) and Diekmann/Preisendörfer’s scale, highlight similar issues and also the need for clarity in construct measurement.

In conclusion, the literature on measuring environmental awareness highlights its complexities. While some progress has been made in understanding its determinants, challenges remain in creating comprehensive measurement tools and defining certain gaps in comprehending awareness, attitude, and behaviour. Sociodemographic factors like age, gender, education, and income play key roles but require further exploration. Understanding environmental awareness remains crucial for furthering competencies that will be required in addressing the environmental challenges that communities face. Therefore, future research should focus on refining measurement tools, exploring causal links between awareness, action, behaviour as well as considering the cultural and contextual factors that affect awareness.

2. Materials and Methods

2.1 The Approach

This chapter outlines the methodology for developing a questionnaire to measure the Sustainability Awareness Index (SAX), which quantifies environmental sustainability awareness using survey responses. The project follows a systematic approach, starting with a literature review across sociology, psychology, sustainability studies, and relevant surveys (e.g., EFEU SAS – EFEU Sustainability Awareness Survey, ISSP, NEP, WVS – World Values Survey). Psychological concepts of attitudes—cognitive, affective, and conative—are central to the idea of sustainability literacy. Consequently, the research employs a twofold methodology: establishing a theoretical base in literacy and analysing existing measurement tools.This approach ensures a scientifically grounded, empirically substantiated instrument. The evaluation tool is developed for measuring and comparing competencies within groups, particularly within the academic setting. The research undergoes a pre-test to identify weaknesses and will include a critical reflection on findings and future research directions.

2.2 Applied Methodology for Developing SAX

The SAX quantifies sustainability awareness through a structured questionnaire covering three dimensions: conative, cognitive, and affective. Each item is scored from 1 to 5, with higher scores indicating greater awareness. The index is calculated by averaging scores within each dimension, ensuring equal weighting across dimensions. The overall SAX score, ranging from 3 to 15, reflects an individual's sustainability awareness level. This approach allows for standardised, comparable assessments, and group comparisons can be made using radar charts, as discussed later in the work.

2.3 Survey Development Methodology

This section outlines the methods used to develop the SAX measurement instrument, a survey. Based on a thorough review of relevant studies and literature, the project team created a solid foundation for the instrument. Surveys are a widely used and standardised method to measure sustainability awareness across various populations, as demonstrated by studies by ISSP, WVS, Diekmann & Preisendörfer, and NEP. Given their established reliability, a similar survey approach is applied here.

The selection of questionnaire items is based on two methods: assessment of questions from existing measuring instruments followed by the combination of similar questions. A selection is made from these similar questions. They are either directly adopted or adapted to meet the needs of the SAX tool. These methods are explained further in the later sections of the paper.

2.3.1 Methodology for Question Formulation

The survey follows a structured approach, integrating relevant scientific principles into a cohesive model. Since environmental awareness is an attitudinal construct, the methodology is based on three domains: Cognition, Conation, and Affection.

Drawing from Stibbe's 2009 work, 26 competencies for environmental sustainability are categorised into 11 key sustainability competence fields. These fields are sourced from recognised literature such as Bianci et al. (2022) and Ehlers (2023). These are then integrated into cognitive, conative, and affective dimensions, reflecting core areas of sustainability awareness. These competencies, as illustrated in Figure 1, form the foundation of the questionnaire.

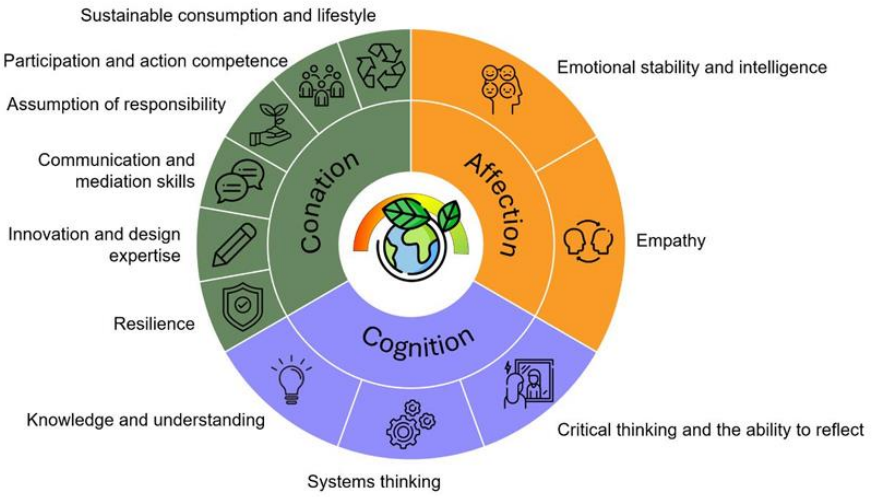

Figure 1*: Assignment of Sustainability Competence Fields to Attitudinal Domains*

2.3.2 Empirically Grounded Question Development

This methodology systematically evaluates existing questionnaires assessing environmental awareness. First, relevant measurement instruments from previous research are identified and reviewed, including the EFEU survey. These are compared to identify content similarities and duplicates. In the second step, items that cover similar topics or contexts are recognised. Items deemed relevant by at least two studies are selected. Finally, in the third step, duplicated questions are categorised into three attitudinal domains: affection, conation, and cognition, forming the structure for the environmental awareness measure.

Einstllungsbereic	Kompetenzfeld	Art	ISSP	WVS
Wissen und Verstehen	Kognition	Frage	Um die Umwelt schützen zu können, braucht Deutschland wirtschaftliches Wachstum.	Hier sind zwei Aussagen, die man über Umweltschutz und Wirtschaf geredet wird. Welche dieser beiden Aussagen k eigenen Meinung näher?
		Antwortmöglichkeiten	*Stimme voll und ganz zu* *Stimme zu* *Weder noch* *Stimme nicht zu* *Stimme überhaupt nicht zu* *Kann ich nicht sagen*	*1 - Dem Umweltschutz sollte Vor eingeräumt werden, auch wenn d Wirtschaftswachstum sinkt und Arbeitsplätze verloren gehen.* *2 – Dem Wirtschaftswachstum u Schaffung von Arbeitsplätzen so eingeräumt werden, selbst wenn darunter die Umwelt etwas leidet.* *3 – Andere Antwort*
		Frage	Wirtschaftswachstum schadet immer der	

Figure 2*: A Section of Table used for the Analysis of Existing Questionnaires*

Figure 2 illustrates a section of the table used in the structural analysis of selected questionnaires. Columns categorise questions by attitudinal domains, competence fields, and response options, while duplicated questions are aligned in the same row.

2.3.3 Questionnaire Development: Integrating competence fields and survey reviews

Integrating competence fields and the review of existing and relevant surveys ensures a solid framework for measuring environmental awareness. These fields of competence and attitudinal domains serve as a "common denominator" to ensure comprehensive measurement of environmental awareness. The 16-item questionnaire directly addresses respondents and effectively measures conation, cognition, and affection. A pre-test with 18 participants will refine its clarity and applicability.

2.4 Indexing as a Method

An index combines multiple indicators into a single variable, aiding in data analysis by simplifying complex constructs (Latcheva and Davidov, 2014). It enables comparisons and the tracking of changes. The SAX captures cognitive, affective, and behavioural dimensions of environmental awareness, facilitating comparative analyses across student populations, administrative bodies, institutional policies, and universities. The results can be used to inform policy decisions, and ultimately foster more effective approaches to sustainable education.

2.5 Summary

In summary, the Sustainability Awareness Index (SAX) combines literature review, empirical analysis, and established frameworks to ensure reliability and validity. Pre-test findings confirm its robustness, positioning the SAX as a valuable tool for assessing sustainability awareness that has the potential for broader application and continued research.

3. Results and Discussion

3.1 Presentation and Analysis of Results

Chapter 3 provides a detailed presentation and analysis of the research results. It includes the developed questionnaire and covers the development of the evaluation tool for interpreting the results. The pre-test conducted to validate the instrument is also discussed. This section also provides additional features and quality criteria forming part of the tool, a summary of key findings, and identified limitations in the research approach.

3.2 Questionnaire for Environmental Awareness

The list below provides the final questionnaire items developed for this project, with adjustments integrated from the pre-test exercise. The questionnaire consists of 16 items, and the environmental consciousness domain they measure.

Items 1.1 – 1.5: These items fall under the "Cognition" domain and "Knowledge and Understanding" competence, assessing the individual’s understanding of climate change effects. For example, item 1.1 asks about the link between droughts and climate change, while other items assess knowledge of impacts on biodiversity, displaced people, sea level rise, and ocean acidification. These items are taken verbatim from the EFEU survey.

Item 2: Also within the "Cognition" domain and "Knowledge and Understanding" competence, this item examines the conflict between environmental protection and economic growth.

Personal Stance on Goal Conflict: This item assesses whether the individual believes environmental protection or economic growth should take precedence, even if it negatively impacts the other. It measures the understanding of the relationship between environmental and economic issues and is taken from the WVS.

Item 3: Under the "Cognition" domain and "Systems Thinking" competence, this item evaluates the individual's understanding of the long-term global consequences of environmentally harmful behaviour. It is slightly modified from the ISSP.

Item 4: Also under "Systems Thinking," this item examines whether the individual recognises the potential ecological catastrophe if human behaviour doesn't change, assessing understanding of the systemic links between current actions and climate change outcomes. It is taken from Diekmann and Preisendörfer's studies.

Items 5-6: These items fall under "Cognition" and "Critical Thinking and Reflection." Item 5 asks if the individual perceives claims about human-caused climate change as exaggerated, measuring their critical approach to climate change. Item 6 examines whether the individual believes political measures are insufficient to combat environmental issues. Both assess reflective and critical thinking and are adapted from the ISSP. The project team combined items from Diekmann and Preisendörfer's study and the NEP to capture the competence field more comprehensively.

Item 7: This item belongs to the "Conation" domain and "Sustainable Consumption and Lifestyle" competence and measures the willingness to reduce one's standard of living for the environment. It assesses if environmental knowledge translates into sustainable behaviour and is adapted from Diekmann and Preisendörfer's study.

Item 8: Also in the "Conation" domain but within "Participation and Action Competence," this item measures the willingness to take environmental action, even if it requires greater effort. It is adapted from the ISSP, with a slight change in wording.

Item 9: This item, under the "Conation" domain and "Assuming Responsibility" competence, assesses the willingness to pay higher prices for environmental protection, reflecting personal sacrifice for the common good. It is adapted from the ISSP with slight wording adjustments. The decision to include this item was made because it covers the competence field well and is empirically verified through the ISSP.

Item 10: In the "Conation" domain and "Communication and Mediation Competence," this item assesses the individual's ability to convey environmental issues clearly, including using modern media. It was independently developed by the research team, as no existing questions met the criteria, and pre-test results confirmed its validity.

Item 11: This "Conation" domain item in the "Innovation and Design Competence" field evaluates whether the individual feels capable of finding innovative solutions to environmental problems. It is taken directly from the ISSP and has proven applicability.

Item 12: Belonging to "Conation" and "Resilience," this item measures the individual's persistence in environmental protection, regardless of others' actions. It is verbatim from the ISSP.

Item 13: In the "Affection" domain and "Empathy" field, this item measures the individual's perception of others' concerns about climate change. It combines formulations from the NEP, ISP, and Diekmann and Preisendörfer studies.

Item 14: Also in the "Empathy" field, this item evaluates whether the individual believes plants and animals have rights similar to humans. It is slightly modified from the NEP.

Items 15–16: In the "Affection" domain and "Emotional Stability and Intelligence" field, Item 15 assesses the individual's ability to stay calm despite climate change threats (adapted from Diekmann and Preisendörfer). Item 16 examines emotional management regarding environmental issues, developed independently by the research team.

The questionnaire includes 16 items, covering all fields within the cognition, cognation and affection dimensions. Response options range from "Strongly agree" to "Strongly disagree," (a 1-5 scale) adapted from the EFEU survey, allowing respondents to express varying levels of agreement. This scale was confirmed as optimal during the pre-test.

The survey was conducted using Microsoft Forms, which proved effective and easy to navigate during testing. The survey data collected via MS Forms is exported to Excel, with columns for respondent details and survey responses. For data analysis, the research team provides an "evaluation tool," a formatted and programmed Excel file. Responses are converted into awareness points using predefined rules detailed in Figure 3. The rules are as such: Maximum points (full agreement indicates strong awareness); Minimum points (full agreement reflects low awareness), Scaling: higher scores indicate greater awareness, with "one" earning the lowest, and Thesis selection (choosing Thesis 1 indicates strong awareness, while Thesis 2 reflects lower awareness).

	A	B	C	D	E	F	G	H
1	Zustimmung maxiamale Punktzahl		Zustimmung minimale Punktzahl		Skala		Antwort 1 oder 2	
2	Antwortmöglichkeit	Bewusstseinspunkte	Antwortmöglichkeit	Bewusstseinspunkte	Antwortmöglichkeit	Bewusstseinspunkte	1	5
3	Stimme voll zu	5	Stimme voll zu	1	1	1	2	0
4	Stimme zu	4	Stimme zu	2	2	2		
5	Stimme weder zu noc	3	Stimme weder zu noc	3	3	3		
6	Stimme nicht zu	2	Stimme nicht zu	4	4	4		
7	Stimme überhaupt nic	1	Stimme überhaupt nic	5	5	5		
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18	Standardformel:		Standardformel:		Standardformel:		Standardformel:	
19	"=WENN(Sheet1!ZELLE=Regelblatt!$A$3;		"=WENN(Sheet1!ZELLE=Regelblatt!$C$3;		"=WENN(Sheet1!ZELLE=Regelblatt!$E$3;		"=WENN(Sheet1!ZELLE=	

Figure 3*: Excel Worksheet 'Rule Sheet' with Point Distribution Code*

The calculated points and average values are depicted in the "Auswertung" worksheet. Based on this foundation, the index value is generated, and there is also the possibility to evaluate the awareness values across the attitudinal domains (highlighted blue, green, and orange in Figure 4). To calculate the SAX, the average of the responses within each of the three dimensions is determined. This methodology ensures that each dimension is equally weighted in the index, minimising distortions caused by individual responses. The average values of the

three dimensions are then summed to represent the overall level. The tool defines a range for the SAX index, between 3 and 15 awareness points.

AUSWERTUNG SAX

Bereich	Durchschnittswert	Anteil	Indexwert
Kognition	3,872222222	35,88%	
Konation	3,435185185	31,83%	10,79352
Affektion	3,486111111	32,30%	

	Frage										
Bewusstseinspunkt	1	2	3	4	5	6	7	8	9	10	11
1	0	0	2	1	0	2	0	0	0	2	1
2	0	1	1	3	0	11	1	1	0	1	4
3	1	1	3	1	6	2	1	2	2	3	4
4	8	7	6	5	7	2	9	8	11	11	8
5	9	9	6	8	5	1	7	7	5	1	1

Figure 4*: Excerpt of Table with Excel Worksheet Evaluation - Calculation of Index Value and Answer Count for Awareness Distribution*

The results are represented in various graphical visualisations. As illustrated in Figure 5, the green-highlighted area offers graphical elements to display the results for each item, while the beige-highlighted area provides direct insight into the cumulative attitudinal domains and fields of competencies. These graphical elements are presented in the "Darstellung" worksheet. In the future, this worksheet will be made available in both German and English, eliminating the need for translations for future presentations of the visualisations.

The value network plays a central role in the presentation of results. It is used to compare individual respondents with average values or to directly compare alternative freely definable measurement groups. Another important representation is the graphical overview of the distribution of awareness points per question. This visualisation clearly illustrates how the responses to the posed items are distributed, enabling an immediate comparison of how the average value was derived. Specific trends or focal points in the response behaviour can thus be quickly identified and interpreted in terms of their significance for sustainability awareness.

A pie chart complements the analysis by showing the profile and proportion of attitudinal domains within environmental awareness, highlighting their contribution to the overall index value. Finally, a separate chart illustrates the long-term trends of sustainability awareness, showing changes in the SAX value over time. This chart assesses whether awareness is increasing, stagnating, or decreasing, revealing fluctuations and trends critical for evaluating effectiveness.

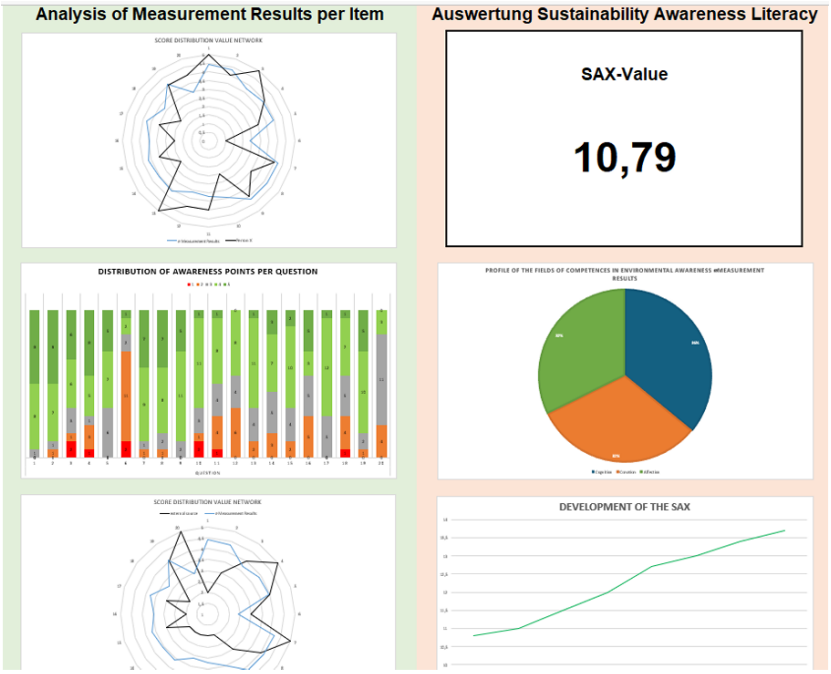

Figure 5*: Excel Worksheet - 'Darstellung'*

3.3 Pre-Test

A pre-test with 18 participants from the Facility Management Department refined the survey for clarity and structure. Issues with questions and scales were addressed, including reducing the scale range from 1–10 to 1–5 for consistency, improving clarity, and shortening completion time.

3.4 Additional Features and Quality Criteria

The SAX framework includes instructions, makes it possible to update formulas, and allows up to 500 responses. The included quality criteria consider: one-dimensionality (items focus on distinct competencies), reduction (averages ensure simplicity and transparency), multiple indicators (mitigates random variations), weight-free validity (no bias from weighting), transparency (published formulas ensure validation), and objectivity (based on neutral,scientific methods).

3.5 Summary

The SAX measures environmental awareness in higher education through an 11-competence, 3-domain questionnaire, producing standardised scores (3–15). It, therefore, aids universities in tracking trends, supports research in sustainability education, and provides evidence for adjusting or optimising sustainability offerings.

3.6 Limitations and Future Research

The current version of the tool needs validation for broader cultural and linguistic contexts. The index's upper limit restricts differentiation among high scorers. Future steps include testing the English version, refining items, and extending the survey to EFEU institutions for cross-national analysis. Incorporating additional social and economic dimensions should be considered but might necessitate shortening the questionnaire, potentially affecting accuracy.

4. Conclusion

This project aimed to develop the Sustainability Awareness Index (SAX), a comprehensive tool to assess sustainability awareness across multiple attitudinal domains and incorporating environmental, social, and economic aspects. The development process involved a detailed review of existing frameworks, the creation of a robust questionnaire, and a series of empirical tests, such as pre-testing, to ensure the validity and clarity of the index. The final SAX represents a reliable and scientifically grounded measure of sustainability awareness that can be applied within an academic context .

The significance of the SAX lies in its ability to provide universities with a structured and standardised tool to evaluate sustainability awareness among students and staff. By assessing cognitive, affective, and conative components of sustainability awareness, the SAX allows for nuanced insights into the factors that shape attitudes and behaviours towards sustainability. The tool's potential for international comparisons further enhances its value, enabling universities to track sustainability efforts and share best practices across borders.

However, several challenges were encountered during the development process, particularly concerning the cultural and linguistic adaptation of the index. While the SAX shows promise in its current form, it would benefit from further validation and refinement, particularly in diverse international settings. Future research should focus on enhancing the index's precision and exploring its potential for broader application, including incorporating additional sustainability dimensions such as social equity and economic factors.

In conclusion, the SAX represents a significant step forward in the measurement of sustainability awareness and serves as a foundation for future efforts to better understand and promote sustainable practices in higher education. By continuing to optimise this tool, universities can more effectively measure and promote sustainability awareness, ultimately contributing to the development of education that addresses the sustainability challenges confronting our communities.

Project Partners

Duale Hochschule Baden-Württemberg (Stuttgart, Germany),

Instituto Politécnico de Leiria (Leiria, Portugal),

Metropolia Ammattikorkeakoulu Oy (Helsinki, Finland), and

Université Polytechnique Hauts-de-France (Valenciennes, France)

Conflicts of Interest

The authors declare no conflicts of interest.

Publication

Ethical publishing guidelines are taken into account. Large Language Models, LLMs, such as ChatGPT, do not currently fulfil our criteria for authorship. In particular,

assigning authorship entails an accountability for the work that cannot be effectively applied to LLMs. The use of an LLM should be properly documented.

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