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Sustainability Assessment Tools in Higher Education Institutions: Comprehensive Analysis of the Indicators and Outlook

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8.1 Introduction

Higher education institutions (HEIs) have been generally considered significant contributors to the promotion of sustainability (Karatzoglou 2013). They can act as transformative agents to shape sustainability (Findler et al. 2018; Wersun et al. 2020) among society and empower individuals to tackle social and ecological problems with entrepreneurial means to put sustainability into practice (Hesselbarth and Schaltegger 2014). The process of sustainability integration in HEIs has recently been gaining increasing attention worldwide, with a stronger interest in Europe (Moreno Pires et al. 2020). Sustainability integration is the entire process of moving from a business-as-usual university to a sustainable university, including all stages of the process along a certain time (Kapitulčinová et al. 2018). A sustainable university is defined by Velazquez et al. (2006) as an HEI that addresses and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects being generated in its use of its resources, and fulfills its functions of teaching, research, outreach, and stewardship in ways to help society make the transition to sustainable lifestyles. Several studies show developing new initiatives to integrate sustainability into the whole systems elements of HEIs, including core elements like education, research, operations, community outreach, and assessment and reporting (Lozano et al. 2015b). Kapitulčinová et al. (2018) schematized three stages of this integration process, namely (i) initiation/awakening, (ii) implementation/pioneering, and (iii) institutionalization/transformation, to shift from a business-as-usual university to a sustainable university. Given the central role of HEIs in fostering the United Nations 17 Sustainable Development Goals (SDGs), in particular SDG 4 (Quality Education) and target 4.7 (United Nations 2015), the adoption of whole-institution approaches and integrated frameworks by the academic community still appears to be in initial stages (Lozano et al. 2013).

There are several practices and initiatives adopted by HEIs to promote sustainability (Alshuwaikhat and Abubakar 2008). These practices can emerge in a wide range of areas (Caeiro et al. 2013), including the curriculum (Lozano 2010; Watson et al. 2013; Xiong et al. 2013; Stough et al. 2018); change in HEIs' assessment and management practices, e.g. through implementing management standard systems such as environmental management systems (EMS) (ISO 14001) and the EU Eco-Management and Audit Scheme (EMAS) (Alshuwaikhat and Abubakar 2008; Amaral et al. 2015; Nurcahyo et al. 2019); and assessing and reporting sustainability through applying sustainability assessment tools (Shriberg 2002; Alghamdi et al. 2017; Findler et al. 2018).

Different tools have been developed to specifically assess sustainability implementation at HEIs, for example Sustainability Assessment Questionnaire (SAQ) (ULSF 2009); Graz Model for Integrative Development (GMI) (Mader 2013), and Graphical Assessment of Sustainability in Universities tool (GASU) (Lozano 2006a) among many others. Also, there are some tools that propose ranking systems to compare the level of sustainability performance at HEIs such as Time Higher Education Impact Ranking System (THE), Three Dimensional University Ranking (TUR) (Lukman et al. 2010), and Sustainability Tracking, Assessment & Rating System (STARS) (AASHE 2019). However, HEIs assessment and ranking systems still require a specific definition of criteria and indicators developed to assess an HEI's progress toward the integration dimensions of sustainability (e.g. environmental, social, economic, academic, and institutional). As a result of usage of various indicators within the tools, the overall rankings based on diverse assessment tools are different (Lukman et al. 2010) and there are still some open questions on why a particular methodology or indicator was chosen by an HEI, how well it was structured, how the assessment and decision process was conducted, and finally what the main similarities and differences among these tools and associated indicators are. These questions are important for better overall comparison and benchmarking of sustainability implementation in HEIs, in terms not of competition but of network and collaboration.

The research aims to follow up earlier research by Caeiro et al. (2020) and critically analyze the existing tools that assess the implementation of sustainability at HEIs as well as their associated indicators and explore how the indicators emerge into the different core elements of sustainability implementation at HEIs, as well as into sustainability dimensions. More specifically, it also reveals through which thematic areas these indicators measure sustainability implementation at the HEIs.

This chapter is structured as follows: Sections 8.2 provides an overview of sustainability assessment at HEIs and describes the existing tools in HEIs and the main gaps; Section 8.3 describes the methods and the steps of the analysis; Section 8.4 presents the results and comparative analysis; Section 8.5 provide the overall discussion and the future development of the research; and finally Section 8.6 concludes the chapter.

8.2 An Overview of Sustainability Assessment and the Associated Tools at HEIs

Assessment should function as a learning and capacity-building instrument to help reflect on actions taken and improve future processes (Mader 2013). According to Lozano and Huisingh (2011), sustainability assessment is "a voluntary activity to assess the current state of an organization in triple-bottom-line of sustainable development." Sustainability is not a single discipline to be assessed but requires the equal analysis of the impact of economic, social, and environmental issues. While definitions of sustainability in the context of HEIs vary, commonalities encompass four dimensions (Moreno Pires et al. 2020): the environmental (defined as the sum of all biophysical processes and the elements involved in them); the social (intrapersonal qualities of human beings); the economic (the formal and informal economic activities that provide services to individuals and groups); and the institutional dimension (particularly within the realms of campus life including the administrative structure and policy directions of HEIs). Moreover, as pointed out in the previous literature (Lozano 2006a; Waheed et al. 2011; Berzosa et al. 2017), the sustainability dimensions in HEIs also include its main activity: academic sustainability, mainly covered by "education, research, and curriculum." Therefore, to evaluate sustainable development, all five dimensions of sustainability need to be reflected within one assessment process and with their interdependencies.

Corresponding to the development of sustainability declarations of HEIs, sustainability assessment practices at the university level have received increasing attention in the past decade (Fischer et al. 2015). As stated by Shriberg (2002), ideal sustainability assessments across institutions, in general, must address the following features: (i) contextualize appropriate issues of major importance to campus environmental, social, and economic efforts and effects; (ii) be calculable and allow for cross-campus comparisons; (iii) move beyond eco-efficiency and stress issues at the nexus of the environment, society, and economy with the goal of no negative impacts instead of focusing only on environmental performance and regulatory compliance; (iv) measure processes and motivations deep into decision-making by asking about missions, rewards, incentives, and other process-oriented outcomes; and (v) be comprehensible to a broad range of stakeholders by developing mechanisms for reporting that are verifiable and lucid.

To foster sustainable development at HEIs, there is a need to provide a tool for assessment and improvement of measures and actions taken toward sustainable development. Findler et al. (2018) defined sustainability assessment tools in the context of HEIs as "instruments that offer HEIs a systematic set of procedures and methods to measure, audit, benchmark, and communicate their sustainable development efforts." These tools allow the assessment of whether all possible dimensions to the implementation of sustainability are being implemented and whether they are doing so holistically (Caeiro et al. 2020). They do not only offer the technical support of implementation and evaluation of measures that actors in HEIs have developed to achieve outcomes that they have agreed on, but also provide a reference framework that is based on normative assumptions about what constitutes a sustainable university (Fischer et al. 2015).

A growing number of diverse assessment tools and methods have been developed and implemented by single institutions as well as alliances across different campuses. These tools are underpinned by different monitoring purposes, from ensuring compliance to predetermined standards, diagnosing the state of internal processes, and providing data for competitive performance comparisons (Fischer et al. 2015). They can be used to confirm the outcomes and impacts of the processes and activities (Smedby and Neij 2013) in a different context. They also provide the ability to decide what actions

should be taken by the authorities to make HEIs more sustainable. However, since the concept of sustainability varies in different organizations – owing to differences between cultural, political, social, and economic conditions (Jones 2010) – therefore, each sustainability assessment tool should be adjusted for particular contexts, reflecting the specific conditions of each case study (Mapar et al. 2017). In the case of HEIs, the assessment tools should cover the whole system by addressing the seven core elements of sustainability implementation in HEIs that are widely accepted in the literature (Lozano et al. 2015a; Findler et al. 2018): (i) governance (i.e. the HEI commitment, policies, vision, mission, sustainable development office, and administrative structure); (ii) operations (i.e. energy use and energy efficiency, green-house gases, waste, water and water management, food purchasing, transport, accessibility for disabled people, and equality and diversity); (iii) education (i.e. courses on sustainable development, programs on sustainability issues, curricular reviews, and "educate-the-educators" programs); (iv) research (i.e. research funding, sustainable development research used in teaching, publications, patents, new knowledge, and technologies); (v) outreach and collaboration (i.e. exchange programs for students in the field of SD, joint degrees with other universities, joint research, SD partnerships such as enterprises, non-governmental organizations, and governments, and SD events open to the community); (vi) on-campus experiences (i.e. SD working group, sustainable development initiatives for students and staff, sustainable practices for students); and (vii) assessment and reporting (i.e. external assurance, reporting cycles, stakeholder identification processes). The majority of sustainability assessment tools in HEIs can be categorized into three types, as follows:

1. The first type includes a set of measurable individual indicators as the most frequent tools to assess sustainable development (Coelho et al. 2010; Ramos 2019; Mapar et al. 2020). Indicators are qualitative or quantitative bits of information that assess organizational performance and bring together multiple areas of sustainability that are generally comparable (GRI and ISO 2014). Using indicators-based methods, as compared to other assessment approaches, seek to achieve the integration of all sustainability issues by using a wide range of indicators in different domains of sustainability (Adinyira et al. 2007). Several studies have compiled a wide list of sustainability indicators at HEIs, including among many others Findler et al. (2018), Alghamdi et al. (2017), Lukman et al. (2010), and Penn State Green Destiny Council (2000).
2. The second type of assessment tool includes composite indices which means a major tool to aggregate or combined different indicators (Gasparatos 2010; Agovino et al. 2018; Mapar et al. 2020) by mathematical or heuristic functions (Ramos et al. 2004) into one single measure to evaluate complex multidimensional phenomena. One example is the uncertainty-based driving force-pressure-state-exposure-effect-action-Sustainability index Model (uD-SiM) (Waheed et al. 2011) which is a causality-based model in which the sustainability index is an outcome of nonlinear impacts of sustainability indicators in different stages of a driving force-pressure-state-exposure-effect-action (DPSEEA) framework and it used to quantitatively assess the sustainability for HEIs.
3. The third type of sustainability assessment tool has a distinct origin, in the tradition of EMSs that involve external audits and certification mechanisms (Fischer et al. 2015) such as the EMS ISO 14001 and the EMAS Regulation. There are some examples of the employment of these management-based assessment tools at HEIs as a means of achieving a sustainable campus (Alshuwaikhat and Abubakar 2008; Amaral et al. 2015; Nurcahyo et al. 2019).

However, among the three types of sustainability assessment tools, indicators are one of the approaches most used in different contexts, playing a central role in sustainability assessment (Ramos 2019), and in the context of HEIs, the various tools for assessing their sustainability are mostly based on indicators, using graphs or final rankings to communicate the results. Indicator-based tools have the advantage of being potentially more transparent, consistent, and comparable and thus useful for monitoring and decision support, although support for decision-making is not yet fully demonstrated (Caeiro et al. 2020). The indicator-based assessment approach is comprehensive and representative (Alghamdi et al. 2017), and in addition to being easily measurable and comparable (Lozano 2006a), it can convey value-added messages in a simplified and useful manner to different types of target audiences, including policy- and decision-makers as well as the general public (Ramos and Moreno Pires 2013; Alghamdi et al. 2017).

Shriberg (2002) analyzed the strengths and weaknesses of 11 sustainability assessment tools at HEIs

and stated that most assessment tools do not provide mechanisms for comparing campus efforts against other institutions. Yarime and Tanaka (2012) developed a comparative analysis of 16 sustainability assessment tools and examined the recent trends in the issues and methodologies addressed in these tools, both quantitatively and qualitatively. The results demonstrated that the reviewed sustainability assessment tools focused mainly on the environmental impacts of HEIs' operation; the other aspects of integration of sustainability at HEIs are not well addressed by these tools. Another study by Fischer et al. (2015) provided a comparative analysis of around 600 indicators and criteria extracted from 12 sustainability assessment tools to find the dominance and marginalization of different fields and issues. Even though education and research are commonly referred to as crucial fields of action and key functions of universities, the results revealed a strong bias in the indicators and criteria toward the field of operations and, more specifically, to physical resource management. Alghamdi et al. (2017) reviewed 12 assessment tools of sustainability in universities by focusing on their associated indicators. The tools reviewed shared a similar pattern in terms of criteria, subcriteria, and indicators, and subsequently five benchmarks were introduced as essential elements for a holistic framework including management, academia, environment, engagement, and innovation. The most recent literature, by Caeiro et al. (2020), reviewed 27 existing tools to assess and benchmark education for sustainable development (ESD) implementation at HEIs and to discuss their applicability in two public universities in Southern Europe – one in Portugal and the other in Spain – and stated that the existing tools were too operational not evaluating the strategic processes.

However, according to several authors, the overall implementation of these tools is still low and development still at an early stage (Caeiro et al. 2020). Also, these studies have focused mainly on analyzing the characteristics of a selected number of assessment tools and there is still a lack of study exploring a comprehensive list of assessment tools, particularly exploring the associated subcriteria and indicators, as well as the similarities and differences between them. On the other hand, those few studies that have covered a comprehensive list of assessment tools (Caeiro et al. 2020) or explored the characteristics of indicators within the tools, do not include a clear picture of thematic areas covered by the indicators and do not cluster them based on sustainability dimensions. So, since there are several sustainability assessment tools across universities worldwide, as asserted by Alghamdi et al. (2017): “The next step should be moving from proposing more tools, criteria, and subcriteria to practically detailing and operationalizing the core of these tools, which is indicators. Indicators should be given more attention. Tools ought to develop indicators in easily measurable ways, clearly defined and agreed upon.” Following this, an analysis is conducted to reveal the thematic areas covered by existing tools and to explore what sustainability dimensions and core elements of sustainability implementation at HEIs are covered by their associated indicators to provide a holistic picture of sustainable university.

8.3 Methods and Steps

The assessment tools in this research were identified based on a review of existing studies of sustainability assessment tools in HEIs and online research that aimed to identify recently developed tools. Thus, a systematic review of the tools for sustainability assessment in HEIs was conducted and the tools were selected based on the following conditions, by Caeiro et al. (2020) and Alghamdi et al.'s (2017) studies:

1. Tools that were specifically developed for assessing the performance of sustainability implementation in HEIs.
2. Tools covering at least two of the seven core elements of sustainability implementation in HEIs, adopted from the studies of Lozano et al. (2015a) and Findler et al. (2018): governance, education, research, outreach and collaboration, operation, on-campus experience, and assessment and reporting.
3. Tools covering at least two of the sustainability dimensions (environmental, social, economic, academic, and institutional), to guarantee that the tools, in some way, were based on a holistic and whole-university approach.
4. Tools that are, to a large degree, indicator-based assessment tools, which means that they are more easily measurable and comparable.

These selection conditions aimed to generate a maximum variety of tools to foster a comprehensive and comparative assessment. Based on these conditions, the assessment tools were searched on Google Scholar using the following keywords: "assessment tools," "higher education institution," "university," "campus," "indicator," and "evaluation"; any tool that does not meet the mentioned conditions were excluded. Each selected tool was then characterized through qualitative and quantitative content analysis based on the structure given in Figure 8.1 including (i) tool structure (ii) core elements of sustainability implementation in HEIs, (iii) sustainability dimensions, and (iv) more commonly covered thematic areas.

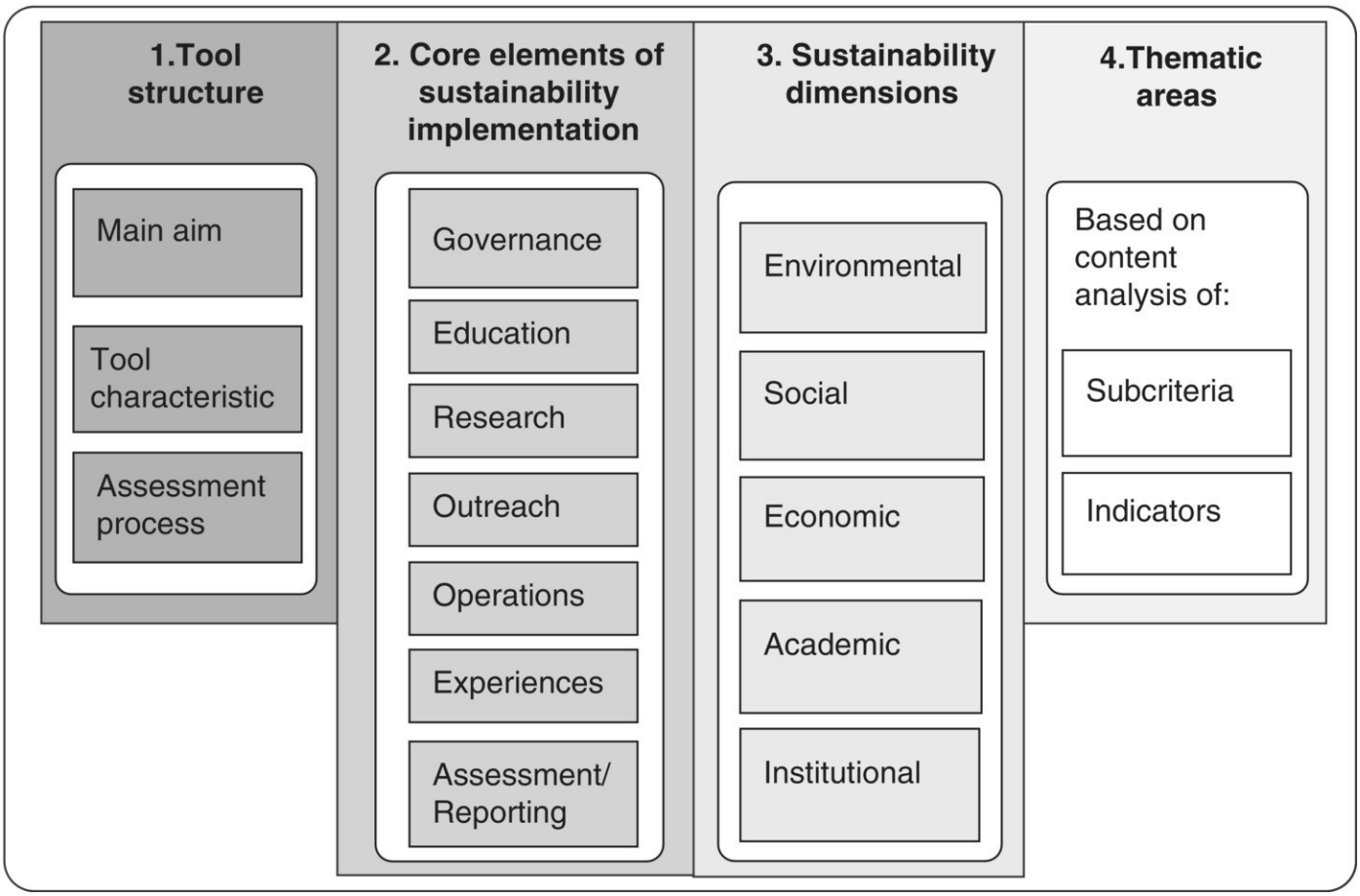

Figure 8.1 The methodology of analyzing the sustainability assessment tools in HEIs.

In the first step, each tool was explored briefly in terms of background, the main aim, the tool characteristics, and the assessment process. Also, each tool was explored succinctly to extract its existing level of hierarchy including the subjective dimensions, the subcriteria, and the associated indicators. In this research, "subcriteria" refers to the middle level of the hierarchy, namely the broad categories under which a bunch of indicators with a similar subject or objective falls. For example, in the STARS tool, "Engagement" as a subjective category is divided into two subcriteria including "Campus engagement" and "Public engagement" under which several indicators are allocated (e.g. participation in public policy, intercampus collaboration, outreach materials and publication, and outreach campaign).

In the second step, the process involved both deductive and inductive parts, adapted from the approaches proposed by Fischer et al. (2015) and Findler et al. (2018). The deductive analysis aimed to link each tool based on the subcriteria to the seven core elements of sustainability implementation in HEIs (see Section 8.2). Each tool was assigned to each core element according to a five-stage scoring system whereby the minimum link between the subcriteria and the core element was assigned 1 and the maximum link 4. Also, 0 was assigned if there was no link between the tool and the core element. Then the contribution of the core elements in the whole scale (based on percentage) was calculated by averaging the score of each core element as a share of the total.

Also, to explore the link of tools to the sustainability dimensions, each indicator was assigned to at least one of the five dimensions of sustainability: environmental, social, economic, academic, and institutional (see Section 8.2 for the definition of each dimension). However, by limiting the link of each indicator to only one dimension without considering the interlinks among them, the profiling sustainability in the tools can become problematic, particularly for those indicators that reflect more

than one dimension at a time. Therefore, in this research, the overlaps of the dimensions were taken into account and the indicators were assigned to more than one sustainability dimension only if they had a significant link with those dimensions. Then the profile of the sustainability dimensions in each tool (based on percentage) was calculated based on the frequency of the indicators in each dimension as a share of the total. Also, the profile of the sustainability dimension in the whole scale was calculated by averaging the obtained values in each dimension.

For the inductive part of the analysis, because several subcriteria in the selected tools were repeated or duplicated, or had the same meaning with different names, based on the approaches of Fischer et al. (2015) and Findler et al. (2018), the authors independently reviewed the descriptions of each subcriterion to combine those with the same meaning and subsequently to identify the main thematic areas covered by them. Finally, the subcriteria were summarized into thematic areas based on their frequency in the assessment tools. The thematic areas that were pointed out more than twice were included in the final list.

8.4 Results and Comparative Analysis

8.4.1 Tools Structure

A total of 27 assessment tools were selected. They are listed in Table 8.1, which represents each tool's capability to assess the sustainable development of HEIs. Also, a total of 239 subcriteria and 1033 indicators were extracted from the tools. Table 8.2 shows the details of each tool including the main structure, the assessment procedure, and the number of indicators in each tool. The results of the analysis show that, although there is a variation in the main purposes, the assessment processes and content of the tools share many commonalities. A common characteristic of the listed assessment tools is the fact that the main structure is based on hierarchical levels and largely includes the main subjective categories, subcriteria, and then indicators. In around half the tools (52%), the total number of indicators is less than 30, whereas 22% of the tools have between 30 and 50 indicators, and 26% of them assess the progress of universities toward sustainability using more than 50 indicators.

Table 8.1 Overview of sustainability assessment tools included in this research.

Source: Adapted and built upon Caeiro et al. (2020).

No.	Brief name	Full name	Country	Year of construction	Main aim/application	References
1	AISHE	Assessment Instrument for Sustainability in Higher Education	Netherlands	2000	Developing a policy toward sustainable development	(Roorda et al. 2009)
2	AMAS	Adaptable Model for Assessing Sustainability in Higher Education	Chile	2014	Assessing sustainability in HEIs among different implementation stages	(Gómez et al. 2015)
3	ASSC	Assessment System for Sustainable Campus	Japan	2013	Enabling a university to discover criteria for its administrative policies	(CAS-NET Japan 2019)
4	AUSP	Assessment of University Sustainability Policies	Spain	2007	Contributing to strengthening sustainability policies in Spanish HEIs	(CRUE 2018)
5	BIQ-AUA	Benchmark Indicator Questions - Alternative University Appraisal	Asian-Pacific	2009	Self-awareness of the universities' strengths/weaknesses in the field of ESD	(Razak et al. 2013)
6	CTIE-AMB	Red de Ciencia, Tecnologia, Innovacion y Educación Ambienal em Iberoamerica	Colombia	2014	Making a diagnosis of the current situation of the institutionalization of environmental commitment in universities, mainly on the top level of universities	(CTIE-AMB et al. 2014; Caeiro et al. 2020)
7	DUK	German Commission for UNESCO	Germany	2011	Sustainability self-assessment concept for HEIs	(Yarime and Tanaka 2012; Findler et al. 2018; DUK 2011)
8	ESDGC	Education for Sustainable Development and Global Citizenship	Wales/UK	2012	Assessing the implementation of ESD in universities, specifically for HEIs in Wales, UK	(Glover et al. 2013)
9	GASU	Graphical Assessment of Sustainability in Universities	UK	2006	Comparing and benchmarking of universities' sustainability efforts and achievement by the graphical overview	(Lozano 2006b)

No.	Brief name	Full name	Country	Year of construction	Main aim/application	References
10	GC	Good Company's Sustainable Pathways Toolkit	US/International	2001	Evaluating the social and environmental impacts of HEIs	(Good Company 2002)
11	GM	GreenMetric University Ranking	Indonesia	2010	Assessing, ranking, and comparing campus efforts toward sustainability	(Lauder et al. 2015)
12	GMID	Graz Model for Integrative Development	Australia/International	2012	Evaluating the transformative potentials of sustainability processes on ESD by focusing on interrelations between HEIs and regional stakeholders	(Mader 2013)
13	GP	Green Plan	France	2010	Assisting HEIs in drawing up their own sustainability plans	(Alghamdi et al. 2017; Caeiro et al. 2020)
14	HE21	Higher Education 21 or Higher Education Partnership for Sustainability (HEPS)	UK	2001	Achieving strategic objectives through positive engagement with the sustainable development agenda	(Buckland et al. 2001)
15	PSIR	Penn State Indicator Report	US	1998	Evaluating the performance at Pennsylvania State University through the lens of sustainability	(Penn State Green Destiny Council 2000)
16	P&P	People & Planet University League	UK	2007	Ranking of UK universities by environmental and ethical performance	(People and Planet University League n.d.; Findler et al. 2018)
17	SAQ	Sustainability Assessment Questionnaire	US	2001	Assessing how sustainable university's teaching, research, operations, and outreach are	(ULSF 2009; Alghamdi et al. 2017)
18	SRC	College Sustainability Report Card	US/Canada	2010	Examining colleges and universities, as institutions, through the lens of sustainability	(Sustainable Endowments Institute 2011)

No.	Brief name	Full name	Country	Year of construction	Main aim/application	References
19	STARS	Sustainability Tracking, Assessment & Rating System	US	2010	Self-reporting of colleges and universities to measure their sustainability performance	(AASHE 2019; Caeiro et al. 2020)
20	SUM	Sustainable University Model	Mexico	2006	Visualizing and achieving a sustainable university system	(Velazquez et al. 2006)
21	SLS	Sustainability Leadership Scorecard	UK/Ireland	2016	Improving social responsibility and environmental performance through a whole-school approach in a self-assessment process	(EAUC n.d.)
22	SustainTool	Program Sustainable Assessment Tool or PSAT	US	2013	Evaluating the sustainability capacity of a program (a small set of organizational and contextual domains that can help build the capacity for maintaining a program)	(Washington University 2013)
23	THE	Times Higher Education Impact University Ranking	International	2019	Assessing universities against the SDGs	(THE Impact Ranking 2021)
24	TUR	Three Dimensional University Ranking	International	2009	Comparison between universities regarding their research, educational and environmental performances.	(Lukman et al. 2010)
25	UEMS	University Environmental Management System	Saudi Arabia	2008	Achieve campus sustainability through overcoming the lack of environmental management practices	(Alshuwaikhat and Abubakar 2008)
26	USAT	Unit-Based Sustainability Assessment tool	Africa	2009	Guiding for educating and aiding the university toward sustainability by a flexible tool used at the departmental, faculty, and unit level	(Togo and Lotz-Sisitka 2009)
27	uD-SiM	Uncertainty-based quantitative assessment of	Canada	2011	Achieving a causality-based impact assessment by using a driving force-	(Waheed et al. 2011)

No.	Brief name	Full name	Country	Year of construction	Main aim/application	References
		sustainability for HEIs			pressure-state-exposure-effect-action (DPSEEA) framework	

Table 8.2 A review of 27 sustainability assessment tools at HEIs.

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
1	AISHE	• Consists of five modules (Operations, Education, Research, Society, Identity)/Each module consists of six criteria • Each criterion is described by five development stages (Activity oriented/Process-oriented /System oriented/Chain Oriented/society oriented) by incorporating the Deming cycle approach • Less emphasis on the environmental component (just one indicator); • The intended target is the university system; • For a university, or a part of it (the application domain adapts according to the university structure as an entire university, campus, buildings, or research institute) • With a wide world application across the universities; • Version 2000 and 2001 only focused on the educational role of universities, however, AISHE 2.0 has a wider scope in terms of the research, operations, and relation with the society	• Assessment is done by a group of 15 people (or less if the assessed institute is small) and it takes about one day • One person who takes notes, and who will have completed the report at the moment the assessment is done • A fee for the external certified assessor (if one is involved) • Tool not available online, only the manual	30
2	AMAS	• A model for sustainability assessment based on a four-tiered hierarchy: goal, criteria, subcriteria, indicators • Indicators with different weights and key actors' participation, allowing to be adapted by each institution but comparable in the same country • With an expert consultation system	• To calculate the 25 indicators, both qualitative and quantitative data are required; 15 indicators need quantitative data (60%), whereas just 10 need qualitative data (40%) • Tool not available online	25

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
3	ASSC	• Indicators are divided into four domains (Management, Education and Research, Environment, Local Community); (based on 170 questions) • Based on other tools (STARS, GM, BIQ - AUA) • Includes specificities of the country where it was developed (e.g. natural disasters) • Reported on graphical form	• Based on a questionnaire • Rating system with four levels, allowing to obtain certification: platinum, gold, silver, and bronze • Tool available online: https://www.osc.hokudai.ac.jp/en/action/assc	26
4	AUSP	• Based on three areas (Organization, Teaching and research, Environmental management), 11 aspects and 140 questions (indicators) based on version 2018 • Less emphasis on the social component • Graphical representation of indicators • Last updated on 2018 • Specifically, for HEIs in Spain and tested in several Spanish Universities	• Data collection by questionnaire and interviews (self-assessment) and reviewed by an external organization; • Each question has three levels of scoring (0/0.5/1) • Questionnaire available online: https://goo.gl/forms/Fol9qwVvYF2juTbC2	140
5	BIQ-AUA	• Calculate indicators for the benchmark (BIQ) and dialogue • The hierarchical level: Main criteria (4); subcriteria (with equal weight) (15); indicators (30), questions (50) • The method is to form a group that represents all users such as administrative staff, faculty staff and members, academics, and students • It does not include environmental management and social responsibility indicators • Dialogue is the component	• Self-assessment process based on questions • The highest rating is 100, thus allowing comparison	30

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
		that enables institutions to share their concerns, best practices and learning about Education for Sustainable Development (ESD)		
6	CTIE-AMB	• Based on five areas (Government and environmental participation, Teaching, Research, Environmental projection, Environmental management) and 27 questions • More focus on environmental strategies and plans and less focus on the environmental component of campus infrastructure and social component • No updates available	• A questionnaire with Yes/No answers • Tool not available online	27
7	DUK	• Based on indicators in four areas (Operations, Research, Education, Community); • With a strong focus on the Education • The tool operates as a moderator in the whole-school approach • It contains 10 action field	• Each field offers five stages of implementation to which HEIs can assign themselves • Tool not available online; only a report about the tool in German is available	10
8	ESDGC	• Based on a ranking system with five Common areas (Commitment and leadership, Teaching and learning, Institutional management, Partnerships, Research and monitoring) • Open and close-ended questions • Based on evidence • Results with a semaphore system; • Adaptation of a maturity model and training usually applied to companies and the industrial sector	• Four-level categorization based upon traffic light system (no color, red, amber, and green) to statements corresponding to the depth of ESDGC material evident • Tool not available online	Five commo areas (Cover 26 questio

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
9	GASU	• Based on GRI report with adaptations to HEIs; • Applied in many universities, • Five main subjective categories (Environmental/Economic /Social/Education/Inter-linking issues and dimensions) • GASU 2006 was updated in 2011 to align it with the GRI G3 (2011), as well as adding Inter-linking issues and dimensions • Graphical presentation of results	• Grading each indicator, either by choosing a number from five different choices, 0–4 • Tool not available online for free, only with a fee payment	43 asp (covere 174 indicat
10	GC	• Based on subcriteria (8) and indicators (20 core +9 supplementary indicators); • The system allows benchmarking and comparison • Along with each indicator goes a benchmark suggesting a desirable performance for the respective area of application • More emphasis on operations • Without focusing two categories of sustainability implementation in HEIs, namely, Research and Stakeholder involvement	• Assessing a set of indicators through three principles: meaningful indicators (targeting those that contribute most to the overall impact or footprint of the institution), feasible action (leading the assessment to the feasible action and address areas where an institution can potentially improve) and measurable (defining quantitative and qualitative measures that can be achieved with minimal cost and time) • The final assessment report for each indicator includes the aspect, the indicator definition, the intent (the importance of and the reason for the indicator), the benchmark, and a summary of performance • Tool not available online, neither report nor update	29
11	GM	• Based on six domains (Setting and infrastructure, Energy and climate change, Waste, Water, Transport, Education & Research) with different weights; • Mainly focus on the environmental dimension, less community involvement or other social components • With a wide world	• It collects data through an online survey. The criteria are assessed and then added up. Each specific indicator within each criterion is assessed based on a points system of awards • Tool available online: • http://greenmetric.ui.ac.id	33

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
		application across the universities		
12	GMID	• Based on narrative and domains: It includes a set of indicators across the basic principles of five domains (Leadership, Social Networks, Participation, Education and Learning, Research) • Applicable but not specific to HEIs • Applied to the RCE, an international network of formal, non-formal, and informal education organizations, mobilized to provide ESD to the local and regional community at three levels	• Based on three levels in each category	15
13	GP	• Based on five domains (Strategy governance, Education and training research, Environmental management, Social policy, Regional presence); 18 subcriteria, 44 indicators • It can be audited and certified by internal and external stakeholders concerning the ISO 26000 (Social responsibility) • Purpose of assisting in the elaboration of sustainability plans/policies	• The framework includes definitions, indicators, supporting documents, action plan, and five levels (categories) for each indicator explaining (awareness, initiation, conformity of green plan scheme targets, control, and leadership) • Tool not available online at the present	44
14	HE21	• Based on indicators (12 key indicators and 8 strategic management indicators); • Focusing mainly on parameters of organizational management change and less emphasis on social indicators and does not encompass in a balanced way all the dimensions of ESD in HEIs (more emphasis on governance); • Difficult to benchmarking	• No available information • Tools not available online	12 key indicat and 8 strateg manag indicat

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
		• Latest version: 2003		
15	PSIR	• Based on indicators across 10 domains • Covering the environmental dimension of the campus, transport, decision support, research, and community • Less emphasis on social indicators and teaching and curriculum components; • To be communicated to the general public how sustainability is being implemented • Suspended in 2012	• Results of each indicator are reported in four levels of implementation and with proposals for improvement • Tool not available online, only on the report: http://www.willamette.edu/~nboyce/assessment/PennState.pdf	33
16	P&P	• Based on indicators across 13 domains • Greater focus on environmental operations • In operation for several years allowing the annual comparison and an annual ranking • Graphical presentation of results	• Data collection is carried out in the universities' webpages and the UK Higher Education Statistics Agency • Tool available online: https://peopleandplanet.org/university-league	40
17	SAQ	• Based on indicators across seven domains • Largely qualitative teaching tool aiming to raise consciousness and encourage debate about what sustainability means for higher education • With greater emphasis on operations	• Based on a questionnaire addressed to various internal stakeholders • It consists of forming a representative sample of 10–15 individuals drawn from students, faculty, staff, and the university administration; and introducing the purpose, the objectives, the definitions in advance, and facilitation of the discussion throughout the exercise. Each participant should take 30 min to fill out the questionnaire. It may take 2–3 h or so • Tool available online: http://ulsf.org/sustainability-assessment-questionnaire	35
18	SRC	• Based on indicators across five domains (Campus operations, Meal service, Donation investment, Transportation, Involvement of key stakeholders) • More focus on energy saving and less emphasis on education	• Presented through a questionnaire with a final grade from A to D • Tool not available online	52

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
19	STARS	• Based on narrative and indicators: Version 2.0: 74 indicators and version 2.2: 67 indicators, 18 subcriteria, and 5 categories with different weights (Academic, Involvement of key actors, Operations, Planning and administration, Innovation and leadership) • One of the most used tools internationally • Updated every year; • Initially developed for HEIs in the US and Canada but applicable to any region	• Five levels of final classification, allowing the ranking (reporter, bronze, silver, gold, platinum) • It is not only an assessment instrument but also a rating framework adding more value to the system as a comparison tool • The ranking process is international and external evaluators are ranked the involved HEIs based on voluntary self-reporting by universities • Tool available online: https://reports.aashe.org/accounts/login/?next=/tool	67
20	SUM	• Based on indicators across four domains (Education, Research, Dissemination and partnership, Campus sustainability) • Tested at various world universities • Without updates	• Divided into four phases (Vision development, Mission, Sustainable committee, Audit of sustainability strategies), incorporating the Deming cycle approach • Tool not available online	23
21	SLS	• Based on performance indicators; four priority areas (Leadership and governance, Partnership and Engagement, Learning, teaching and research, Estates and operations), 18 Framework areas, and each framework area include 7 activities areas • No weights in the indicators and final result in a dashboard index • Linked to SDGs	• Final scores with a range from 0 to 4 • Tool available online for free to the UK and Ireland: www.sustainabilityleadershipscorecard.org.uk/#!/login	18
22	SustainTool	• Based on indicators (Questions), focused on areas/programs or at the institution level; eight subcriteria (Environmental support, Funding stability, Partnership, Organizational capacity, Program, Evaluation,	• Self-assessment Questionnaire based on 40 multiple-choice questions, with answers being given individually or in a group • The assessment takes about 10–15 min to finish • Tool available online: https://sustaintool.org/assess	40

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
		Program adaptation, Communications, Strategic planning) with low weight in the environmental component • Allows the communication, review, and development of an action plan • Available for several years with updates • Developed particularly in the North American context, but especially directed to the health area		
23	THE	• Each SDG has some indicators associated with it • The tool covers all 17 SDGs across 75 metrics, and 227 required evidences • Equal weight is given to each SDG, but with different weights on each metric • The rankings are open to any university that teaches at either undergraduate or postgraduate level • Participation in the overall ranking requires universities to submit data to at least four SDGs, one of which must be SDG 17 – Partnerships for the Goals	• The overall score is generated from the score for SDG 17 (worth up to 22% of the overall score), plus the three strongest of the other SDGs for which they provided data (each worth up to 26% of the overall score) • The ranking process is international and external evaluators are ranked the involved HEIs based on voluntary self-reporting on each metric through evidence • Tool available online (requesting by free registration): https://www.timeshighereducation.com/how-participate-times-higher-education-rankings	75 met and 22 require eviden
24	TUR	• Based on indicators across three domains (Research, Education, Environment) • Weighted based on a participatory process and Analytical Hierarchical Process (AHP) • Less holistic approach • Graphical presentation of results • Tested in the best universities, but without updates	• Allows ranking based on rankings of world universities • Tool not available online	15

No.	Tool name	Tool characteristics	Assessment procedure	No. of indica
25	UEMS	• Based on EMAS/ISO14001 with a social responsibility component and indicators • Three strategies (University EMS, Public participation and social responsibility, Teaching and research in sustainability), 8 initiatives (subcriteria), and 27 indicators	• The assessment process is based on three strategies. Each strategy has initiatives that can lead to achieving the sustainability mission at the institution. Moreover, higher • Tool not available online	27
26	USAT	• Based on indicators across four domains (Teaching, Research and community services, Operation and management, Student involvement, Written policy and statement), 9 subcriteria and 75 indicators • Adapted from SAQ, AISHE and GASU • It Can be used in the department, college, or HE unit • Without updates	• Scoring system (based on 1–4) • Assessment criteria including: Rating X = Don't know (no information concerning the practice) 0 = None (There is a total lack of evidence on the indicator) 1 = A little (Evidence show poor performance) 2 = Adequate (Evidence show regular performance) 3 = Substantial (Evidence show good performance) 4 = A great deal (Excellent performance) - Tool not available online but questionnaire available online on the report: www.ru.ac.za/elrc/publicationsandresources/unit-basedsustainabilityassessmenttoolusattool/	75
27	uD-SiM	• Based on indicators and the models of Driving force, Pressure, Exposure, Effects, Action (DPSEEA) and a multicriteria decision process (applying Fuzzy logic) • With different weights and normalized indicators • Indicators based on the GASU model; four areas (Environmental, Economic, Social and Education) and five categories –DPSEEA; • Applied to Canadian universities but its implementation is international	• Aggregate scores in a final index that integrates the non-linear effects of the indicators • The calculation method is complex • Tool not available online	56

Some tools propose the assessment of the indicators as a set of questions to make it more user-friendly for audiences to assess HEIs' progress toward each indicator (e.g. ASSC, AUSP, BIQ-AUA, CTIE-AMB, ESDGC, SAQ, and SustainTool). Although the data collection process in these tools differs from those that directly measure the indicators, the main content and the assessment process do not differ.

Based on the characteristics of the tools shown in Table 8.2, the tools were critically analyzed to

explore their real assessment pattern based on the core elements of sustainability implementation in HEIs (Section 8.4.2), the sustainability dimensions covered by the indicators (Section 8.4.3), and the thematic areas covered by the subcriteria (Section 8.4.4).

8.4.2 Analysis of Core Elements of Sustainability Implementation at HEIs

The overall distribution of the indicators across the seven core elements of sustainability implementation at HEIs is shown in Table 8.3. The proportion of each core element shows a strong focus on the core elements of "governance" and "operations," which stand in joint first place (25%) (Figure 8.2). This result is aligned with the study of Yarime and Tanaka (2012), which showed that among 16 sustainability assessment tools at HEIs, the operation and governance dimensions had approximately the same score (44% and 39%), standing in first and second places. Also, other studies that reviewed some of the assessment tools at HEIs (Fischer et al. 2015; Kosta 2019) highlighted that STARS, AISHE, and SAQ have a higher incidence on the percentage of indicators for governance and operations, again aligning with our results.

Table 8.3 Distribution of core elements at HEIs on the 27 studied tools.[a]

Source: Based on the five-stage scoring system.

No.	Tool (abbreviation)	Core elements at HEIs						
		Governance	Education	Research	Outreach	Operations	On-campus experiences	Assessment and reporting
1	AISHE	2	2	2	2	1	0	1
2	AMAS	4	1	1	1	2	0	2
3	ASSC	3	1	1	2	3	0	0
4	AUSP	2	1	1	1	3	0	1
5	BIQ-AUA	3	2	1	2	0	0	1
6	CTIE-AMB	3	2	2	1	1	0	1
7	DUK	2	3	2	0	2	0	1
8	ESDGC	4	2	2	1	0	0	0
9	GASU	3	1	1	1	3	1	1
10	GC	1	1	0	0	4	0	0
11	GM	0	1	1	0	4	0	1
12	GMID	2	2	2	4	2	0	0
13	GP	3	2	2	1	2	0	0
14	HE21	4	2	1	1	3	0	1
15	PSIR	1	0	1	0	4	1	0
16	P&P	3	1	0	0	4	0	0
17	SAQ	2	1	1	1	3	1	0
18	SRC	3	0	0	1	3	0	0
19	STARS	3	2	1	1	3	0	1
20	SUM	1	2	1	2	3	0	0
21	SLS	2	1	1	2	3	0	0
22	SustainTool	4	0	0	2	0	0	2
23	THE	2	3	3	2	3	2	1
24	TUR	2	3	3	0	1	0	0
25	UEMS	1	2	2	3	3	0	0
26	USAT	3	2	1	1	2	1	0
27	uD-SiM	1	2	1	0	3	0	0

[a] The minimum link with core element is allocated to one and the maximum link to four. Also, 0 is allocated if there is no link.

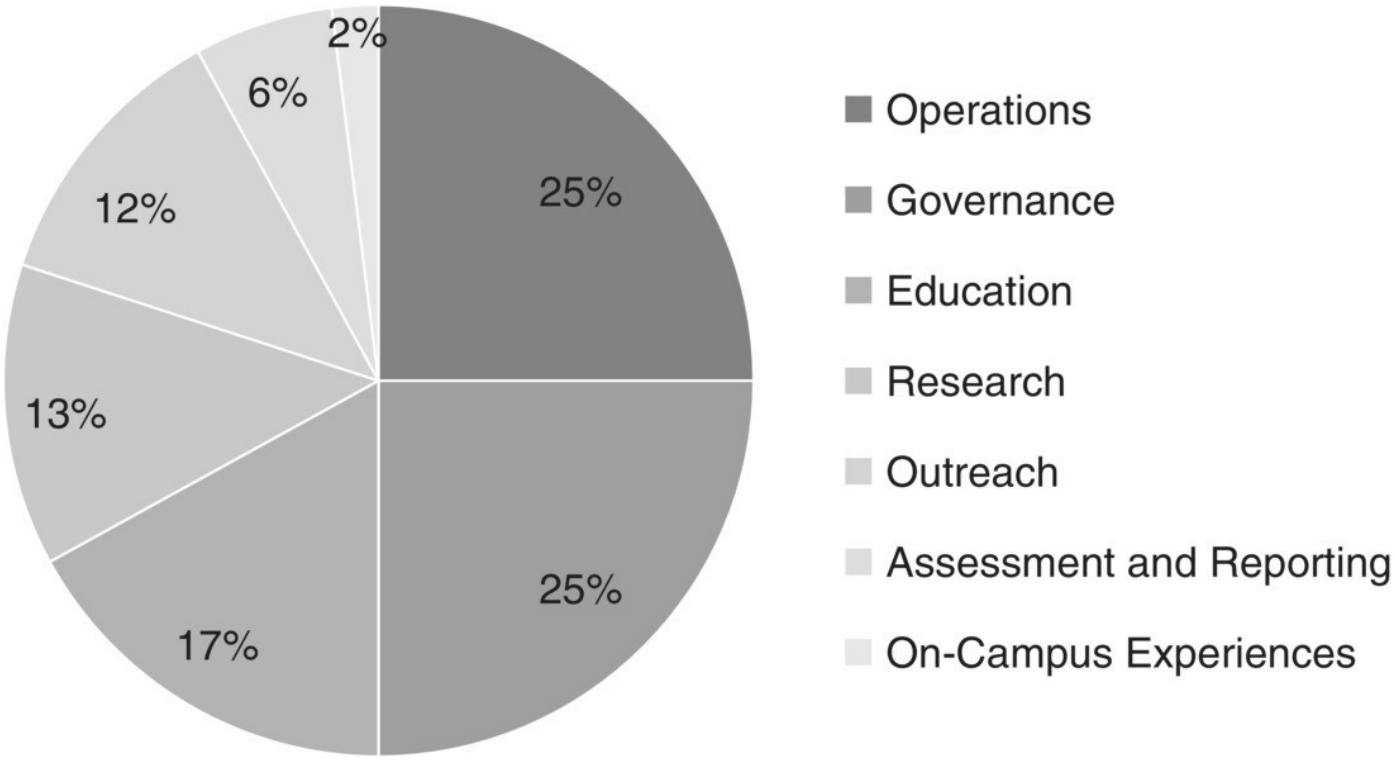

Figure 8.2 The proportion of core elements of sustainability implementation at HEIs within the tools.

However, there is still a bias in favor of the operations element over the other core elements, since operations are not the main function of HEIs. For example, the earlier study by Fischer et al. (2015) showed that even though there are some differences between the distribution of core elements among the analyzed assessment tools, overall an extensive share was for the field of operations (67%), followed by the fields of education, research, and community engagement (with only 18%, 10%, and 6%, respectively). Also, it seems that in some earlier studies, the definitions of governance and operations have been combined; for instance, as defined by Ceulemans et al. (2015b), all the organizational activities supporting the creation of HEIs' services (e.g. student administration and planning, accounting, facility management, human resource management, marketing, and communication, among many others) are part of HEI's operations activity. However, based on Findler et al. (2018), "on broad-scale policies and the administrative structure of the HEIs, including, e.g. governance body structure, vision and mission statements, policies for staff and faculty hiring, budget issues, student associations, and development programs for staff and faculty" are the issues that should emerge on the governance element rather than operations. This might be the reason that in some studies the operations activities show a remarkable difference from other core elements. In the current research, the reasons behind obtaining the same score for both governance and operations might be because of: (i) addressing a more holistic assessment tools inventory in this research (N = 27) rather than the previous studies that mainly focus on the number of 8–19 tools, (ii) addressing more recent assessment tools in our final list (such as THE), which effects more accurate results on the distribution of the core elements, and (iii) the definition of each core element in this research where indicators concerning the administrative issues and policies were assigned to the governance element.

The "education" element (17%) stands in second place, closely followed by "research" (13%), and "outreach" activities (12%). Although education and research are commonly referred to as crucial fields of action and key functions of universities, we are observing a gap between postulated areas with the highest priorities in the assessment of sustainable performance in HEIs, including operations and governance, as we have already discussed. So, as stressed by Yarime and Tanaka (2012) and Fischer et al. (2015), more work is needed to further engage "education" and "research" in the sustainability assessment of HEIs.

The areas where the indicators have seen weaker use are "assessment and reporting" and "experiences" such that only 6% of the tools are associated with the assessment and reporting indicators and only 2% with the on-campus experiences. Among the tools, AISHE, STARS, and THE are those with some explicit indicators on the participatory assessment and reporting system. However, sustainability reporting in HEIs is still in its early stage (Lozano et al. 2015a; Kapitulčinová et al.

2018) due to the low number of HEIs publishing sustainability reports, the low quality of the reports, the lack of consecutive reporting, and the lack of institutionalization of sustainability reporting in the higher education system (Lozano 2011; Ceulemans et al. 2015a). So, HEIs should apply the assessment tools not only for guiding or assessing but also for comparing and reporting to make sure that they are heading in the right direction (Alghamdi et al. 2017).

8.4.3 Sustainability Dimensions

The profile of the sustainability indicators within each sustainability dimension of the analyzed tools is shown in Table 8.4. Also, Figure 8.3 shows the overall distribution of the indicators in the whole scale.

Table 8.4 Scope of the different sustainability tools analysis.

No.	Tool (abbreviation)	Sustainability dimensions covered by the tool (% based on the frequency of indicators)				
		Environment	Social	Economic	Academic	Institutional
1	AISHE	3	23	3	40	30
2	AMAS	26	23	10	13	29
3	ASSC	37	26	15	15	7
4	AUSP	40	11	4	14	31
5	BIQ-AUA	0	24	9	39	27
6	CTIE-AMB	21	16	2	26	35
7	DUK	18	9	9	45	18
8	ESDGC	0	40	0	40	20
9	GASU	20	36	13	16	15
10	GC	52	21	6	6	15
11	GM	72	7	5	14	2
12	GMID	0	40	0	40	20
13	GP	21	24	3	23	29
14	HE21	26	16	5	5	47
15	PSIR	64	19	0	11	6
16	P&P	31	31	6	9	22
17	SAQ	27	19	0	27	27
18	SRC	53	23	14	0	11
19	STARS	32	34	4	21	9
20	SUM	41	30	0	15	15
21	SLS	42	37	0	11	11
22	SustainTool	11	22	11	0	56
23	THE	24	34	6	21	14
24	TUR	6	6	6	65	18
25	UEMS	41	31	3	21	5
26	USAT	20	34	2	29	15
27	uD-SiM model	45	17	16	19	3

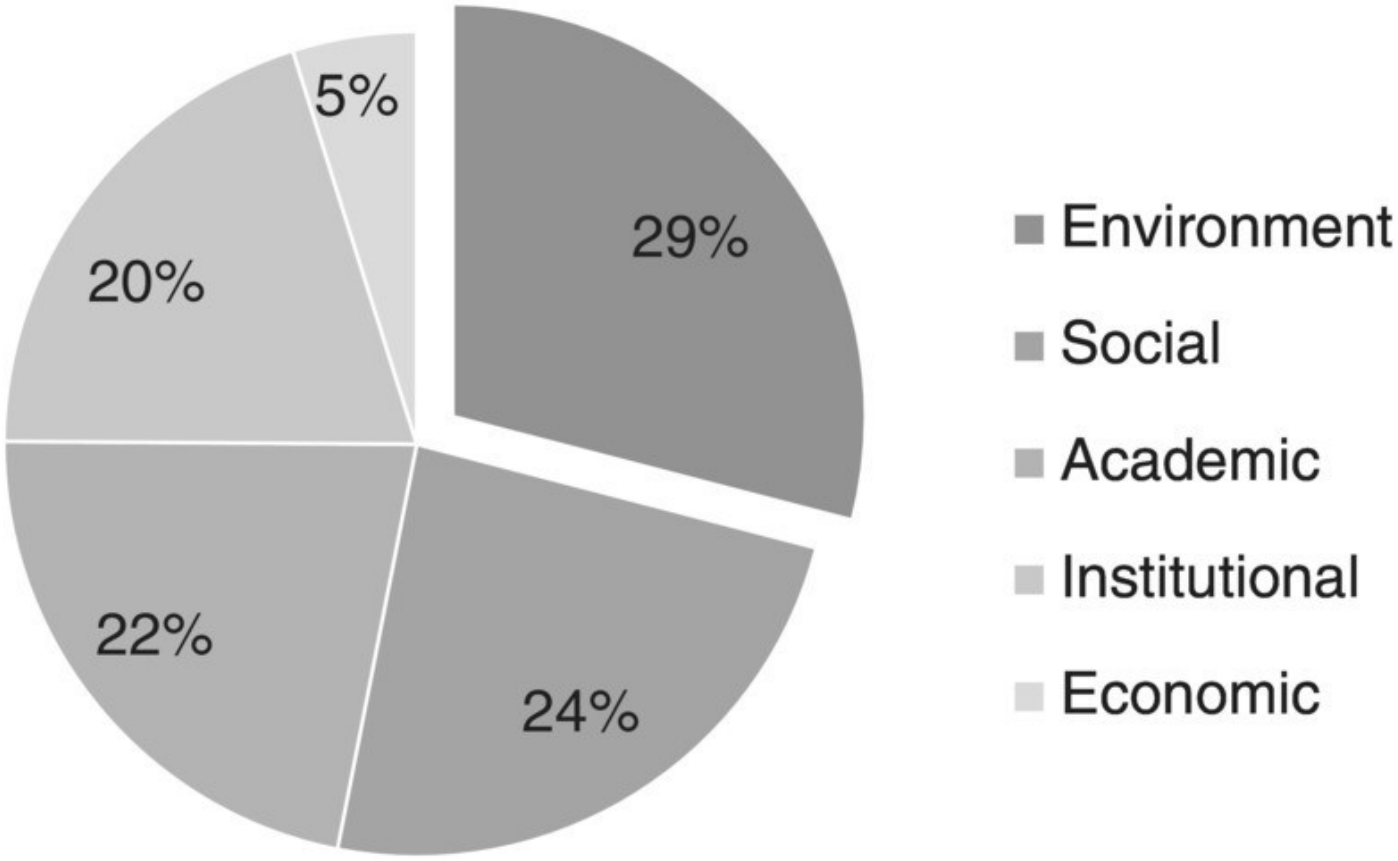

Figure 8.3 The profile of the sustainability dimensions within the assessment tools.

Overall, the "environmental" (29%) dimension is the most addressed among the assessment indicators. The "social" and "academic" dimensions jointly occupy the second and third positions in the assessment indicators (24% and 22%, respectively). As already noted by several authors (Cunningham et al. 2010; Lozano and Huisingh 2011; Mapar et al. 2017), there has been a bias when considering sustainability, where environmental issues have gained much more attention than social or economic issues. These results are also aligned with those of Blasco et al. (2019), who found, in a study conducted within Spanish universities, that more attention was given to the environmental dimension and that more holistic approaches were necessary to achieve an integrated perspective of sustainability. However, these authors also asserted that there was a correlation between the three dimensions of sustainability so that those entities with the higher environmental score also had higher social and economic scores, which would evidence that universities have been exploring an integrated concept of sustainability in their performance (Blasco et al. 2019).

Notably, there are still some differences in the profile of the sustainability dimensions among the assessment tools analyzed. For instance, in some tools, the profile relating to the social and environmental indicators is approximately the same, namely for STARS, P&P, and AMAS. Also, among the tools, there is one example where the social dimension is predominant over others, namely the GASU tool, which addresses five main categories on the social dimension, namely labor practices and decent work, human rights, society, product responsibility, and overall social issues.

Some tools exclusively focus on the assessment of the academic dimension of sustainability. As an example, TUR is a three-dimensional ranking tool that makes it possible to compare universities in respect to three main subcriteria of research, education, and environmental performances. In TUR, although one of the subcriteria is entitled "environment," most indicators belonging to this thematic area (e.g. including sustainability vision and mission, sustainability-oriented courses and programs, and office or council for sustainable development) mainly address the academic and institutional dimensions.

The "institutional" dimension covers 20% of the total indicators and is placed fourth in relation to the other dimensions. Institutionalization refers to the process in which an idea passes from individual efforts and attitudes to changes in the system, stakeholders, and the sustainability dimensions at HEIs. So, to achieve institutionalization, the whole university community (including students, academic staff, non-academic staff, and stakeholders) must receive the proper sustainable development skills to help promote a sustainable development institutionalization process by enforcing it with their

attitudes and behaviors (Lozano 2006b). Among the assessment tools, SustainTool is unique by having been explicitly developed to address the institution dimension at HEIs by exploring the areas of programs and plans such as program evaluation, program adaptation, and strategic planning, with low weight on the environmental component.

The "economic" dimension is placed last, relating to other dimensions; only 5% of the total indicators addressed the economic issues directly. Among the tools, only GASU, SustainTool, and THE include specific subcriteria for financial and economic issues that mainly cover the economic performance, indirect economic impact, funding stability, decent work, and economic growth. Some tools solely assess the economic dimension of HEIs by indicators that are placed on the interlinking dimension of sustainability. As an example, AMAS assesses the number of students with low socioeconomic backgrounds on the equality subcriteria. The uD-SiM tool also shows a distinct focus on addressing economic indicators (e.g. financial and economic growth rate; increasing education, operation, and maintenance cost; percentage of expenditure, facilities and infrastructure costs; financial impacts; and effects on revenues through educational cost and investments) where the economy is addressed as one of the four performance categories of sustainability based on the DPSEEA framework (Waheed et al. 2011). However, in comparison with other dimensions, the state of development of the tool is revealed by the lack of assessment of the impact on the economic dimension of sustainability so that only 16% of the total indicators in uD-SiM are associated with economy and finance.

8.4.4 Thematic Areas

Overall, 25 thematic areas, extracted from the content analysis of the subcriteria, were identified, as shown in Table 8.5. Also, Figure 8.4 shows the contribution of the top 10 thematic areas in the tools. The heterogeneity of thematic areas of sustainability implementation in HEIs is still remarkable, with the "education" and "research" areas remaining the best addressed with the highest frequency.

Table 8.5 The thematic areas applied in the studied sustainability assessment tools at HEIs.

No.	Thematic areas	Frequency	Including but not limited to:
1	Education	34	Informal education/programs and education/education for sustainable development/quality education/subject-related teaching/interdisciplinary teaching/training/curriculum
2	Research	21	Interdisciplinary, multidisciplinary, and disciplinary research/research and development/research activities and integration
3	Management and planning	19	Management systems/Institutional management/strategic planning/policies/coordination & planning /institutional mission, structure and planning/decision making/organizational capacity/administration and planning
4	Partnership and engagement	18	Government and environmental participation/public participation and engagement/staff willingness to participate/staff and student engagement/shareholder engagement/campus engagement/national, regional, and international partnership/partnerships for the goals
5	Society and communities	13	Responsible society/development of a knowledge-based society/campus community and beyond/community learning/community services/sustainable cities and communities
6	Waste	9	Solid waste and hazardous materials/waste policy/waste minimization/waste disposal
7	Energy	9	Energy management/energy sources/renewable energy/affordable and clean energy
8	Water	8	Water policy/water reduction/clean water and sanitation/life below water
9	Climate and carbon reduction	7	Air pollution policy/climate change/climate action/managing carbon/carbon reduction
10	Transportation	7	Transportation program/sustainable transportation/mobility
11	Staff and students' development	6	Development of staff sustainability skills/development of students' sustainability skills
12	Food	6	Food service/sustainable food/food and dining/zero hunger
13	Economy and finance	6	Direct economic impact/economic growth/investment and finance/ethical investment and banking/investment priority/funding stability/scholarships
14	Resources and consumption	6	Resources/consumption/responsible consumption and production
15	Social issues	5	Social network/social responsibility/social policy/peace and social justice
16	Diversity and equality	5	Diversity and affordability/equality policy for students/gender equality/reduced inequalities
17	Labor practices and decent work	5	Working rights/decent work/human rights/employee benefits
18	Commitment and leadership	5	Commitment/leadership/vision/leadership and governance
19	General environmental issues	5	General issues/environmental extension or projection/environmental support
20	Outreach	4	Outreach services/outreach support
21	Monitoring, evaluation	4	Monitoring process/program evaluation/examination of sustainability topics/impact assessment

No.	Thematic areas	Frequency	Including but not limited to:
22	Purchasing and Procurement	4	Sustainable purchasing and procurement
23	Health	3	Employee health and safety/good health and well-being
24	Land	3	Life on land/grounds
25	Infrastructure and building	3	Industry, innovation, and infrastructure/buildings/green building

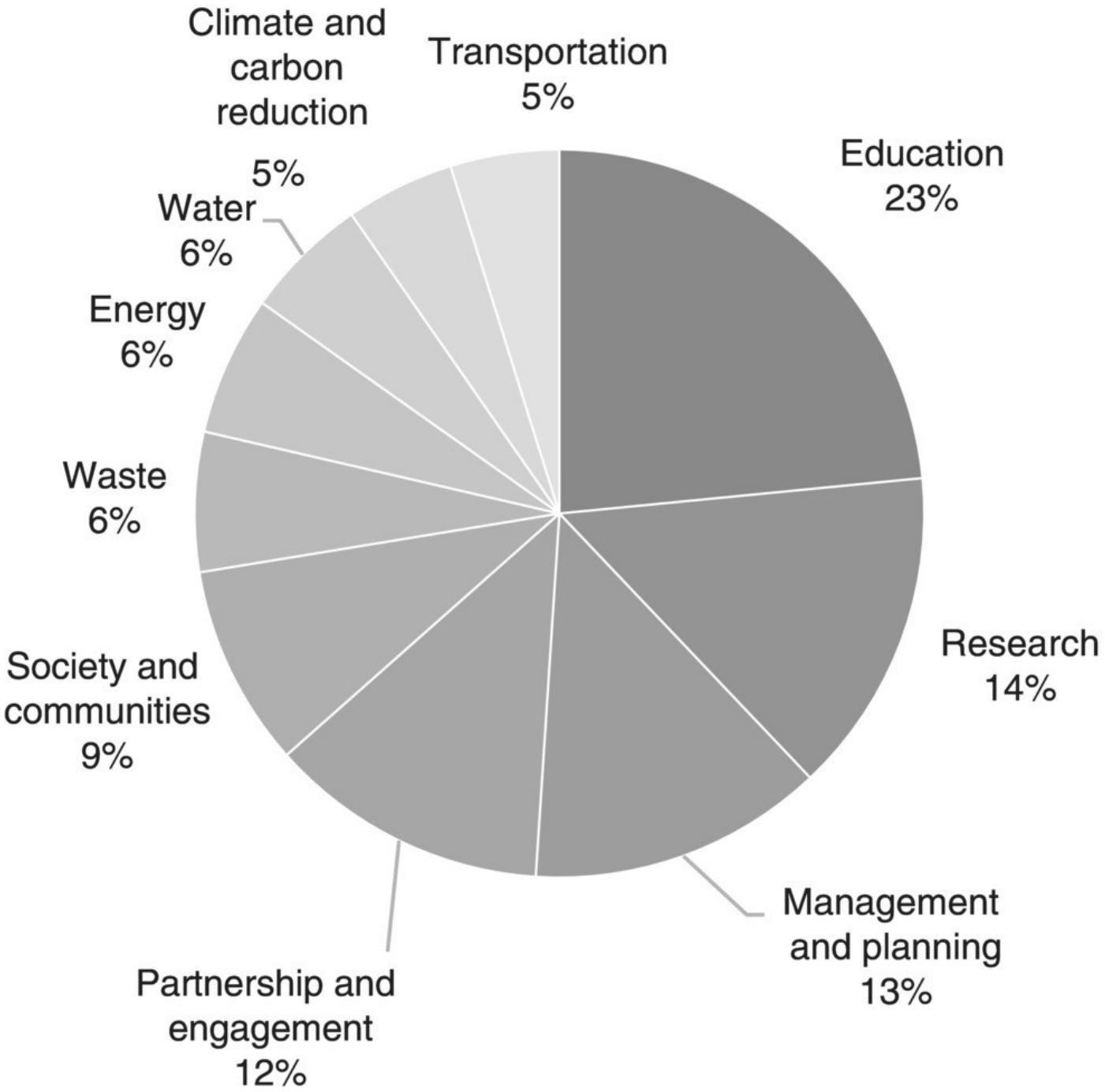

Figure 8.4 The top core thematic areas based on subcriteria in the studied sustainability assessment tools.

The main topics covered by the "education" thematic area are informal education, ESD, quality education, subject-related teaching, interdisciplinary teaching, training, and curriculum. Also, making the curriculum more sustainable is a topic that has also been explicitly repeated seven times among studied tools. As already emphasized by Karatzoglou (2013), "greening" of the curriculum has been repeatedly included among the best practices applied by universities to enhance their sustainable standing. So, if the approach is to be achieved, sustainability should be addressed as the core theme that runs through the curriculum (Cotgrave and Kokkarinen 2010).

In the "research" thematic area, the main topics covered by the tools are focused more on

interdisciplinary, multidisciplinary, and disciplinary research, research and development, research activities, and research integration. Some tools (e.g. GreenMetric) apply direct quantitative indicators about the ratio of sustainability research funding relating to total research funding at university and emphasize research priorities based on the sustainability context. Another noticeable point in terms of research is the importance of sustainability research on recent international assessment tools for HEIs. One example is the research area in THE ranking systems (THE Impact Ranking 2021), which measures the proportion of the university's publications in each SDG independently through a set of exclusive indicators. Then, each SDG topic is measured against a keyword search of the Scopus database of peer-reviewed literature to reflect on the excellence of academic output. However, it is notable that still, the majority of HEIs who engage in the sustainability assessment focus more on education topics rather than research, as indicated by Wals (2014), which is also in line with our results (see Figure 8.4).

"Management and planning" and "Partnership and engagement" and thematic areas were at third and fourth place, respectively. The "management and planning" thematic area encompasses management standard systems, institutional management, strategic planning, policies, coordination, mission, and decision-making. Many HEIs adopt environmental management systems to achieve sustainability (Nurcahyo et al. 2019). Among them, ISO 14001 EMS is the most frequently used set of management standards adopted by universities in recent years. It is a framework for organizations to facilitate the implementaion of an environmental management system (Rahdari and Anvary Rostamy 2015; Zilahy 2017), and to assess the environmental impact of operations and improve their performance (Lozano and Huisingh 2011).

The partnership refers to both global and multistakeholder partnership to facilitate engagement in the implementation of sustainability, bringing together government, civil society, private sector, and other actors and work together to achieve a common purpose or undertake a specific task and to share risks, responsibilities, resources, and benefits. In HEIs, partnerships range from research and development, knowledge exchange, and technology transfer platforms to economic development and urban reform projects. HEIs should be seeking to improve the possibilities of expanding innovations out of their borders through a process of continuous learning, in collaboration with the public and the private sectors (Trencher et al. 2014; Özuyar and Moreira 2017). As an example, "collaboration with stakeholders in addressing community sustainability challenges" is addressed as one of the sustainability assessment indicators in the USAT tool (Togo and Lotz-Sisitka 2009). Also, as stated by Trencher et al. (2014), in HEIs, individual partnerships are making strong social, environmental, and sustainability impacts, with far less confidence shown for contributions to economic development. However, internal university policies are yet to prove a substantial driver for sustainability partnerships.

The next frequent thematic area is "society and communities," covering subjects such as responsible society, development of a knowledge-based society, campus community and beyond, community services, and sustainable communities. There are some initiatives in this thematic area that need the engagement of students, staff, and the whole university body to achieve a sustainable society. Voluntary community service by students related to sustainability and environment, and student groups with an environmental or sustainability focus are some examples of these initiatives applied in the tools to assess the progress of universities toward sustainable societies and communities (Togo and Lotz-Sisitka 2009).

In the field of environmental issues, there are five distinct thematic areas addressing "waste," "energy," "water," "climate and carbon reduction," and "transportation" closely following each other, to which both policy and action are addressed in these environmental clusters. However, most of the environmental indicators in these thematic areas focus more on the operations core element of HEIs, e.g. total recycling waste and recycling infrastructure (GC), and use of water-efficient appliances (GM), and indoor air quality (USAT). It is noted that there is still a distinct dedicated cluster for "general environmental issues" area in the final list (e.g. environmental extension or projection and environmental support), which assesses the environmental issues in a broader concept rather than explicit environmental themes.

8.5 Overall Discussion and Potential Areas of Improvement

The 27 tools reviewed show many similarities in their main structure. In comparing the number of

indicators among the tools, it is obvious that, although the number of indicators differs in each tool, overall 74% of the tools use 50 or fewer indicators for assessing sustainability in HEIs. Even though sustainability indicators help in knowing the direction and distance from the target (Panda et al. 2016; Mapar et al. 2017, 2020), whenever a large number of indicators exists, it is more difficult to make comparisons across different systems, over time and space (Ciommi et al. 2017). Therefore, setting a list of adequate indicators for assessing the progress of an institution toward sustainability is a highly challenging task since it is difficult to measure a large number of indicators while assessing the progress toward sustainable development, due to the time limitation, high cost, and complex process of assessing sustainability when we are dealing with too many indicators (Mapar et al. 2020).

Another noticeable aspect behind the communalities in the tools is that the majority of tools are filled out through self-assessment, requiring only a leader or researcher to complete them, a point stressed by Caeiro et al. (2020). Only a few of the tools, e.g. THE ranking system and STARS, assess the performance of HEIs based on international assessment systems through collaboration with a group of international evaluators. In this case, the HEIs just provide the evidence for each indicator for further evaluation by the external evaluators.

The analysis of the tools also highlights the concrete thematic areas for sustainable development assessment at universities, currently covered by the subcriteria and indicators. The sample contains a relatively higher proportion of education, research, and management and planning thematic areas in the assessment process of HEIs, specifically those that can be measured in quantifiable units based on data readily available to HEIs, as also indicated by Findler et al. (2018). As an example, there are several indicators in the thematic areas of research and education that directly assess the current status of HEI research and education through direct quantitative measurement units, such as the amount of sustainability-related research (AMAS), the number of scholarly published papers in the different areas of sustainability (GM, THE), the ratio of sustainability courses to total courses, the ratio of sustainability research to total research (GM), and the percentage of faculty members who teach or do research on sustainability issues (SAQ), among many others.

On the top 10 thematic areas, even though the assessment indicators with an overwhelming focus on research, education, and management and planning reached the higher places, there are still several indicators associated with natural environment themes (e.g. energy, water, waste, climate and carbon reduction, and transportation; see Figure 8.4) where the total portion of the indicators in these environmental themes can be same or higher than indicators in the “management and planning” theme. The main reason for this might be that the ability to measure natural environmental issues quantitatively makes them easier to assess than many other institutional management indicators. Thus, the majority of tools focus on the indicators that can be measured based on internally available data in a quantitative way. The same trend could be also observed in the profile of the sustainability dimensions within the tools, where the proportion of environmental indicators is greater than the social one (see Figure 8.3). Again, it might be because of the simplicity of assessing the environmental performance indicators in a quantitative way rather than social ones such as HEIs' sustainability culture. So it seems the assessment tools have a tendency to focus more on the subjects that can be measured based on internally available data quantitatively, as also suggested by Findler et al. (2018).

The stakeholder participatory approach is another issue that can be discussed by reviewing the list of assessment tools. Ideally, the concepts of sustainable development should be integrated into the policies, approaches, and learning of all the university's stakeholders, including academic and non-academic staff, students, and the broad range of internal and external stakeholders; however in practice, it is almost impossible to include this approach in the first stages of sustainable development integration into the HEIs system, as stated by Lozano (2006b). Some tools, e.g. GMID and SRC, also focus on the involvement of key stakeholders and the interrelations between HEI and stakeholders as a requirement and a benefit toward the integration of sustainable development into the HEIs. As stated by Alghamdi et al. (2017):

> Applying these assessment tools through not only education and research but also operating the campus and engaging with the internal community (students, faculties and supporting employees) and with the external communities (different stakeholders) creates a culture of sustainability at universities and beyond benefiting societies and promoting living more sustainably.

Although, the majority of tools proposed equal weights for subcriteria and indicators, there are still some tools, e.g. AMAS, GM, STARS, THE, TUR, uD-SiM, that proposed different weights for the

subcriteria and indicators. As an example, THE proposes the same weight for the main subcriteria of SDGs, but each metric in this tool has a different weight so that the maximum score for each metric is given as an exact percentage (here, weight) within each SDG and as an approximate percentage if the SDG was to be used for the overall ranking of that university (THE Impact Ranking 2021).

The strong focus of the tools on the operations elements needs to be further discussed in future studies since, as stated by Lozano et al. (2015a), education, research, and community outreach should be perceived as the core activities of HEIs, while operations should be realized as a supporting activity. Also, tools with open-ended questions (e.g. SAQ and ESDGC) still need to be discussed in the future development of the tools since it is difficult to apply them as a comparative tracking tool due to the lack of establishing a final score (Berzosa et al. 2017).

Using the assessment tools that cover all sustainability dimensions as well as core elements of sustainability at HEIs can open new space to integrate sustainability within HEIs. However, with the 2030 Agenda to steer global society toward sustainability, it is clear that further development of the tools should also encompass all 17 SDGs to reach a holistic integration approach at HEIs. Among the studied tools, some tools directly address the SDGs within their main structure. One example is STARS, which shares a similar intent and scope with the SDGs so that an institution's STARS score can be used to demonstrate progress toward helping deliver the SDGs. Another example is THE which is entirely built upon the SDGs framework so that each SDG is assigned to a subcriterion and then several metrics are assigned to each SDG to assess the progress of HEIs toward the whole agenda. On the other hand, a recently published report by United Nations Environment Programme (2021) highlights the transformation of humankind's relationship with nature as a defining task of the coming decades toward a sustainable future. So, all actors, including HEIs, have individual, complementary and nested roles to initiate and lead transformative changes in their domains. One illustration of the transformative change in the human relationship with nature can emerge in the social responsibility initiatives and practices in HEIs that are also covered by some assessment tools (e.g. social responsibility coordination [AMAS], social responsibility policy [BIQ], and community services and social justice as main indicators of social responsibility [UEMS], among others). However, this topic is still in its early stages and more in-depth analysis to explore the contribution of the existing tools and indicators on human relationships with nature, as well as the interlink between SDGs and the thematic areas in future studies, can enrich this research. It can also provide a better understanding of the areas that still need to be covered by the tools to comprehensively integrate the context of the SDGs within HEIs.

There are some limitations associated with these kinds of qualitative analyses. The limitations of the applied method in this research are mainly associated with the time-consuming process of content analysis, the human resources needed for content analysis to be rigorously applied, and the fact that the content analysis is a meticulous process (Maier 2017). Another limitation was data availability since some tools were suspended or there were not updated versions (e.g. HE 21 and SRC) which made it problematic to comprehensively compare them with the new tools such as THE. Another limitation of this research was the possibility that some tools missed being included during the screening process. However, selection bias was minimized by using a range of keywords to select the studies and a wide date range of multiple databases for screening and searching.

8.6 Conclusions

This research expands upon previous development of sustainability assessment tools in HEIs, which have mainly focused on how the existing tools root for an integrated approach toward sustainability rather than on what they achieve for society, the economy, and the environment distinctly. In this research, four approaches were used to analyze the 27 sustainability assessment tools at HEIs: (i) tool structure, (ii) core elements of sustainability implementation in HEIs, (iii) sustainability dimensions, and (iv) more commonly covered thematic areas. Several commonalities were found in the structure of the tools that mainly address the similarities on the levels of hierarchy (including subjective categories, subcriteria, and indicators), the total number of indicators (commonly less than 50), and the self-assessment process in the majority of tools. The top 10 underlying thematic areas in the tools are education, research, management and planning, partnership and engagement, society and communities, waste, energy, water, climate and carbon reduction, and transportation.

Among the core elements, a strong focus is jointly on the “governance” and “operations” core

elements, whereas the core element that the indicators have seen having weaker use was the "assessment and reporting" and "on-campus experiences." In terms of sustainability dimensions, the environmental dimension is the most addressed among the indicators, while the economic dimension of sustainability is weak in the tools. Therefore, there is still a need to draw out economic indicators in the future development of the tools.

The increasing variety of these assessment tools makes a great potential for more tailored and structured development processes in HEIs. However, the progress of the tools is still inadequate to assess the university system in an integrated way by covering all sustainability dimensions and core elements as well as the main activities of HEIs. The results of this research can be used to modify the existing sustainability assessment tools, specifically by contributing to the indicators that were less addressed on the proposed thematic areas and sustainability dimensions. Also, sustainability assessment in HEIs should be viewed as a social construction that makes a significant contribution to the development of society. Therefore, the successful implementation of these assessment tools needs the active involvement of different stakeholders, where the various internal and external actors within and beyond the university contribute positively to the implementation of these tools.

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