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## **Mapping sustainability initiatives in higher education institutions in Latin America**

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### **Abstract**

Many higher education institutions (HEIs) around the world are involved in a variety of sustainability initiatives. These are acknowledged to be important elements in fostering the cause of sustainability in HEIs, in further developing the organizations' culture and in acting as enablers in the institutional embedding of sustainability. But despite the relevance of sustainability initiatives, there is a lack of systematic international efforts in how best to map them, especially in Latin America. On the basis of the need to address this gap, this paper reports on the results of an empirical study, aimed at analyzing the current status of sustainability initiatives among Latin American HEIs.

Apart from a review of the latest literature, an international survey was performed to design a model using principal component analysis to identify the main descriptors of sustainability initiatives among Latin American HEIs and also the major drivers and challenges. The study sheds some light on the ways universities perceive and handle sustainability-related initiatives. The results show that sustainability is being incorporated in more than 80% of the sampled universities, and that a special emphasis is being given to campus operations. The value of the paper resides on the fact that it is one of the few papers that have holistically investigated trends in sustainable development across universities in Latin America. The implications of the study are twofold. Firstly, it maps for the first time how sustainable development initiatives are being practiced in 157 universities in 13 countries, being one of the most comprehensive studies of its kind. Secondly, it outlines some of the main challenges that universities in the region face. The central message of this paper is that the different levels of emphasis given to SD in Latin American universities need to be better understood in order to catalyze continued and long-term actions.

Key words: Latin America, higher education, sustainability initiatives, mapping

## **Mapping sustainability initiatives in higher education institutions in Latin America**

### **1. Introduction**

The Latin America region, which is extended from Mexico in the North, to Argentina and southern Chile in the south, is characterised by a set of developing countries, where languages such as Spanish, Portuguese, and French are predominantly spoken.

The region has many environmental problems, which include degradation of ecosystems, exposure to contaminants, deforestation and increased pollution (Furley et al., 2018, Nathaniel et al (2021), among others.

Research has shown that economic growth and intensive fossil fuel usage have been leading to increased carbon dioxide emissions and air pollution in Latin American countries. Also, increases in urbanisation have led to the release of harmful pollutants that affect human health, and contribute to environmental degradation (Koengkan et al., 2021).

A set of countries (Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and the overseas territory of French Guiana) are within close proximity to the Amazon rainforest, and rely heavily on mining and agricultural practice for their economic growth. Apart from encouraging deforestation and increases in carbon emissions (Nathaniel et al., 2021), these practices have been associated with a severe disturbance of eco-systems, and land degradation (Deng et al., 2020).

An example of an industry that threatens biodiversity and eco-systems is the palm oil sector. Unsustainable practices in this sector have been leading to habitat losses and displacement of people. In addition, oil production via unsustainable methods has been contributing to a deterioration of climate conditions in the region (Ocampo-Peñuela et al., 2018).

More recently, the COVID-19 pandemic has worsened environmental conditions in the region. Since the world's attention has shifted to the pandemic, there has been a rise in the levels of activities such as illegal logging, illegal mining and land grabbing. Such activities are known to adversely affect the natural environment (López-Feldman et al., 2020) and to exacerbate the levels of poverty in the region.

It is therefore clear that sustainability-oriented activities are needed in Latin America, so as to put the region in a better position to handle its current problems. Only through the responsible use of natural resources can regional problems be countered. In this context, education as a whole, and higher education in particular, has a key role to play in this process. A mapping of current initiatives may provide a sound basis for moving forward in this rapidly changing field.

Conceptually, mapping Latin American university sustainable initiatives can be understood as the process of representing and understanding relationships between elements that contribute to the success of an initiative (Geissdoerfer et al., 2016). Consequently, the mapping should offer insights for enriching the endless debate about how to become a more sustainable university. To map best practices, it is vital to gather reliable information (Salvioni et al., 2017). Another issue is the criteria for mapping (Shawe et al., 2019). Some reports stress the gaps and difficulties in implementing the sustainability concept across university structures, administrators, and teachers and their

external influence in the larger society (Amaro, 2018). A set of key criteria for a reasonable mapping may encompass sustainable education policies, strategies, initiatives and outreach, particularly those networks that reflect partnerships with the society at large.

Historically, the *International Journal of Sustainability in Higher Education* from Emerald Publishing and the *Journal of Cleaner Production* from Elsevier have been the primary scholarly outlets that include publications on sustainability strategies and practices undertaken on campuses (Blanco-Portela et al., 2017; Findler et al., 2019). More recently, the *Sustainability-Open Access Journal* has also become an option. In addition, there is the traditional marked emphasis in Latin America on prioritizing teaching over research, mainly due to the lack of resources (Amaro, 2018), which discourages article submissions to journals by Latin American scholars.

However, most articles published in peer-review journals, some noted above, come from universities and researchers in Europe and North America, with little work from universities in South America (Guenther and Roos, 2020). As a consequence, the stock of articles in the peer-reviewed journals about sustainable universities within a Latin American context is limited. In many cases, sustainability in higher education is still treated as a challenge (Barth & Rieckmann, 2012), since it is still not evident how higher education is transforming and adapting to the achievement of sustainability and integrating this concept in its activities. All sectors of the educational institution may be involved or impacted, from the campus operational activities to its institutional philosophy (Leal Filho, 2010). By recognizing sustainable activities, HEIs can identify the existing gaps and promote new activities, even enabling benchmarking of cooperation with other HEIs. This endorses the need to map initiatives oriented towards

SD, especially in Latin American countries that are in a development stage. This research fills this gap by exploring the current status of sustainability initiatives among HEIs through an international survey. Based on a sample of Latin American universities, this study identifies current trends and showcases some areas where improvements are needed.

## **2. *HEIs general initiatives to address SD***

Since Stockholm 1972, higher education institutions (HEIs) around the globe have been pursuing sustainability education and integrating sustainability initiatives into their core systems, including education, research, community outreach, and operation (Blanco-Portela et al., 2018; Leal Filho, et al., 2016; Schweizer et al., 2019). According to Yáñez et al. (2019), SD initiatives should work as the “golden thread” that integrates the entire university system, as well as those areas considered essential in achieving sustainable societies. As stated by Lozano et al. (2017 and Leal Filho et al 2016), research into and the practice of SD in HEIs has been increasing during the last two decades.

Regarding the educational and research systems, there is a broad consensus that HEIs must boost competences in SD to their students in order to fulfil their role. Hensley (2018) states that the conventional approaches to higher education are failing to equip students with the ability to respond to the sustainability issues, such as climate change, the rapid loss of biodiversity, the extreme poverty, and water shortages, to name a few. According to Etse and Ingley (2016), in order for education to be able to play its

role in promoting the sustainability agenda, the curriculum should be developed for shaping the sustainable world.

To reassemble education in order to implement SD in the curriculum of HEIs, Schweizer et al. (2019) suggest the following three approaches: 1) integrating it as a perspective into the existing curriculum; 2) offering specific degree programs or shorter courses on SD; and 3) providing elective study programs in which students may achieve competencies related to SD in addition to their conventional degree program. One of the most important aspects for an engaging curriculum is by putting theory into practice. The same is observed in studies related to the integration of sustainability into curricula (Tasdemir and Gazo, 2020).

Several authors have discussed which competencies should be developed among students so as to meet the knowledge and skills demands related to sustainable development, as well as the pedagogical methods that permit the acquisition of the required competencies (Faham et al., 2017; Molderez & Fonseca, 2018; Warda, 2014). Among the pedagogical methods that have been adapted to address the learning gaps in promoting sustainability literacy, are the project-based and problem-based learning approaches: two student-centered approaches based on “learning by doing,” which involve students in design, problem-solving, decision-making, or investigation of activities related to complex tasks (Dobson & Tomkinson, 2012; Leal Filho et al., 2016).

According to del Mar Alonso-Almeida et al. (2015), the commitment of HEIs to embolden research in the SD field has been pursued by means of a considerable number of agreements and declarations, such as Rio+20 and the UN Conference, in which a HEI “commits to teach concepts related to SD, encourage research on

development issues, support sustainability efforts and engage with and share its results through international sustainability research frameworks.”

The work of Genus and Theobald (2015) intended to improve the understanding of the potential roles of academic researchers in facilitating the development of low carbon and generally more environmentally sustainable neighbourhoods and communities. The authors highlight the importance of securing research funding for SD projects and for assessing the quality of the research undertaken in HEIs and also emphasize the benefits of integrating academic research teams and local agencies in order to promote applied and field-based research.

Integrating sustainability development into the outreach system involves sharing sustainability knowledge and expertise beyond the academic sphere. Beringer et al. (2008) suggest that “the university outreach should be based more on the concepts of collaboration and cooperation with all the players as equal partners with free flow of information between all the players.” For Narasimbarao (2013, p. 245) HEIs have been evolving programs/research focused on “knowledge integration and knowledge management at all levels and facilitates the use of academic capacity in practice and also in developing academic capacity based on the practice in real life situations.” Dlouhá et al. (2018) explains that HEIs have been focused on setting up and/or endorsing international sustainability treaties, charters and declarations to reinforce their external impact with key stakeholders. An increasing number of sustainability networks have been developed to share commitments and help HEIs in this endeavour. Those networks generally provide HEIs with a systematic set of procedures and methods to implement, assess, audit, benchmark, and communicate their SD initiatives.



A set of networks has been created to this end. Some of them are outlined in

Table 1.

*Table 1 - Some Higher Education Sustainability Networks*

<b>Network</b>	<b>Area</b>
Association for the Advancement of Sustainability in Higher Education (AASHE)	North America
North American Association for Environmental Education (NAAEE)	North America
Inter-University Sustainable Development Research Programme (IUSDRP)	Global
European School of Sustainability Science and Research (ESSSR)	Global
Green Campus Network	Global
Australian Campuses for Sustainability	Australasia
Sustainable Development Solutions Network (SDSN)	Global
La Unión de Responsabilidad Universitaria Latinoamericana (URSULA)	Latin America

Being part of an international or national SD network may leverage the opportunities to face the challenges related to implementing, assessing, and reporting the SD agenda into HEIs. Though outreach and engagement are widely practiced by traditional HEIs, they are often paralleled by embryonic strategies and challenges that need to be matured (Vargas et al., 2019), especially in developing countries (Narasimharao, 2013).

The significance of campus operations systems has been highlighted in most HEIs' SD declarations, such as Rio + 20 and Higher Education Sustainability Initiatives (HESI) in 2012. The implementation of campus operations initiatives is one of the SD topics in HEIs that has shown significant progress with a large number of publications (Lozano et al., 2015). The campus operations system generally covers physical operations/facilities management, and includes energy efficiency (Altan, 2010; Leal Filho et al., 2019b; Salehi et al., 2015), transport and GHG emissions (Robinson et al., 2015; Xu et al. 2018), waste management (Merger et al., 2018), green building (Abdelalim, 2017), water management (Bhattacharyya, 2020), and ethical procurement (Leal Filho et al., 2019c).

For HEIs that seek to integrate sustainable development, empowerment can be one of the main motivators for effective organizational change (Akins et al., 2019; Lambrechts et al. 2017) and capacity building, a motivational tool by which managers, teachers, employees and others become advocates of sustainability (Akins et al., 2019). According to Barth (2013), the process of implementing sustainability in HEIs is driven by a flexible organizational structure based on continuous communication, systems support and leadership, while Adams (2013) highlights the importance of proactive leadership, clear and consistent communication, inclusion of sustainability in the strategy of HEIs, multidisciplinary in research and courses, engagement of students and staff, and other initiatives that promote involvement in sustainability practices. To achieve SD in universities and transform them into organizations that foster innovation and entrepreneurship, actions are required from highly engaged and pioneering individuals (Hermann and Bossle, 2020; Wakkee et al., 2019), who engage in sustainability-oriented teaching, research and outreach activities, as well as the often absent leadership displayed by management teams (Radinger-Peer & Pflitsch, 2017; Wakkee et al., 2019).

HEIs have a major challenge and deep responsibility when it comes to raising awareness, knowledge, technologies, and tools to create a more sustainable future through education, research, policy development, and information dissemination (Association of University Leaders for a Sustainable Future, 2015; Shawe et al., 2019). Therefore, it is sometimes necessary to make some adaptations and changes in order to make them more sustainable, since they are potential agents of change due to distinct roles and functions in society (Stephens et al., 2008). In addition, HEI's are considered ideal organizations for experimenting with initiatives to create societal transformations,

starting at a small scale before being transferred to society at large (Shawe et al., 2019; Trencher, et al. 2014).

Universities, with their transformative and educational roles, are constantly challenged to contribute with models for the formation of critical sustainable thinking, adopting measures for a sustainable management system of the institution itself, as well as the incorporation of innovative concepts for the dissemination of sustainable awareness among teachers, students, and the entire academic community (Almeida et al. 2019). For Aleixo, Leal, and Azeiteiro (2018), such institutions play an important role in promoting sustainability. A growing number of stakeholders expect them to be sustainable organizations, but this can only be achieved when barriers and challenges are overcome (Leal Filho et al., 2015, 2017).

### **3. Methodology**

This work aimed to analyze the current status of sustainability initiatives performed by Latin American HEIs to investigate their commitment in facing SD challenges and move society into more sustainable pathways. To address the established goal, the cross-sectional descriptive research was carried out through a mixed-method approach.

According to Saunders, Lewis, and Thornhill (2009) and Wiid and Diggins (2010), the purpose of descriptive research is to portray an accurate profile of studied events or situations to describe the research domain accurately and thoroughly. Saunders et al. (2009) define mixed methods as a general term used when both

quantitative and qualitative data collection techniques and analysis procedures are performed in research design.

The adopted methodological process comprises the following three steps:

a) Design of data collection instrument: a multi-language (English, Portuguese, and Spanish) survey was designed to identify and analyze the main SD initiatives adopted by a sample of Latin American HEIs. The survey was divided into 6 sections, as presented in Table 2. These sections covered the main HEI sustainability initiatives described in the literature review topics, with the addition of demographic characteristics of HEIs.

*Table 2 - Survey sections and their descriptions*

Section 1	Composed of 7 variables: language (English/Portuguese/Spanish) and demographic characteristics (university name, the segment of the respondent, respondent position, number of students, year of foundation, public/private, country);
Section 2	Composed of 5 variables: 2 dichotomous (existence of sustainability policy, and initiatives related to teaching), and 3 Likert items (curriculum innovation, project-based learning, and problem-based learning).
Section 3	Composed of 4 variables: 1 dichotomous (existence of initiatives focusing on research), and 3 Likert items (research on theory/principles of SD, applied research on SD, field-based research on SD).
Section 4	Composed of 4 variables: 1 dichotomous (existence of initiatives focusing on outreach), and 3 Likert items (small seminars with external stakeholders, symposia/conferences, specialist workshops).
Section 5	Composed of 11 variables: 1 dichotomous (existence of initiatives focusing on campus operations), 10 Likert items (paper consumption, energy, water, landscaping, renewable energy, emissions, food, biodiversity, green purchasing, and waste management).
Section 6	Composed of 2 variables to list challenges and drives related to the implementation of SD initiatives in HEIs, plus open space for additional comments.

Sections 2-6 also had open spaces to allow the respondent to include and assess initiatives not mentioned, if desired. The designed survey was then piloted and pre-tested by a panel of co-authors, and a group of experts in the incorporation of sustainability in HEIs validated the survey. The pre-test results are included in the final sample and results, since only changes in wording or structure organization were performed.

b) Data collection procedures: Data was collected through the developed survey, which used open-ended and multiple-choice questions on a 5-point Likert Scale. The survey was designed and distributed through Google Forms, and, adopting the convenience sample approach, the link was emailed to the list of members of the Inter-University Sustainable Development Research Programme (IUSDRP), (<https://www.haw-hamburg.de/en/ftz-nk/programmes/iusdrp.html>), composed of over 140 HEIs; also, other representatives were approached via personal contacts and by a web search. Respondents were classified according to the university with which they were affiliated. Lecturers, administrative employees and students from 157 universities in 13 countries completed the survey. The data was collected from March 18 to April 26, 2020.

c) Data analysis: the final step consisted of the techniques adopted for data analysis. The method used to calculate normality assumptions, adequacy and the validity of the questionnaire was the Exploratory Factor Analysis (EFA), using principal component analysis (PCA) and varimax rotation. The reliability analysis for the survey used Cronbach's alpha following Field (2013).

## **4. Results and Discussion**

This section is divided into three subsections. The first section exposes and discusses the general findings from the descriptive statistics. The second section discusses the validity of the survey and presents the model that emerged from the data. The third section presents the drivers and challenges found in this research.

### ***4.1 Descriptive Statistics***

Among the 157 participant universities, the sample reveals that more than half (61%) of them have Spanish as their official language. It should also be noted that 57% of the respondents were lecturers, who also demonstrate greater knowledge of the subject researched. Other important factors revealed in the research are that more than 50% of the universities have less than 20,000 students, 38% have less than 10,000, and 24% have between 11-20,000. More than half of them (61%) are public and were founded after 1950. It is important to note that the process of creating universities in Latin America was a late process in relation to other continents, and it began in the 16th century with peculiarities of European influence in the colonial period (Schwartzman, 2000; Serrano, 1994). For the study, it is worth mentioning that 2 universities were founded in 1623, and 3 universities were founded in the 1800's, being very important in the context of Latin American history.

As far as the scope of the survey is concerned, the 157 participating universities come from 13 countries, as shown in Fig. 1, with Brazil, Mexico, and Colombia being the countries that stood out most in the participation. The significance of the study to universities in Latin America is considerable, since it is one of few works that have mapped trends across the whole region. Table 3 presents the main characteristics of Latin American universities.



Fig. 1. Participating countries

Table 3 - Characteristics of universities in Latin America

<b>1) Language</b>		<b>6) Country</b>	
English	27	Argentina	2
Portuguese	48	Brazil	47
Spanish	82	Chile	5
<b>2) Academic segment</b>		Colombia	37
Student	22	Costa Rica	2
Lecturer	89	Ecuador	2
Staff	28	Guatemala	2
Administrative	18	Honduras	2
<b>3) Number of students</b>		Mexico	38
- 10 k.	61	Nicaragua	2
11 - 20 k.	38	Panama	2
21 - 30 k.	24	Peru	8
31 - 50 k.	25	Venezuela	8
+ 51 k.	5	<b>7) University has a sustainability policy</b>	
+ 100 k.	4	Yes	128
<b>4) Public/private</b>		No	29
	97	<b>8) Sustainability-related initiatives focused on education</b>	
Public		Yes	112
Private	60	No	45
<b>5) Year of foundation</b>			

		<b>9) Sustainability-related initiatives focusing on research</b>	
1623 – 1700	2		
1701 – 1800	0	Yes	140
1801 – 1900	3	No	17
		<b>10) Sustainability-related initiatives focused on achieving</b>	
1901 – 1950	31		
1951 - 2000	108	Yes	137
2001	13	No	20

With regard to the sustainability indicators, presented in items 7 to 10, the results show that sustainability is being implemented in more than 80% of universities. 81% highlight that they have a sustainability policy. 87% have sustainability initiatives focused on education. 89.18% have sustainability initiatives focused on research, and 87% highlight that they have a sustainability focus (related to operations, activities and philosophy). These results of the sustainability initiatives can be highlighted by the efforts of universities to meet the Millennium Development Goals and currently the SDGs. In addition to these objectives, it should also be noted that universities in Latin America are promoting cooperation with several universities around the world, in addition to participating in educational networks such as AASHE, NAAEE, IUSDRP, ESSSR and SDSN.

## **4.2 The emerged model**

### **4.2.1 Emerged model for sustainability initiatives at Latin-American HEIs**

The survey that was designed from the literature review allowed the authors to model how SD initiatives are implemented into Latin American HEIs, as is shown in Fig. 2. This implementation occurs by means of three distinctive groups: campus operations, outreach and research, and teaching.



Campus operations acts within the scope of sustainability practices aimed at the management of operational aspects, such as water, energy, landscaping, reduction of consumption, control of emissions, and green purchasing.

The second group - outreach and research - clustered initiatives related to the interaction of the HEIs with their stakeholders and SD-related research. Referring to the need for integration between theory, research and practice, Ali and Brown (2017) recognize that these three aspects have to be better integrated in order to offer practical solutions to face the challenges of the 21st century. In particular, in the field of applied research there are some efforts to integrate the research dynamics with institutional outreach actions. For example, in the work carried out by Redwood et al. (2016), the development and establishment of micro-level 'operating units' was undertaken evolved through a structural partnership between the National Health Service (NHS), local authorities, patients the public and universities, to foster collaboration across its stakeholders and generate healthcare knowledge and foster good practice. This system, characterised by mutual engagement and collaboration, created the right conditions to produce the desired outcomes of integration and innovation. This approach also facilitated the collaboration and information flow among research and communities of practice, while assuring the development and promotion of a common agenda of research on health issues.

Finally, the teaching group embraced strategies that were developed to provide students with the necessary skills to work in their professions with consideration of SD aspects.

Both the model and the survey were proved by conducting a PCA on the 19 items, with orthogonal rotation (varimax).

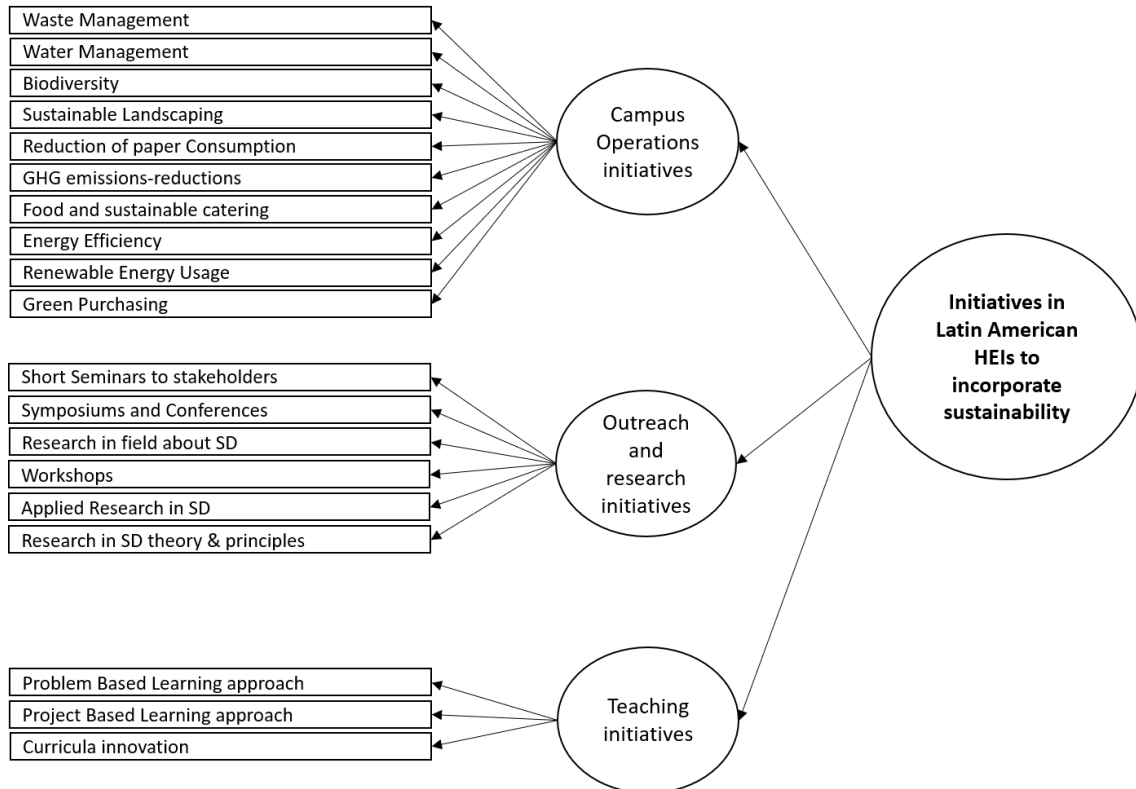


Fig. 2. Model for sustainability initiatives at Latin-American HEIs  
SD: sustainable development.

#### 4.2.2 Construct validity

The set of statistical procedures that measures the suitability of the obtained data were the Kaiser–Meyer–Olkin (KMO) test, which is the measure of sampling adequacy, and the Bartlett's test of sphericity, which tests the null hypothesis that the original correlation matrix is an identity matrix (Hair et al., 2014). The KMO was 0,90 and all KMO values for individual items were greater than 0.85, which is well above the acceptable limit of 0.5 (Field, 2018). Bartlett's test of sphericity was also significant ( $X^2(171) = 1422.171, p < .05$ ). An initial analysis was run to obtain eigenvalues for each factor in the data. Three factors had eigenvalues above Kaiser's criterion of 1, and

in combination explained 69% of the variance, explained by the extracted components after rotation. Table 4 shows the rotated component loads; all the items from the survey were retained because their loads were above the acceptable value of 0.4. For the reliability analysis, Cronbach's Alpha was used, resulting in expressed values much higher than the acceptable level of 0.6 for all components (Field, 2018)

*Table 4- Results of Principal Component Analysis and Reliability Analysis*

Items	Rotated Component Matrix			Mean	Standard Deviation
	Campus operations	Outreach and Research	Teaching		
Waste Management	<b>0.823</b>	0.025	0.251	3.59	1.25
Water Management	<b>0.822</b>	0.005	0.228	3.19	1.21
Biodiversity	<b>0.792</b>	0.324	-0.025	2.99	1.32
Sustainable Landscaping	<b>0.726</b>	0.304	0.130	2.97	1.30
Reduction of paper consumption	<b>0.719</b>	0.040	0.327	3.68	1.09
GHG emissions-reductions	<b>0.719</b>	<u>0.418</u>	-0.015	2.53	1.26
Food and sustainable catering	<b>0.713</b>	0.314	-0.148	2.46	1.26
Energy Efficiency	<b>0.710</b>	0.187	0.245	3.33	1.10
Renewable Energy Usage	<b>0.635</b>	0.159	0.193	2.69	1.19
Green Purchasing	<b>0.634</b>	0.399	0.215	2.61	1.25
Short Seminars to stakeholders	0.356	<b>0.797</b>	0.192	2.44	1.38
Symposiums and Conferences	0.258	<b>0.783</b>	0.227	2.55	1.35
Research in field about SD	0.112	<b>0.775</b>	0.415	2.81	1.35
Workshops	0.363	<b>0.759</b>	0.210	2.49	1.37
Applied Research in SD	0.133	<b>0.747</b>	0.408	2.86	1.33
Research in SD theory & principles	0.078	<b>0.604</b>	0.536	2.54	1.37
Problem Based Learning approach	0.266	0.343	<b>0.796</b>	2.91	1.31
Project Based Learning approach	0.194	0.340	<b>0.770</b>	2.96	1.33
Curricula innovation	0.196	0.405	<b>0.661</b>	2.74	1.42
<b>Components mean</b>	3.00	2.62	2.99		
<b>Reliability (Cronbach's Alpha)</b>	0.908	0.929	0.863		
<b>Eigenvalue</b>	5.87	4.44	2.83		
<b>Percentage of variance</b>	30.90 %	23.35 %	14.88 %		

<sup>a</sup>Note: component load >0.6 marked in bold.

### 4.2.3 Component analysis

Three components emerged from the EFA analysis. The items clustering on the same components suggested that the first component represents the initiatives about

campus operations, the second component about outreach and research, and the third component about teaching.

Results suggest that behaviour similar to that of HEIs in developed countries has appeared in Latin-American HEIs. Thus, campus operations had the highest score in the proposed model, as literature has shown it to be the outstanding component in the incorporation of sustainability in the HEIs (Hallinger & Chatpinyakoo, 2019; Leal Filho, 2011; Lozano et al., 2015; Trad, 2019). Most of the inventoried assessment tools reported in the literature on sustainability in HEIs emphasize campus operations (Alghamdi et al., 2017; Kapitulčinová et al., 2017). Thus, Latin-American HEIs could see these initiatives as drivers. 96.6 % of the respondents' HEIs implement sustainability-related initiatives in campus operations, following the trend presented by Amaral et al. (2020). The more significant initiatives were policies and actions to reduce paper consumption, actions regarding waste management, actions to improve energy efficiency, and actions and policies to promote water management. The less significant initiatives were actions regarding food and sustainable catering and green purchases (Table 4). Given the varied approaches that universities can use to be more sustainable, strategies to specifically improve environmental sustainability demand specialized teams and an integrated combination of initiatives (Amaral et al., 2020; Vieira et al., 2018)

The second component of the model grouped sustainability initiatives related to research and outreach. Respondents affirmed that their HEIs adopt practices related to research (89.8 %) and practices related to outreach (87.3 %). These results and the component factor load suggest the relevance of Latin-American HEIs being engaged with the internal and external communities for sustainability issues, and the

communication and disclosure of sustainability practices, as (Lozano et al., 2013) found. Although outreach activities seemed to contribute more to the component than researching initiatives, the component mean suggests that the implementation is not very high. This result is consistent with similar trends identified by Hallinger and Chatpinyakoop (2019), regarding the low amount of research in education for SD in HEIs in developing countries and the need for research in sustainability sciences. The last component, which had the lowest load and a mean of 2.54, could suggest the misunderstanding of the HEI's community (directors, students, administrative and academic staff) about what SD is (Godemann et al., 2011; Hallinger & Chatpinyakoop, 2019), how to implement it, and what to research. This misunderstanding could also affect the cooperation needed to improve outreach activities and research networks (Leal Filho, et al., 2019d), highlighting the importance of sustainability events to promote further understanding, cooperation, and research on the topic (Berchin et al., 2018). Thus, further studies on research gaps, needs, opportunities, trends and capabilities related to the appropriation of sustainability in Latin-American HEIs could be useful.

Finally, despite the UN's urgent call to incorporate SD in HEIs (Sector, 2006; UN, 1992), the teaching component had a low component load and considerable mean in this research. Problem and project-based learning methodologies seemed to be recognized initiatives among the HEIs surveyed. However, other pedagogical approaches, such as action, experiential, active and transformative learning were mentioned; they are the approaches inventoried by Kapitulčinová et al. (2017) in HEIs. The curriculum innovation initiative showed that Latin-American HEIs are increasing their awareness of the importance of teaching sustainability in their academic programs,

as Hernandez et al (2018) suggested. However, it is important to notice that both curriculum innovation and research in SD theory & principles had crossed-load values very close to the cut-off point ( $<0.4$ ). Thus, further research is needed to understand the barriers to the promotion of sustainability in academic programs. This could be due to the lack of academic staff who understand and link their lectures to sustainability issues, as was found in Bolivian HEIs by Litzner and Rie (2019).

### 4.3 Drivers and challenges

The survey also assessed challenges and drivers to the implementation of sustainability initiatives at universities. The results are presented in Fig. 3.

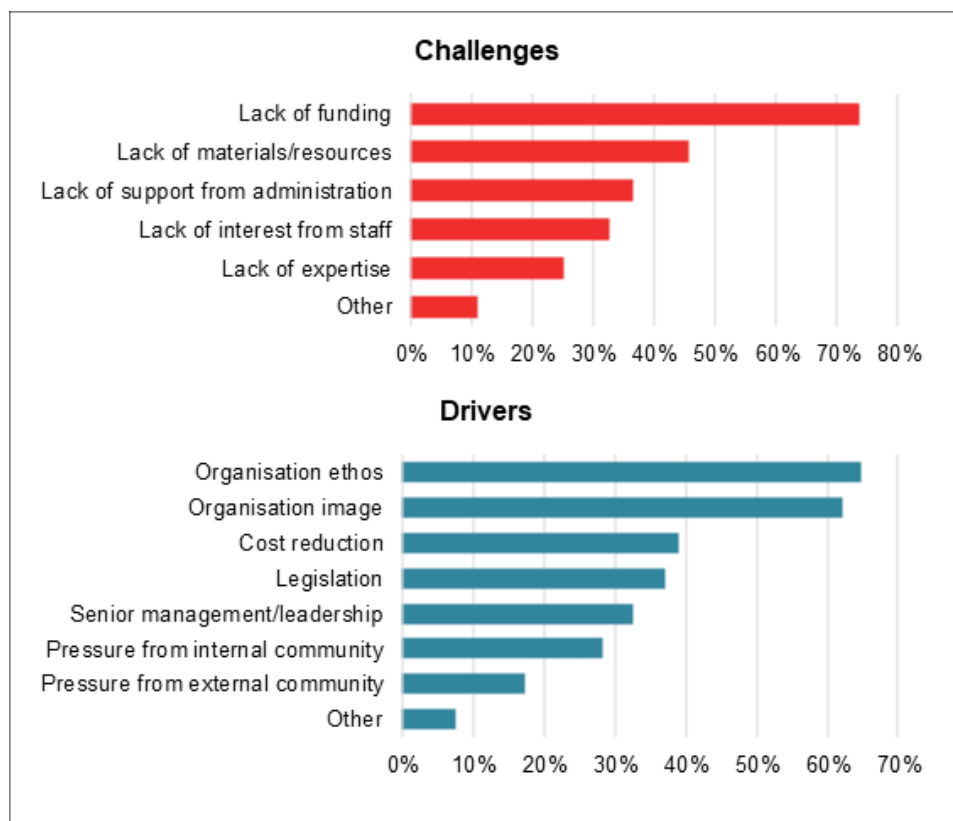


Fig.3. Challenges and drivers of the process of implementing sustainability initiatives at universities in Latin America. Note: Since each respondent could indicate more than one option, the total exceeds 100 %

Regarding challenges, lack of funding was the most indicated choice (by 74% of the respondents). This result aligns with many other studies which investigated similar issues and which reported the lack of financial resources to be a challenge for sustainability in higher education, both in specific regions or globally (Blanco-Portela et al., 2017; Leal Filho, et al., 2019e; Lo, 2015). Lack of funding is followed by the lack of resources/materials, lack of support from administration, and lack of interest from staff (46%, 37%, and 33%, respectively). The least indicated choice was the lack of expertise, with only 25% of the respondents choosing this as a challenge. The open space for indicating other challenges not listed was used by 11% of the respondents, and the challenges listed included the concern about the lack of laboratories, lack of awareness about the importance of sustainability, the engagement of professors and students, the lack of support from government bodies, and the need for changing organizational culture. As indicated by Adams et al. (2018), making culture visible within universities not only contributes to internal goals but also improves their social legitimacy.

On the other hand, it is also important to acknowledge the drivers for sustainability. These can help organizations understand the main reasons for overcoming the challenges and investing in different initiatives. According to the studied sample, the organization image and ethos are the main drivers in implementing sustainability initiatives (indicated by 65% and 62% of the respondents, respectively). Cost reduction appears as the third most important driver (39%), followed by legislation (37%). The pressure from internal and external communities appears in the last position on the list, but the internal community tends to have more impact on sustainability decisions. Similar results were observed by Leal Filho et al. (2019d) when assessing the

drivers for sustainability practices in procurement at HEIs. As for challenges, the respondents also used the open space to indicate other drivers (8%): social responsibility, education and curriculum greening, participation in university networks, and involvement of researchers. As expected, there were no mentions of government pressure on sustainability initiatives, as observed in the Chinese sustainability experience in HEIs (Lo, 2015), which may indicate that the government in Latin America is not putting pressure on universities to invest in sustainability actions, as already happens in other regions.

For questions 9, 11, 13 and 15, which investigated which sustainability-related initiatives are being undertaken in the fields of teaching, research, outreach, and campus operations, the respondents could also indicate other initiatives not listed in the given options. Although not used for the mathematical model, these other initiatives are worth analyzing in this paper so that they can be considered in future studies and used in future models' assessments. The additional responses are presented in Table 5.

*Table 5 - Additional sustainability-related initiatives indicated by the respondents*

<b>Research</b>	<b>Campus operations</b>
<ul style="list-style-type: none"> <li>- Association with the SDGs</li> <li>- Application in master's and PhD theses</li> <li>- Implementation of research related to sustainability within the university campus</li> </ul>	<ul style="list-style-type: none"> <li>- Carbon Neutrality</li> <li>- Certifications ISO 14.001 and 50.001</li> <li>- Investment in sustainable buildings</li> <li>- Sustainable mobility (e.g. promoting bicycle use)</li> <li>- Environmental education programs</li> <li>- Environmental policy</li> </ul>
<b>Teaching</b>	<b>Extension/Outreach</b>
<ul style="list-style-type: none"> <li>- Specific classes on sustainability/environmental management offered to all courses</li> <li>- Practical classes using the campus to learn/field practice</li> <li>- Environmental Education activities</li> <li>- Network for voluntary activities</li> <li>- Virtual laboratories</li> <li>- Simulated case studies</li> <li>- Active learning and transformative learning</li> </ul>	<ul style="list-style-type: none"> <li>- Association with the SDGs</li> <li>- Participation in local, national, and international sustainability networks</li> <li>- Sustainability outreach projects</li> <li>- Awards to acknowledge sustainability efforts of local organizations</li> <li>- Voluntary activities</li> <li>- Partnership with local government</li> <li>- Business incubation</li> </ul>



- Problem-based learning	- Training activities with local community (e.g. with recyclable waste pickers; rural communities to encourage use of biodigesters) - Special activities such as “Earth Hour” or “Beach cleaning day”
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The additional comments presented by the participants to complement their responses could be divided basically into two categories: acknowledging the role of universities in sustainability and reinforcing the need to overcome specific challenges. Although many universities have just recently started investing in sustainability initiatives, some report that they start by involving sustainability in the curriculum and by reinforcing the importance of participating in sustainability networks, of seeing sustainability as everyone’s goal, and of bringing more practical activities to the courses. Similar actions were presented by León-Fernández & Domínguez-Vilches (2015) while investigating environmental management and sustainability in Spanish universities; the authors acknowledged the importance of university networks, the incorporation of environment/sustainability into the curriculum, projects with associations, and environmental volunteering, corroborating the need for practical components in a sustainable curriculum (Tasdemir and Gazo, 2020).

Some respondents indicated that the political-economic crisis in their countries hinders the investments in sustainability, and some universities have been recently founded, which also implies that sustainability is not a priority for the administration.

The novelty of the study can be noticed if it is considered that the mapping here presented goes to a great level of details in identifying both gaps and opportunities, which may support further efforts by the universities across the Latin American region. For instance, the importance of applying sustainability to several aspects, and not only focus on the environmental aspects, was clearly highlighted. This concern was also reported by White (2014) in a study about integrative plans for sustainability within

North American college campuses; the author indicated that environmental aspects are most prominent in sustainability plans, leaving less space for social equity aspects.

## **Conclusions**

This study aimed to map the initiatives oriented towards SD in Latin American HEIs and discuss their drivers and challenges. The results show that sustainability elements are being incorporated in more than 80% of the sampled universities, and this mostly occurs by means of campus operations, followed by outreach and research and teaching. When this data is compared to what is seen in universities in more developed countries, a similar pattern is observed: campus operations is the most widely implemented component, followed by research and outreach.

Regarding the campus operations, the more significant initiatives were policies and actions regarding waste and water management, policies to reduce paper consumption, actions regarding biodiversity, and landscaping and policies to improve energy efficiency. The less significant initiatives were actions regarding food and sustainable catering and green purchases.

The more significant initiatives related to research in sustainability were short seminars to stakeholders, workshops, symposiums, conferences and applied or theoretical research in SD. In terms of outreach, the initiatives that appeared the most were the problem and project based learning approaches.

The implications of the study are twofold. Firstly, it maps for the first time how sustainable development initiatives are being practiced in 157 universities in 13 countries, being one of the most comprehensive studies of its kind. Secondly, it outlines some of the main challenges that universities in the region face. In addition, the model

allows the identification of initiatives undertaken at Latin American HEIs, clustered under the three dimensions.

Moreover, it has shown that some conditions need to be fulfilled in order to allow more Latin American universities to pursue the path of sustainable development, to become more sustainable, and to increase the scope of their sustainability initiatives. These conditions are: increased provision of financial investments, more efforts in developing suitable resources and materials, and a greater awareness and support from their administrations and university staff. A second implication is that it contributes to current knowledge, by demonstrating the different levels of emphasis and priorities that HEIs give to sustainable development.

The central message of this paper is that the different levels of emphasis given to SD in Latin American universities need to be better understood in order to catalyse continued and long-term actions. Implementing SD in university structures is a complex task, but is worth the effort, since it helps universities address their needs and take advantage of the opportunities that an emphasis on SD may offer to their institutional development. The study is significant due to the fact that it has built a profile of the way that matters related to sustainable are perceived and handled by universities across Latin America.

This study had some limitations. For instance, the survey was limited to a number of questions deemed as relevant in ascertaining the level of commitment from Latin American HEIs to sustainable development. Also, despite a careful statistical analysis, the validity and reliability of the data is influenced by the fact that the responses were provided by academic staff and reflect their level of information and views on how their universities see and perceive sustainable development, along with

the broadness of the issues covered. Finally, the findings from the study are limited to the responses provided by the sampled HEIs.

Despite these limitations, which are common in studies performed without external funding, the research can be regarded as innovative for three main reasons. The first reason is based on the fact that this is the largest study on matters related to SD ever performed in a Latin America context. No previous research has ever entailed such a large sample, or gathered a data set on sustainability initiatives from so many Latin American universities. The second reason is that the study has built a profile of the extent to which universities across the region handle sustainability. Finally, the data obtained offers a profile of the current emphasis that HEIs in Latin America give to matters related to sustainable development, and it outlines the most common features.

A further novelty of the work is that it also considered aspects of governance, which are essential components of sustainability practice in higher education. This can have substantial implications on the practice of sustainable development in higher education, since without adequate governance systems, it is very difficult to pay continued attention to matters related to sustainable development, as it competes with other priorities.

It is hoped that this work will motivate further research on aspects of sustainable development in universities in Latin America, which are among the least investigated in the world.

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## References

- Adams, C., 2013. Sustainability reporting and performance management in universities. *Sustain. Accounting, Manag. Policy J.* 4, 384–392. <https://doi.org/10.1108/SAMPJ-12-2012-0044>
- Abdelalim, A., 2017. A Multi-Scale Approach to Exploiting Measured and Modelled Building Performance Data to Improve Campus Operations. Carleton University, Ottawa, Ontario. <https://doi.org/10.22215/etd/2017-12017>
- Akins, E.E., Giddens, E., Glassmeyer, D., Gruss, A., Kalamas Hedden, M., Slinger-Friedman, V., Weand, M., 2019. Sustainability Education and Organizational Change: A Critical Case Study of Barriers and Change Drivers at a Higher Education Institution. *Sustainability* 11, 501. <https://doi.org/10.3390/su11020501>
- Aleixo, A.M., Azeiteiro, U.M., Leal, S., 2016. Toward sustainability through higher education: sustainable development incorporation into Portuguese higher education institutions, in: Davim, J.P., Leal Filho, W. (Eds.), *Challenges in Higher Education for Sustainability*. Springer.
- Aleixo, A.M., Leal, S., Azeiteiro, U.M., 2018. Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability: An exploratory study in Portugal. *J. Clean. Prod.* 172, 1664–1673. <https://doi.org/10.1016/j.jclepro.2016.11.010>
- Alghamdi, N., den Heijer, A., de Jonge, H., 2017. Assessment tools' indicators for sustainability in universities: an analytical overview. *Int. J. Sustain. High. Educ.* 18, 84–115. <https://doi.org/10.1108/IJSHE-04-2015-0071>
- Ali, S. R., & Brown, S. D. (2017). Integration of Theory, Research and Practice: Using our Tools to Address Challenging Times. In *Integrating Theory, Research, and Practice in Vocational Psychology: Current Status and Future Directions*. Florida State University Libraries. <https://doi.org/10.17125/svp2016.ch6>
- Almeida, R., Souza, T.T. de, Galvão, A.S. da S., Cerqueira, M.R. de J., Silva, N. dos S. da, 2019. Desafios à sustentabilidade em uma instituição de ensino superior na Bahia. *Rev. Eletrônica Gestão e Tecnol. Ambient.* 7, 1. <https://doi.org/10.9771/gesta.v7i7.28059>
- Altan, H., 2010. Energy efficiency interventions in UK higher education institutions. *Energy Policy* 38, 7722–7731. <https://doi.org/10.1016/j.enpol.2010.08.024>
- Amaral, A. R., Rodrigues, E., Gaspar, A. R., Gomes, Á., 2020. A review of empirical data of sustainability initiatives in university campus operations. *Journal of Cleaner Production*, 250, 119558. <https://doi.org/10.1016/j.jclepro.2019.119558>
- Association of University Leaders for a Sustainable Future, 2015. Report and Declaration of the President's Conference (1990) [Online].
- Barth, M., 2013. Many roads lead to sustainability: a process-oriented analysis of change

- in higher education. *Int. J. Sustain. High. Educ.* 14, 160–175.  
<https://doi.org/10.1108/14676371311312879>
- Berchin, I.I., Sima, M., de Lima, M.A., Biesel, S., dos Santos, L.P., Ferreira, R.V., Guerra, J. B. S. O. A., Ceci, F., 2018. The importance of international conferences on sustainable development as higher education institutions' strategies to promote sustainability: A case study in Brazil. *Journal of Cleaner Production*, 171, 756-772.
- Beringer, A., Wright, T., Malone, L., 2008. Sustainability in higher education in Atlantic Canada. *Int. J. Sustain. High. Educ.* 9, 48–67.  
<https://doi.org/10.1108/14676370810842184>
- Bhattacharyya, S., 2020. Green Campus Initiative: Response from a Self-financed Educational Campus—A Case Study, in: *Sustainable Waste Management: Policies and Case Studies*. Springer Singapore, Singapore, pp. 321–331.  
[https://doi.org/10.1007/978-981-13-7071-7\\_29](https://doi.org/10.1007/978-981-13-7071-7_29)
- Blanco-Portela, N., Benayas, J., Pertierra, L.R., Lozano, R., 2017. Towards the integration of sustainability in Higher Education Institutions: A review of drivers of and barriers to organisational change and their comparison against those found of companies. *J. Clean. Prod.* 166, 563–578. <https://doi.org/10.1016/j.jclepro.2017.07.252>
- Blanco-Portela, N., R-Pertierra, L., Benayas, J., Lozano, R., 2018. Sustainability leaders' perceptions on the drivers for and the barriers to the integration of sustainability in Latin American Higher Education Institutions. *Sustain.* 10.  
<https://doi.org/10.3390/su10082954>
- del Mar Alonso-Almeida, M., Marimon, F., Casani, F., Rodriguez-Pomeda, J., 2015. Diffusion of sustainability reporting in universities: current situation and future perspectives. *J. Clean. Prod.* 106, 144–154.  
<https://doi.org/https://doi.org/10.1016/j.jclepro.2014.02.008>
- Deng, Q., Alvarado, R., Toledo, E., & Caraguay, L. (2020). Greenhouse gas emissions, non-renewable energy consumption, and output in South America: the role of the productive structure. *Environmental Science and Pollution Research*, 1-15.  
[doi:https://doi.org/10.1007/s11356-020-07693-9s](https://doi.org/10.1007/s11356-020-07693-9s)
- Dlouhá, J., Henderson, L., Kapitulčinová, D., Mader, C., 2018. Sustainability-oriented higher education networks: Characteristics and achievements in the context of the UN DESD. *J. Clean. Prod.* 172, 4263–4276.  
<https://doi.org/10.1016/j.jclepro.2017.07.239>
- Dobson, H.E., Tomkinson, C.B., 2012. Creating sustainable development change agents through problem-based learning: Designing appropriate student PBL projects. *Int. J. Sustain. High. Educ.* 13, 263–278. <https://doi.org/10.1108/14676371211242571>
- Etse, D., Ingle, C., 2016. Higher education curriculum for sustainability: Course contents analyses of purchasing and supply management programme of polytechnics in Ghana. *Int. J. Sustain. High. Educ.* 17, 269–280. <https://doi.org/10.1108/IJSHE-07-2015-0121>
- Faham, E., Rezvanfar, A., Movahed Mohammadi, S.H., Rajabi Nohooji, M., 2017. Using system dynamics to develop education for sustainable development in higher

- education with the emphasis on the sustainability competencies of students. *Technol. Forecast. Soc. Change* 123, 307–326. <https://doi.org/10.1016/j.techfore.2016.03.023>
- Field, A., 2018. *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. SAGE Publications, London.
- Furley, T. H., Brodeur, J., Silva de Assis, H. C., Carriquiriborde, P., Chagas, K. R., Corrales, J., . . . Miglioranza, K. S. (2018). Toward sustainable environmental quality: Identifying priority research questions for Latin America. *Integrated environmental assessment and management*, 14(3), 344-357. doi:<https://doi.org/10.1002/ieam.2023>
- Genus, A., Theobald, K., 2015. Roles for university researchers in urban sustainability initiatives: the {UK} Newcastle Low Carbon Neighbourhoods project. *J. Clean. Prod.* 106, 119–126. <https://doi.org/https://doi.org/10.1016/j.jclepro.2014.08.063>
- Godemann, J., Herzig, C., Moon, J., Powell, A., 2011. Integrating sustainability into business schools-analysis of 100 UN PRME Sharing Information on Progress (SIP) reports. Nottingham.
- Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2014. *Multivariate Data Analysis*, Seventh Ed. ed. Pearson Education., Essex.
- Hallinger, P., Chatpinyakoo, C., 2019. A Bibliometric Review of Research on Higher Education for Sustainable Development, 1998–2018. *Sustainability* 11, 2401. <https://doi.org/10.3390/su11082401>
- Hensley, N., 2018. Transforming higher education through trickster-style teaching. *J. Clean. Prod.* 194, 607–612. <https://doi.org/10.1016/j.jclepro.2018.05.116>
- Hernandez, P.M., Vargas, V., Paucar-Cáceres, A., 2018. Education for Sustainable Development: An Exploratory Survey of a Sample of Latin American Higher Education Institutions, in: Leal Filho, W. (Ed.), *Implementing Sustainability in the Curriculum of Universities*. Springer, Berlin, pp. 137–154. [https://doi.org/10.1007/978-3-319-70281-0\\_9](https://doi.org/10.1007/978-3-319-70281-0_9)
- Hermann, R. R., Bossle, M. B., 2020. Bringing an entrepreneurial focus to sustainability education: A teaching framework based on content analysis. *Journal of Cleaner Production*, 246, 119038. <https://doi.org/10.1016/j.jclepro.2019.119038>
- Kapitulčinová, D., AtKisson, A., Perdue, J., Will, M., 2017. Towards integrated sustainability in higher education – Mapping the use of the Accelerator toolset in all dimensions of university practice. *J. Clean. Prod.* <https://doi.org/https://doi.org/10.1016/j.jclepro.2017.05.050>
- Koengkan, M., Fuinhas, J. A., & Silva, N. (2021). Exploring the capacity of renewable energy consumption to reduce outdoor air pollution death rate in Latin America and the Caribbean region. *Environmental Science and Pollution Research*, 28(2), 1656-1674. doi:<https://doi.org/10.1007/s11356-020-10503-x>
- Lambrechts, W., Verhulst, E., Rymenams, S., 2017. Professional development of sustainability competences in higher education. *Int. J. Sustain. High. Educ.* 18, 697–714. <https://doi.org/10.1108/IJSHE-02-2016-0028>

- Leal Filho, W., 2011. About the Role of Universities and Their Contribution to Sustainable Development. *High. Educ. Policy* 24, 427–438. <https://doi.org/10.1057/hep.2011.16>
- Leal Filho, W., Doni, F., Vargas, V.R., Wall, T., Hindley, A., Rayman-Bacchus, L., Emblen-Perry, K., Boddy, J., Avila, L.V., 2019a. The integration of social responsibility and sustainability in practice: Exploring attitudes and practices in Higher Education Institutions. *J. Clean. Prod.* <https://doi.org/10.1016/j.jclepro.2019.02.139>
- Leal Filho, W., Manolas, E., Pace, P., 2015. The future we want. *Int. J. Sustain. High. Educ.* 16, 112–129. <https://doi.org/10.1108/IJSHE-03-2014-0036>
- Leal Filho, W., Salvia, A.L., Paço, A. do, Anholon, R., Gonçalves Quelhas, O.L., Rampasso, I.S., Ng, A., Balogun, A.-L., Kondev, B., Brandli, L.L., 2019b. A comparative study of approaches towards energy efficiency and renewable energy use at higher education institutions. *J. Clean. Prod.* <https://doi.org/10.1016/j.jclepro.2019.117728>
- Leal Filho, W., Shiel, C., Paço, A., 2016. Implementing and operationalising integrative approaches to sustainability in higher education: the role of project-oriented learning. *J. Clean. Prod.* 133, 126–135. <https://doi.org/10.1016/j.jclepro.2016.05.079>
- Leal Filho, W., Skanavis, C., Kounani, A., Brandli, L.L., Shiel, C., Paço, A. do, Pace, P., Mifsud, M., Beynaghi, A., Price, E., Salvia, A.L., Will, M., Shula, K., 2019c. The role of planning in implementing sustainable development in a higher education context. *J. Clean. Prod.* 235, 678–687. <https://doi.org/10.1016/j.jclepro.2019.06.322>
- Leal Filho, W., Skouloudis, A., Brandli, L.L., Salvia, A.L., Avila, L.V., Rayman-Bacchus, L., 2019d. Sustainability and procurement practices in higher education institutions: Barriers and drivers. *J. Clean. Prod.* <https://doi.org/10.1016/j.jclepro.2019.05.202>
- Leal Filho, W., Vargas, V.R., Salvia, A.L., Brandli, L.L., Pallant, E., Klavins, M., Ray, S., Moggi, S., Maruna, M., Conticelli, E., Ayanore, M.A., Radovic, V., Gupta, B., Sen, S., Paço, A., Michalopoulou, E., Saikim, F.H., Koh, H.L., Frankenberger, F., Kanchanamukda, W., Cunha, D.A. da, Akib, N.A.M., Clarke, A., Wall, T., Vaccari, M., 2019e. The role of higher education institutions in sustainability initiatives at the local level. *J. Clean. Prod.* <https://doi.org/10.1016/j.jclepro.2019.06.059>
- Leal Filho, W., Wu, Y.-C.J., Brandli, L.L., Avila, L.V., Azeiteiro, U.M., Caeiro, S., Madruga, L.R. da R.G., 2017. Identifying and overcoming obstacles to the implementation of sustainable development at universities. *J. Integr. Environ. Sci.* 14, 93–108. <https://doi.org/10.1080/1943815X.2017.1362007>
- León-Fernández, Y., Domínguez-Vilches, E., 2015. Environmental management and sustainability in higher education. *Int. J. Sustain. High. Educ.* 16, 440–455. <https://doi.org/10.1108/IJSHE-07-2013-0084>
- Litzner Ordóñez, L.I., Rieß, W., 2019. La Educación para el Desarrollo Sostenible en la universidad boliviana. Percepciones del profesorado. *Teoría la Educ. Rev. Interuniv.* 31, 149–173. <https://doi.org/10.14201/teri.19037>
- Lo, K., 2015. Campus sustainability in Chinese higher education institutions. *Int. J.*



- Sustain. High. Educ. 16, 34–43. <https://doi.org/10.1108/IJSHE-04-2013-0032>
- López-Feldman, A., Chávez, C., Vélez, M. A., Bejarano, H., Chimeli, A. B., Féres, J., . . . Viteri, C. (2020). Environmental impacts and policy responses to Covid-19: a view from Latin America. *Environmental and Resource Economics*, 1-6. doi:<http://doi.org/10.1007/s10640-020-00460-x>
- Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, F.J., Waas, T., Lambrechts, W., Lukman, R., Hugé, J., 2015. A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. *J. Clean. Prod.* 108, 1–18. <https://doi.org/10.1016/j.jclepro.2014.09.048>
- Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., Lambrechts, W., 2013. Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. *J. Clean. Prod.* 48, 10–19. <https://doi.org/10.1016/j.jclepro.2011.10.006>
- Lozano, R., Merrill, M.Y., Sammalisto, K., Ceulemans, K., Lozano, F.J., 2017. Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustain.* 9, 1–15. <https://doi.org/10.3390/su9101889>
- Merger, A.C., Sudan, D.C., Watanabe, E., 2018. An Experience of Participatory Construction of Solid Waste Management and Environmental Education Indicators on a University Campus, in: Leal Filho, W., Frankenberger, F., Iglecias, P., Mülfarth, R.C.K. (Eds.), *Towards Green Campus Operations: Energy, Climate and Sustainable Development Initiatives at Universities*. Springer International Publishing, Cham, pp. 763–775. [https://doi.org/10.1007/978-3-319-76885-4\\_50](https://doi.org/10.1007/978-3-319-76885-4_50)
- Molderez, I., Fonseca, E., 2018. The efficacy of real-world experiences and service learning for fostering competences for sustainable development in higher education. *J. Clean. Prod.* 172, 4397–4410. <https://doi.org/10.1016/j.jclepro.2017.04.062>
- Narasimharao, B.P., 2013. Strategies for Developing Academic Abilities for Corporate Education: Relevance of Outreach and Engagement for Developing Countries, in: Ahmad, J., Crowther, D. (Eds.), *Education and Corporate Social Responsibility International Perspectives*. Emerald Group Publishing Limited, Bingley-UK, pp. 243–265. [https://doi.org/10.1108/S2043-0523\(2013\)0000004013](https://doi.org/10.1108/S2043-0523(2013)0000004013)
- Nathaniel, S. P., Nwulu, N., & Bekun, F. (2021). Natural resource, globalization, urbanization, human capital, and environmental degradation in Latin American and Caribbean countries. *Environmental Science and Pollution Research*, 28(5), 6207-6221. doi:<https://doi.org/10.1007/s11356-020-10850-9>
- Ocampo-Peñuela, N., Garcia-Ulloa, J., Ghazoul, J., & Etter, A. (2018). Quantifying impacts of oil palm expansion on Colombia's threatened biodiversity. *Biological Conservation*, 224, 117-121. doi:<https://doi.org/10.1016/j.biocon.2018.05.024>
- Radinger-Peer, V., Pflitsch, G., 2017. The role of higher education institutions in regional transition paths towards sustainability. *Rev. Reg. Res.* 37, 161–187. <https://doi.org/10.1007/s10037-017-0116-9>

- Redwood, S., Brangan, E., Leach, V., Horwood, J., & Donovan, J. L. (2016). Integration of research and practice to improve public health and healthcare delivery through a collaborative “Health Integration Team” model - a qualitative investigation. *BMC Health Services Research*, 16(1), 201. <https://doi.org/10.1186/s12913-016-1445-z>
- Robinson, O., Kemp, S., Williams, I., 2015. Carbon management at universities: A reality check, in: *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2014.06.095>
- Salehi, M.M., Cavka, B.T., Frisque, A., Whitehead, D., Bushe, W.K., 2015. A case study: The energy performance gap of the Center for Interactive Research on Sustainability at the University of British Columbia. *J. Build. Eng.* 4, 127–139. <https://doi.org/https://doi.org/10.1016/j.jobbe.2015.09.002>
- Saunders, M., Lewis, P., Thornhill, A., 2009. *Research Methods for Business Students*, 5th ed. Prentice Hall, Essex.
- Schwartzman, S., 2000. *Tempos de Capanema*, 2nd ed. Paz e Terra; Editora da Fundação Getúlio Vargas, São Paulo – Brasil.
- Schweizer, C.R., Di Giulio, A., Burkhardt-Holm, P., 2019. Scientific support for redesigning a higher-education curriculum on sustainability. *Sustain.* 11, 18–20. <https://doi.org/10.3390/su11216035>
- Sector, U.E., 2006. *Framework for the UNDESD international implementation scheme*. Paris, France.
- Serrano, S., 1994. *Universidad y Nación: Chile en el siglo XIX*. Editorial Universitaria, Santiago de Chile.
- Shawe, R., Horan, W., Moles, R., O’Regan, B., 2019. Mapping of sustainability policies and initiatives in higher education institutes. *Environ. Sci. Policy* 99, 80–88. <https://doi.org/10.1016/j.envsci.2019.04.015>
- Stephens, J.C., Hernandez, M.E., Román, M., Graham, A.C., Scholz, R.W., 2008. Higher education as a change agent for sustainability in different cultures and contexts. *Int. J. Sustain. High. Educ.* 9, 317–338. <https://doi.org/10.1108/14676370810885916>
- Tasdemir, C., Gazo, R., 2020. Integrating sustainability into higher education curriculum through a transdisciplinary perspective. *Journal of Cleaner Production*, 121759. <https://doi.org/10.1016/j.jclepro.2020.121759>
- Trad, S.P., 2019. A framework for mapping sustainability within tertiary curriculum. *Int. J. Sustain. High. Educ.* 20, 288–308. <https://doi.org/10.1108/IJSHE-09-2018-0151>
- Trencher, G., Bai, X., Evans, J., McCormick, K., Yarime, M., 2014. University partnerships for co-designing and co-producing urban sustainability. *Glob. Environ. Chang.* 28, 153–165. <https://doi.org/https://doi.org/10.1016/j.gloenvcha.2014.06.009>
- UN, 1992. *Agenda 21*. Chapter 36. Promoting Education, Public Awareness And Training, in: UN (Ed.), *Earth Summit*.

- Vargas, V. R., Lawthom, R., Prowse, A., Randles, S., Tzoulas, K., 2019. Sustainable development stakeholder networks for organisational change in higher education institutions: A case study from the UK. *Journal of Cleaner Production*, 208, 470-478.
- Vieira, K. R. O., Battistelle, R. A. G., Bezerra, B. S., de Castro, R., Jabbour, C. J. C., Deus, R. M., 2018. An exploratory study of environmental practices in two Brazilian higher education institutions. *Journal of Cleaner Production*, 187, 940-949.
- Wakkee, I., van der Sijde, P., Vaupell, C., Ghuman, K., 2019. The university's role in sustainable development: Activating entrepreneurial scholars as agents of change. *Technol. Forecast. Soc. Change* 141, 195–205. <https://doi.org/10.1016/j.techfore.2018.10.013>
- Warda, S.H.A., 2014. Mediation effect of sustainability competencies on the relation between barriers and project sustainability (the case of Egyptian higher education enhancement projects). *Sustain. Accounting, Manag. Policy J.* 5, 68–94. <https://doi.org/10.1108/SAMPJ-04-2011-0017>
- White, S.S., 2014. Campus sustainability plans in the United States: where, what, and how to evaluate? *Int. J. Sustain. High. Educ.* 15, 228–241. <https://doi.org/10.1108/IJSHE-08-2012-0075>
- Wiid, J., Diggins, C., 2010. *Marketing Research*. Juta and Company, Cape Town.
- Xu, P., Jin, Z., Zhao, Y., Wang, X., Sun, H., 2018. Design and operation experience of zero-carbon campus. *E3S Web Conf.* 48, 03004. <https://doi.org/10.1051/e3sconf/20184803004>
- Yáñez, S., Uruburu, Á., Moreno, A., Lumbreras, J., 2019. The sustainability report as an essential tool for the holistic and strategic vision of higher education institutions. *J. Clean. Prod.* 207, 57–66. <https://doi.org/10.1016/j.jclepro.2018.09.171>