Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Holistic integration of sustainability at universities: Evidences from Colombia

Paula M. Hernández-Diaz ^{a, *}, Jorge-Andrés Polanco ^b, Manuela Escobar-Sierra ^b, Walter Leal Filho ^c

^a Universidad EAFIT. Processes Engineering Department, Carrera. 49 N° 7 Sur-50, Medellín, AA 3300, Colombia

^b Universidad de Medellin. Economic and Administrative Sciences, Carrera 87 N° 30 - 65, Medellín, Colombia

^c European School of Sustainability Science and Research, Hamburg University of Applied Sciences. Faculty of Life Sciences, Ulmenliet 20, D-21033, Hamburg, Germany

A R T I C L E I N F O

Article history: Received 23 December 2019 Received in revised form 28 March 2021 Accepted 13 April 2021 Available online 16 April 2021

Handling editor: Cecilia Maria Villas Bôas de Almeida

Keywords: University sustainability Sustainability measurement Higher education institution

ABSTRACT

Education for sustainable development in universities provides the university's community (i.e. students, administrative and academic staff) with the skills and capabilities needed to contribute to the achievement of sustainable development. Education for sustainable development has been introduced into curricula, research, outreach activities and campus operations. Several tools exist nowadays to assess this incorporation. Most of them are focused on the environmental aspect of campus operations and within academic issues but do not consider the entire system. This research aimed to propose an integration of sustainability throughout the university as a system, considering existing tools and frameworks, and proving the theoretical proposal in an empirical context. Thus, this paper focuses on sustainability from a whole-institution perspective, analysing the university as a system conformed of two subsystems, the academic and the administrative. The research used a sequential, mixed-method. The quantitative phase undertook a literature review using bibliometric and content analysis, followed by a qualitative phase using the thematic analysis method to develop the University Sustainability concept. The University Sustainability analysis integrated education for sustainable development aspects for the academic subsystem and the corporate sustainability paradigm for the administrative subsystem. Consequently, a sustainability measurement scale for the University Sustainability concept was developed and proved using the exploratory factor analysis. The survey was applied to directors, academic and administrative staff, and under and post-graduate students of two private universities located in Medellin, Colombia. A total of 1799 useable responses were collected and analysed with SPSS software. The analysis' outcome exposed all factors loaded above 0.40, and overall, the alpha coefficient was 0.930. Results revealed the reliability and validity of the instrument. Hence, the University Sustainability concept was validated, and its measurement scale is suitable to be used in assessing the sustainability of universities holistically. The evidence from the studied universities shows the relevance of corporate sustainability and social issues in the developed University Sustainability concept.

© 2021 Elsevier Ltd. All rights reserved.

1. Introduction

Contributing to the achievement of sustainable development is a challenge facing universities. They are key actors in the process of implementing sustainable development by linking knowledge generation with the transfer of this knowledge to society (Adomssent et al., 2007). Education for Sustainable Development (ESD) in universities (ESDU) seeks to develop skills and abilities in students to face global problems and contribute to their solution, protecting environmental, social and economic well-being (QAA-HEA, 2014). ESDU is being implemented through their missional functions, teaching, research and outreach, as well as through institutional commitment, campus operations, evaluations and communication to their stakeholders (Leal Filho, Manolas and Pace,







 $[\]ast\,$ Corresponding author. Universidad EAFIT, Carrera. 49 N° 7 Sur-50, Medellín, AA 3300, Colombia.

E-mail addresses: phernand@eafit.edu.co (P.M. Hernández-Diaz), japolanco@ udem.edu.co (J.-A. Polanco), maescobar@udem.edu.co (M. Escobar-Sierra), walter. leal2@haw-hamburg.de (W. Leal Filho).

2009) (Cortese, 2003; Fadeeva and Mochizuki, 2010; Leal Filho, 2011; Müller-Christ et al., 2014). The adoption of ESDU has increased over time but was first focused mainly on campus operations and academic processes (Hallinger and Chatpinyakoop, 2019; Lozano, 2018; Müller-Christ et al., 2014; Waas et al., 2010).

Other concepts referenced in literature, such as 'green university' (Yuan et al., 2013), 'sustainable university' (Amaral et al., 2015) or 'university sustainability (Isaksson and Johnson, 2013; Shi and Lai, 2013), would be related to ESD. 'Green' and 'sustainable university' consider approaches to campus operations, which support the so-called hidden curriculum (Barth, 2013; Kapitulčinová et al., 2018), and 'university sustainability' denotes sustainability assessment and report models. Research has emerged on sustainability assessment in universities, developing several tools to improve ESDU (e.g., Alghamdi et al., 2017; Kapitulčinová et al., 2018; Urquiza et al., 2015). Some tools are based on environmental aspects of campus operations (e.g., Drahein et al., 2019; Suwartha and Sari, 2013) and others integrate academic, research and outreach aspects (e.g., AASHE, 2017; Lozano, 2006; Razak et al., 2013).

Therefore, ESD seems to be more related to sustainability practices, and universities should have a more integrated organisational structure and strategy towards sustainability (Beringer and Adomßent, 2008; Lukina et al., 2017; Zhao and Zou, 2015). However, the literature does not report a single model that includes all the features (Lozano, 2018; Lukina et al., 2017), and sustainability is not yet an integral part of the university system (Lozano et al., 2013). These absences may be partly due to the fact that each university assumes different priorities in the integration of sustainability (Beringer and AdomBent, 2008). It could also be caused by the complex conditions of its social, economic, political and cultural environment (Kopnina and Meijers, 2014) and the fact that institutions still misunderstood sustainability (Waas et al., 2010). Therefore, one must understand the university system in order to achieve the integral incorporation of sustainability (Lozano, 2018), strengthen the 'whole-institution' perspective (Kapitulčinová et al., 2018), and engage sustainability in and outside of universities (Lozano et al., 2013; Lukina et al., 2017).

Gough and Scott (2008, p. 166) defined a university as an open and dynamic system, 'a discrete entit [y], capable of planning [its] actions and coordinating [its] internal components [with] fluid and permeable boundaries across which [it] interacts with a wide range of external agencies and groups'. This system is composed of two subsystems with their respective subcultures: the academic and the administrative subsystems. The academic subsystem includes teaching, learning, research and knowledge transfer to the community (outreach), and the administrative subsystem is related to management, serving the former to achieve its purposes. (Gough and Scott, 2008; Miller, 2016). In the universities' system, the main actors are students and teachers, while the faculties and departments are the operational units (Arif, 2016). Universities have to find their permanence in a globalised world (Guzmán-Valenzuela, 2016a,b; Melewar and Akel, 2005). Thus, they tend to adopt strategies and structures from the productive sector (Arif, 2016; Lewis et al., 2007; Melewar et al., 2017). This sector has adopted corporate sustainability (CS), applying it to the entire organisational system. CS contributes to sustainable development while increasing its long-term economic performance (Annunziata et al., 2018). Thereof, the university's system partially integrates ESDU, but it could be possible to incorporate CS concepts, as a managerial approach, into the administrative subsystem to improve it.

In Latin American universities, some authors suggest future studies that consider, for example, the incorporation of sustainability concepts between universities that increase their contribution to the regional and global agenda (Benavas and Blanco-Portela, 2020). The collaboration of local communities during the sustainability implementation (Agostino and Dal Molin, 2016). The addition of professors, administrative staff, and students during the conceptualization and implementation of universities (Aleixo et al., 2018). Adopting assessment tools that support universities and their continuous improvement (Alghamdi, den Heijer and de Jonge, 2017). The integration of sustainability assessment tools in a comparative empirical analysis (Berzosa et al., 2017). The commitment of universities to overcome social and ecological challenges, meet human rights, and preserve the earth (Casarejos et al., 2017). The execution of a compared analysis considers different sustainability frameworks (Alonso-Almeida et al., 2015). The comprehension of universities' cultural and social impacts on sustainable development (Findler et al., 2019). Finally, Latin American universities have active consumers that concern about universities actions (Guzmán-Valenzuela, 2016a,b).

Thus, the question that emerged in this research was: How can universities integrate sustainability throughout their organisational system, considering the existing tools and frameworks? Based on the above discussions, this study aimed to propose an integration of sustainability throughout the university as a system, considering existing tools and frameworks, and proving the theoretical proposal in an empirical context.

This paper comprises two interrelated parts. The first part presents a literature review of sustainability incorporation in universities and provides a theoretical background of CS. The second part develops the University Sustainability (USus) concept and its measurement scale, which looks for the holistic integration of sustainability in Universities. This kind of sequential mix-method design is relatively new; some authors have implicitly used it (Cortés-Pérez et al., 2020; Escobar-Sierra, Valencia-DeLara, & Vera-Acevedo, 2018), but there is not an explicit protocol. Thus, the methodology used is explained, followed by results and discussion of key findings. It includes the USus concept structure, results for the survey, the measurement's accuracy and validity and the current research limitations. The paper ends with the main conclusions of this research.

2. Literature review for ESDU

2.1. Review method

This research examined the status of how universities incorporate sustainability using bibliometric analysis. The research criteria used the 'citation pearl growing' technique (Shute and Smith, 1993). Table 1 shows the results for the indexed title consulted in the Web of Science (WoS), Korean Journal Database (KCI), Russian Science Citation Index (RSCI), Scielo Citation Index (SciELO) and Scopus from 1985 to January 2019.

The bibliometric analysis (authors, the publication title, source, and summary) used VOS *viewer*® software, version 1.6.6, on the resulting data. This software rates and maps the connections between publications, authors, and research areas by measuring quantity, performance, and some structural indicators (Durieux and Gevenois, 2010). Fig. 1 shows the map of knowledge for sustainability in universities (Top Fig. 1), classified by year (Bottom Fig. 1) and co-occurrence of terms in the selected databases.

Terms repeated in the studies more than 20 times were considered as concurrence indicators using full counting method. The terms that met the threshold were 308, and 185 terms were the most relevant in 60% of the search results. Six clusters emerged from the revision of concurrent terms in the literature (Top Fig. 1). However, an overlapping occurred in three of them, conducting a definition of three final clusters, coinciding with Hallinger and Chatpinyakoop (2019) results. The first cluster corresponds to

P.M. Hernández-Diaz, J.-A. Polanco, M. Escobar-Sierra et al.

Table 1

Search criteria and the number of publications in WOS, KCI, RSCI, SciELO, and Scopus.

Search equation in the title of publications	Database	Document results	From
TITLE (((SUSTAINAB*) AND (Universit* OR Colleg* OR "HIGHER EDUCATION INSTITUTION*")))	WoS, KCI, RSCI, SciELO	1354	1987
TITLE (((("SUSTAINAB*") AND ("Universit*" OR "Colleg*" OR "HIGHER EDUCATION INSTITUTION*"))))	Scopus	2131	1985

Source: Prepared by the authors of this paper.

academic aspects (red and purple in Top Fig. 1) about ESD. It includes topics such as learning, technology, science, program, course, curriculum, faculty, engineering, skill, training and capacity. The second

cluster (i.e. green and blue in Top Fig. 1) is related to sustainability management in universities, encompassing two themes: campus operation and management processes. Issues such as buildings, energy efficiency, consumption, implementation, operation, production, waste, climate change and water are part of campus operation. Management process, instead, includes terms such as factor, tool, assessment, indicator, performance and report. The third cluster (yellow and blue in Top Fig. 1) denotes researching topics in ESDU. The co-occurrences are in student, knowledge, group, survey, awareness, engagement, attitude, perceptions, behaviours, culture, effects, questionnaire, literature, data and integration. Those are the most recent researching topics reported in the literature (Bottom Fig. 1-cluster yellow).

Articles for 'integration' were analysed to obtain an overview of how and where universities incorporate ESD. Those articles were extracted from the documents resulting from the literature review, using the words 'integration' and 'incorporation' in title, abstract, or keywords. Table 2 summarizes the result of the content analysis of the 130 resulting articles that emerged from the search regarding the incorporation of sustainability in universities.

Work related to sustainability incorporation in teaching and learning predominated, followed by management activities. Management activities include assessment, reports and ranking. Among them are the tools that can indicate what is being evaluated as sustainability in universities. Thus, from bibliometric results, the articles titled with 'assessment' were analysed to determine the existing tools used to assess sustainability at universities (see Table 3).

2.2. Sustainability assessment tools for universities

Several of the found works compared sustainability assessment tools (Alghamdi, den Heijer and de Jonge, 2017; Berzosa et al., 2017; Fischer et al., 2015; Yarime and Tanaka, 2012). Table 3 compiles 24 tools found in the literature. Among them, STARS had references as the most complete tool for measuring sustainability in universities (Alghamdi et al., 2017; Sayed et al., 2013). It covers management, academia, environment and engagement aspects. It has quantitative measurement and a qualitative component, allowing for selfmanagement and not just a comparison (Berzosa et al., 2017). Some rate STARS as one of the most transparent, comprehensive and detailed tools (Casarejos et al., 2017).

Despite the STARS' relevance, the literature references GRI as the most used tool (Berzosa et al., 2017). GRI mentions that 81 universities are reporting as of 2019 (GRI, 2019). Companies find universities with a GRI report to be innovative organizations for investment in research or other social financing (Alonso-Almeida et al., 2015). GRI has a modular structure that covers foundational aspects and environmental, social and economic topics. It is the only tool that considers in depth the economic aspects applicable to universities (Alghamdi et al., 2017). GRI does not have a higher education institution's supplement, but Lozano (2006) developed

GASU as a proposal to complement GRI with the academic components of the teaching-and-learning, research and social services. Bullock and Wilder (2016) found GASU as the best alternative for the evaluation of sustainability in universities.

The findings of the sustainability integration and assessment tools could indicate that sustainability is partially integrated into the universities' system with a gap in its administrative subsystem. Thus, Corporate Sustainability (CS) could help to integrate sustainability in this subsystem, because corporates lead in the incorporation of sustainability holistically compared to universities (Lozano et al., 2013b). Therefore, this research built its theoretical foundation choosing the following administrative theories that structure CS.

3. Theoretical foundation

Dyllick and Hockerts (2002, p. 131) defined CS as 'meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc), without compromising its ability to meet the needs of future stakeholders as well'. CS includes economic, social and environmental interrelations as they evolve through time in all the company's subsystems and its stakeholders. Thus, CS moves an organisation from a short-term, economic orientation to a holistic one (Chang et al., 2017; Hahn et al., 2015; Lozano, 2012, 2015; Roca and Searcy, 2012; Starik and Kanashiro, 2013; Vildåsen et al., 2017; Welford, 1993).

CS's temporal aspect, seen as future performance, is associated with the corporation's governance (Polanco and Ramírez, 2017). Thus, CS converges throughout the structure, strategy and management, operations and processes, supply chain, organisational culture, in its relationship with the environment, and within evaluation and communication to stakeholders (Lozano, 2012, 2015, 2018). Therefore, CS increases the organisation's performance (Annunziata et al., 2018; Rajnoha, Lesnikova, & Kraj\vc'\ik, 2017).

In this way, several authors have discussed the administrative theories that structure CS (Lozano et al., 2015). However, the most cited theories are Institutional Theory (IT), Stakeholders Theory (ST) and Resource-Based View (RBV) theory (Bansal, 2005; Chang et al., 2017; Daddi et al., 2018; Gauthier, 2013; Lloret, 2016; Montiel and Delgado-Ceballos, 2014; Polanco and Ramírez, 2017; Starik and Kanashiro, 2013; Upward and Jones, 2016). Table 4 shows how each theory could contribute to sustainability in universities.

Consequently, CS can contribute to the holistic integration of sustainability in universities. The administrative subsystem should be its primary focus. Nevertheless, since this subsystem serves the academic subsystem, the CS could end up improving the performance of both. But managers must be careful to not lose the main focus of the SC, because otherwise CS could lead to a misunderstanding of the priority of the university (i.e. its academic subsystem). With these theories, summed up by the literature review's results, the concept of university sustainability was structured to propose a measurement scale to integrate sustainability in universities holistically using the methodology described below.



Fig. 1. Map of knowledge for the incorporation of sustainability in universities. Bottom Fig. 1: overlay visualization by average publication year Top Fig. 1: a network visualization

Source: Prepared by authors using VOS viewer® software.

4. Methodology

The methodology used to structure the concept of University Sustainability (USus) was a sequential, mixed-method design. It started with a qualitative phase followed by quantitative analysis (Hernández-Sampieri et al., 2014). The qualitative phase used the theoretical thematic analysis method for social sciences. 'This is a method for identifying, analysing and reporting patterns (themes)

Table 2

Integration of sustainability in universities.

Searching keyword	Emerged categories	Emerged codes	Total papers	Total papers per category
INTEGRATIONa	Teaching & Learning ^b	Integration into curricula ^c	42	70
	5 5	Academic programs	3	
		Suitable pedagogy ^c	13	
		Learning Outcomes	9	
		Teacher training	1	
		Experience on campus	2	
		Voluntary programs	1	
	Research ^b	Solutions of SD problems	2	4
		in ESDU	1	
		Interdisciplinary	1	
	Outreach ^b	Alumni	2	4
		Community outreach ^c	3	
	Management	Campus management ^c	6	51
	-	Availability of social capital ^c	3	
		Awareness ^c	4	
		Institutional commitment	curricula ° 42 70 ams 3 gg ° 13 mes 9 g 1 ramsu 2 ramsu 2 ramsu 1 problems 2 y 1 y 1 y 2 immet ° 6 social capital ° 3 mmitment 6 blicy 6 social capital ° 3 gement ° 3 amplementation 6 amplementation 3 amplement ° 3 amplement ° 3 amplement ° 3 amplement ° 6 amplementation 3 amplement ° 3 <	
		Emerged codesTotal papersTotal papers perIntegration into curricula c4270Academic programs3Suitable pedagogy c13Learning Outcomes9Teacher training1Experience on campus2Voluntary programs1Solutions of SD problems241Interdisciplinary1Alumni24Community outreach c3Campus management c6Availability of social capital c3Awareness c4Institutional commitment6Declarations/policy6Barriers & drivers for implementation3Barriers drivers for implementation3Barriers & drivers for implementation3Barriers & drivers for implementation6Strategy2Planning for SD3Barriers-drivers6Welfare3Financial management c1Assessment reports & rankings7		
		Barriers & drivers for implementation	gration into curricula ° 42 70 lemic programs 3 3 lobe pedagogy ° 13 ning Outcomes 9 her training 1 rrience on campus 2 ntary programs 1 tions of SD problems 2 DU 1 disciplinary 1 nni 2 pus management ° 6 lability of social capital ° 3 reness ° 4 tutional commitment 6 arations/policy 6 iers-drivers for implementation 6 iers-drivers 6 fare 3 ncial management ° 1	
		Strategy	2	
		Planning for SD	3	
		Barriers-drivers	6	
		Welfare	3	
		Financial management ^c	1	
		Assessment, reports & rankings	7	

Elaborated by authors based on content analysis of the literature review.

^a integration of sustainability in universities

^b from Kapitulčinová et al. (2018)

^c accordingly with the eight factors of Chiong, Mohamad, & Aziz (2017)

Table 3

Sustainability assessment tools for universities.

Category/Name (Reference)	Responsibility					
	Academic staff		Management staff			
	Teaching	Research	Operations	Engagement & outreach	Administration incl. Assessment & reporting	
Assessment Instrument for Sustainability in Higher Education- AISHE 1.0 and 2.0 Adaptable model for assessing sustainability in HEIs - AMAS	Х	Х	Х	х	X X	
Alternative University Appraisal-AUA	Х	Х	Х	Х	Х	
Benchmarking Indicators Questions-Alternative University Appraisal-BIQ-AUA (2)	Х	Х	Х	Х	Х	
Education for Sustainable Development and Global Citizenship-ESDGC-Framework					Х	
Graphical Assessment of Sustainability in Universities-GASU-					Х	
Global Reporting Initiative-GRI- reporting standards					Х	
INDICARE model				Х	Х	
Sustainability Assessment Questionnaire-SAQ-(1)	Х	Х	Х	Х	Х	
Sustainability Tool for Assessing Universities' Curricula Holistically-STAUNCH	Х				Х	
Sustainability Literacy test- Sulitest (3)	Х					
Sustainability Tracking and Assessment Rating System (STARS)	Х	Х	Х	Х	Х	
Sustainability University Model- SUM - (2)					Х	
Sustainable campus assessment system- SCAS -(4)					Х	
University environmental management system- UEMS (2)					Х	
The green plan (2)					Х	
The program Sustainability Assessment Tool V2-Sustain-Tool (1)	Х	Х	Х	Х	Х	
Uncertainty-based quantitative assessment of sustainability for HEIs -UDSiM model					Х	
Unit-Based Sustainability Assessment Tool -USAT					Х	
University Environmental management System- UEMS (2)					Х	
GreenMetric-UI's GreenMetric University Sustainability Ranking-GM- (2)					Х	

Adapted from Kapitulčinová et al. (2018). Completed by authors with (1) (Berzosa et al., 2017), (2) (Alghamdi et al., 2017), (3) (Bullock and Wilder, 2016; Décamps et al., 2017). HEIs: Higher Education Institutions.

within data' (Braun and Clarke, 2006). As a recursive process, it allowed for the structure of themes and sub-themes using results from a literature review of ESD and the analysis of CS principles. Besides the analysis of literature from Table 2, the STARS-2.1-Technical Manual, the GRI Standards-2016 and GASU were the primary literature selected for thematic analysis because of their importance and relevance. Themes and sub-themes were subsequently operationalized to construct the perception survey for data

collection.

The quantitative phase covered data collection and analysis. The survey used for data collection sought to acquire the perception of sustainability practices. It consists of close-ended, multiple-choice questions with a 6-point Likert-type scale for the 32 items that resulted from the qualitative phase. The options for the answers were high, very, moderate, slight, not at all, and don't know (0). Researchers used Qualtrics software for the survey's design and

 Table 4

 Theories supporting the University Sustainability concept

Theorem Supporting the Oniversity Subunitability concept.								
Administrative Theory	Application for sustainability in universities	References						
RBV	Useful to understand the distribution and integration of work in the university, but keeping in mind that an organisation is more than an administrative unit.	(Conner and Prahalad, 1996; Penrose, 2009)						
ST	This theory allows one to understand how substantive functions and academic processes are structured and strengthened (based on their tangible and intangible aspects, human resources, organisational capital and organisational capacities). It allows one to recognize the stakeholder's relationship Allows managers to understand, holistically, how to interact with groups that influence or are influenced by the university. This understanding equilation a groater controliced control in the university.	(Fierro and Mercado, 2012) Freeman et al. (2004) Lozano et al. (2015)						
IT	It supports the university's political position and how it associates with organizations and government to fulfil its functions	(DiMaggio and Powell, 1991; Gauthier, 2013)						

Notes: Resource-Based View (RBV), Stakeholders Theory (ST), Institutional Theory (IT).

distribution. Mixing modes of the online data collection was done to improve answering effectiveness (Dillman et al., 2016), using the QR code directly on campus and customised emails with the survey link.

The survey was administered to undergraduate and graduate students, administrative employees, managers and teachers of two private, accredited universities in Medellin, Colombia. The selection of the universities considered the following aspects: having declarations about sustainability commitment, participation in the GreenMetric ranking, has a report of sustainability performance, but also, does not have funding from the state. An additional consideration was the facility to collect enough answers to achieve the validation of the developed instrument. One of these universities was Universidad de Medellin with a total population of 12.538 people (among students, administrative and academic staff). The other one was Universidad EAFIT with 15.871 people. Sample size (N) was 1799: there were 793 respondents from Universidad de Medellin and 1006 respondents from Universidad EAFIT. A total of 1064 students, 406 teaching staff, 303 administrative staff and 26 directors completed the survey. Data collecting was from April 30 to May 30, 2019. The Exploratory Factor Analysis (EFA) with Oblim's oblique rotation was the method used to calculate normality assumptions, adequacy and the validity of the questionnaire, while the reliability analysis used Cronbach's alpha following Field (2013) and SPSS software.

5. Results and discussion

This section comprises four subsections. The first one discusses the construction of the USus concept in terms of its name and structure; the second section discusses the sustainability measurement scale for universities using the results from USus; the third section discusses the model structure for university sustainability; the fourth section discusses the findings in the context of Latin American and private universities with the future recommendations previously done by other authors. Finally, the fifth section presents the limitations of this research.

5.1. The university sustainability concept-USus

The name 'University Sustainability' (USus) follows Lozano's (2018) suggestion to use the term 'organisational sustainability' instead of sustainable organisation. The term 'sustainable university' implies that a university is sustainable, which is impossible because of the intrinsic permanent change and evolution of sustainability (Lozano, 2018), and because it is a term which is continuously evolving (Kapitulčinová et al., 2018). Other authors have used 'university sustainability' but did not use a holistic

perspective for an organisation, which universities require. Isaksson and Johnson (2013) only tested students, while Shi and Lai (2013) focused on carbon management and climate change.

The construction of USus uses the whole-institution lens mentioned by Kapitulčinová et al. (2018). It encompasses all of the community to learn sustainability in a 'vivid' way, achieving and transforming a university from a business-as-usual university to university sustainability. Thus, to achieve holistic incorporation, considering all the components of the organisation, the USus concept was built by integrating ESD and CS notions. Fig. 2 shows the results of the thematic analysis. Two broad themes were the starting point of the USus concept: the academic and the administrative subsystems that form the university system (Gough and Scott, 2008).

The academic subsystem is shaped by teaching and learning. research, and extension or outreach, as Gough and Scott (2008) defined. Despite the universities' missionary functions. ESDU involves the incorporation of sustainability in operations (Leal Filho, 2011; Lozano et al., 2015). In this aspect, the literature highly references campus sustainability, leadership, reporting, stakeholders and assessments (Hallinger and Chatpinyakoop, 2019). Those topics and the CS's concepts (such as the temporal aspect reflected in future performance) and the university's governance formed the administrative subsystem. Consequently, the strategy-structure, networking, campus, governance, and assessment/reports configured the administrative subsystem. In this way, ESDU mainly structured the academic subsystem and CS concepts structured the administrative subsystem. The codes configuring the subsystems were outlined after defining each sub-theme. Those definitions are described below, and they were configurated mainly from STARS and GRI standards.

Teaching-and-learning: includes formal education programs and courses that promote in students 'the knowledge and understanding, skills and attributes needed to work and live in a way that safeguards environmental, social and economic well-being, both in the present and for future generations'(QAA-HEA, 2014, p. 5). It comprises academic processes, such as curricula integrity and flexibility, interdisciplinarity, teaching-learning methodologies, the assessment system, hidden curricula (campus as a learning laboratory), academic courses, and learning outcomes in sustainability (AASHE, 2017; Disterheft et al., 2016). This last-mentioned process includes the skills in sustainability, such as those defined by Rieckmann (2012), Barth (2013) and Wiek et al. (2011). As one of the university's primary functions (AASHE, 2017), teaching-and-learning seems to be one of the most active and influential issues in ESDU (Hallinger and Chatpinyakoop, 2019).

Research: embraces new knowledge and technological development, which contribute to solving problems in social welfare,



Fig. 2. Thematic map for USus concept.

Standards analysed: STARS*: 2.1-Technical Manual (AASHE, 2017), GRI** Universal, economic, environmental, and social standards 2016 (GRI, 2016). GASU***-GRI adjustment for universities, made by Lozano (2006).

STARS comprises four areas: Academics-AC- (it includes curriculum-AC1-to -AC8- and research -AC9-to-AC11-); Engagement-EN- (it comprises Campus engagement-EN1-to-EN9-, and Public engagement -EN10-to-EN15); Operations-OP- (it embraces Air & climate -OP1&OP2, Buildings -OP3&OP4, Energy -OP5&OP6, Food and dining -OP7&OP8, grounds -OP9&OP10, purchasing -OP11-to-OP14, transportation -OP15-to-OP18-, waste -OP19-to-OP21-, and water -OP22&OP23); Planning and Administration-PA (it includes coordination and planning-PA1-to-PA3-, diversity and affordability -PA4-to-PA7-, investment and finance -PA8-to-PA10, well-being and work -PA11-to-PA14); Innovation and leadership-IN (it was not included in this analysis because it is not explicitly described and are optional aspects. GRI embraces GR102-General disclosures, Series GR1200-Economic, GR1300-Environmental, GR1400-social Standards. GASU comprises Curriculum-CU, Research-RE and Community activity and service -SE.

economic prosperity and ecological health. It includes research that: 1. Explicitly addresses sustainability, and fosters an understanding of the interconnectedness of social, environmental and economic problems, or both; 2. Contributes directly to solving one or more of the leading sustainability challenges; and 3. Involves society (community, organizations, civil society, and industries) and the state to combine knowledge and actions that achieve results for sustainability (AASHE, 2017). Research and development in universities seem to have become the primary functions of many universities (MASHE, 2017); it could be due to the transition of universities' management to third-generation universities and the way in which the university acquires funding (Wissema, 2010).

Outreach: includes programs and projects that interrelate with the external sector (social, cultural, productive and governmental sectors) in all places where the university has a presence (CNA, 2013). They must contribute to the solution of regional, national and international problems that are raised by sustainability. It includes all continuing education courses and programs that help develop knowledge of particular issues of sustainability, which are offered to university and community members and the external sector. These courses and programs do not have academic credits. (AASHE, 2017). It also includes all programs that engage the university's members to serve in the internal and external communities for sustainability issues, and the communication and disclosure of sustainability practices (Lozano et al., 2013b).

Strategy and Structure: It contemplates both the superior

purpose definition and the management of resources and capabilities to achieve the university's three substantive functions. It is reflected in the definition of the mission, vision, strategic and operational plan, budget, human talent management (teachers and administrative staff), students, process map, and organisation chart. Sustainability would be declared in the superior purpose and would benefit from the resources and capabilities of the organisation, to be put into practice (AASHE, 2017; GRI, 2016). It includes the four aspects described by Aleixo et al. (2018): environmental, economic, social/cultural and institutional/educational/political.

Networking: It is the cooperation with institutions and programs, nationally and internationally (CNA, 2013). In some cases, it may include the training and development of skills and abilities on sustainability issues in the global and local context in the university's community (AASHE, 2017). It can also include activities such as teaching, research, extension, internships, short courses, exchanges, and collaborative work. Networks can also evolve into partnerships (Razak et al., 2013), and they 'can support bottom-up and top-down development of both policy and practice for sustainable development implementation in higher education nationally and internationally' (Vargas, Lawthom, Prowse, Randles and Tzoulas, 2019a, p. 738).

Campus: It embraces all activities related to an efficient and safe campus operation in terms of infrastructure, environmental legislation and human well-being. Infrastructure includes energy, air and climate change, sustainable buildings, food and restaurant services, landscape and biodiversity, sustainable purchases, transportation and commuting, waste and water management. Wellbeing includes components such as university's community health, safety, equity, diversity and welfare (AASHE, 2017; GRI, 2016). The main areas documented for ESDU includes infrastructure and environmental legislation (Kapitulčinová et al., 2018; Lozano, 2018; Müller-Christ et al., 2014; Waas et al., 2010). However, human well-being has been more related to CS, and GRI standards documented them more widely than ESDU (Agostino and Dal Molin, 2016) assessment tools.

Governance: It refers to the organisational approaches which result from the participation, deliberation and negotiation between agents to achieve sustainability (Polanco and Ramírez, 2017) at the university. Committees, workshops, norms, agreements, protocols, and policies, amongst others, materialise in governance (Larrán et al., 2015). This component has been researched and implemented in a minor way in universities (Larrán et al., 2015; Vargas, Lawthom, Prowse, Randles and Tzoulas, 2019b). Governance is the area that is reported to present the highest obstacles to implementing sustainability in universities, thus 'universities should establish formal structures to guide the implementation of SD policies and programmes, with specific personnel, instead of trying to pursue them on an ad hoc basis' (Leal Filho et al., 2017, pp. 103–104).

Assessment and reports: These cover the verification and adjustment processes used to achieve the university sustainability's activities and goals. It embraces accountability for self-evaluation purposes. Standards, metrics and improvement plans materialise this area (AASHE, 2017; GRI, 2016).

After analysis of STARS, GRI and GASU, 39 codes emerged. Fig. 2 shows the corresponding standard component for obtaining more details about what characterises each code. Although universities use the GRI to a great extent, the thematic analysis could prove that the GRI does not consider the missional functions of universities (Bullock and Wilder, 2016). Thus, GASU was useful to analyse them, but it has still uncovered some relevant issues, such as communication.

USus can be proposed to be 'the contributions of the [universities] to sustainability equilibria, including the economic, environmental and social dimensions of today, as well as their contributions within and throughout the time dimension' Lozano (2018, p. 16). The USus concept map could contribute to the universities' institutional strategy (Zhao and Zou, 2015) and to obtaining sustainability in a more integrated, organisational structure (Amaral et al., 2015; Lukina et al., 2017).

5.2. The sustainability measurement scale for universities

Codes determined by thematic analysis (Fig. 2) were condensed into an instrument to measure USus. Three academic experts, familiarised with sustainable practices at universities, validated the survey. Then it was distributed to five professionals in research methods. Table 5 outlines the measurement's scale of sustainability at universities after feedback and adjustments.

5.2.1. Responses' frequencies

Fig. 3 summarizes the response frequencies for the measurement scale applied, in both Colombian private universities.

This figure relates, for each question code (32 items of the USus Measurement Scale), the percentage distribution of the obtained answers, classified according to the 6-point Likert scale.

A brief overview of Fig. 3 reveals that most of the respondents do consider that their universities incorporate sustainability in both subsystems in a proper manner. It seems that the aspects more susceptible to improvement (i.e. those summing more than 20% for

the three lower rates) are in the occupational health and transport & commitment areas in the administrative subsystem, and in research in the academic subsystem. There seem to be many drivers in these universities that conduct the appropriation of sustainability. However, many respondents do not have information regarding several aspects, which could become opportunities for improvement; perhaps most of them could be due to a lack of communication about the activities or achievements. Some of the highest opportunities (i.e., those with more than 20% for the 'don't know' answer) to communicate are the efforts and achievements in the certifications and rankings, the extracurricular activities and social services to the community, the participation in policymaking, the duties concerning the environmental management and campus operation.

There seems to be a lack of academic programs in sustainability in these universities. It could become an opportunity and a challenge, or it may reflect local needs or demands in other aspects of training, as suggested by Hallinger and Chatpinyakoop (2019) because of the scarcity of literature from developing countries. Thus, this becomes another topic to research further.

The highest satisfaction with the administrative subsystem seems to be in the aspects of governance and responsible investment, with the most relevant being the management of ethical and corruption aspects, the access to information, and the thrust in the decision bodies. For the academic subsystem, the more relevant aspects are the development of skill and learning outputs for sustainability and the external consultancy. Most of these aspects are highly concerned with the social component of sustainability. Therefore, it could demonstrate the importance of a holistic model of sustainability incorporation in universities, transcending the environmental aspects. Theoretically, these are the prior aspects in CS (Loorbach, 2010; Polanco and Ramírez, 2017) and ESDU, respectively (Hallinger and Chatpinyakoop, 2019; Kopnina and Meijers, 2014; Leicht et al., 2018).

Finally, although surveyed universities have sustainability commitments, the results seem to indicate the absence or lacking recognition of a coordinator for sustainability identified in the organisational chart, which integrates all areas of the university. It could reflect the need for establishing formal structures with qualified personnel that guide sustainability implementation correctly, as suggested by Leal Filho et al. (2017). Further research could help to understand the importance of this position in this sort of organisation. They have the particularity of having two subsystems with their proper management structures, which should be systemically integrated to get all the benefits from the CS perspective (Haffar and Searcy, 2017) and to fulfil the challenges that universities have in contributing to the achievement of sustainable development (Findler, Schö;nherr, Lozano, Reider and Martinuzzi, 2019; UNESCO, 2017).

5.2.2. Construct validity

This research used Exploratory Factor Analysis (EFA) to determine the questionnaire's validity on the 32 items. Correlation analysis suggested the use of principal component analysis and oblique rotation (direct Oblim) (Field, 2013). The Kaiser-Meyer-Olkin measurement verified the sampling adequacy for the analysis. KMO = 0,951 indicated excellent sample size according to Field (2013). All KMO values for individual items were >0.9, which is well above the acceptable limit of 0.5 (Field, 2013). The determinant and validity test showed a high correlation between factors without collinearity. Table 6 shows that all items loaded with more than the acceptable loading factor of 0.4 (Field, 2013); thus, all 32 items were retained.

Table 5

USus measurement scale.

Code	Item	Relation with themes in Fig. 2		
US1	In our university, sustainability is part of its strategic planning (i.e. mission, vision, institutional educational plan or strategic plan)	Sustainability in strategic planning	Strategy	Administrative
US2	In our university, there is a coordination of sustainability (committee, office or person), identified in the organisational chart which integrates all areas of the university	Sustainability in Organisational structure		
US3	In our academic programs, students acquire sustainability skills such as systemic thinking, critical thinking, teamwork, solving sustainability problems, a vision of the	Learning outputs-Skills	Teaching & learning	Academic Subsystem
US4	In our academic programmes, students learn about sustainability topics	Curricula integration		
US5	Our institution offers academic programs in sustainability	Academic programs		
US6	Within the subjects, the campus serves to learn about sustainability practices	Campus as a learning laboratory		
US7	Our university promotes interdisciplinary research projects that contribute to	Interdisciplinarity Solving SD challenges and	Research	
1100	sustainable development	Address sustainability understanding	o	
US8	There is an offer of continuing education courses in sustainability	Continuing education in sustainability	Outreach	
039	our university provides services to the community to improve their quality of me (e.g.,	service to community programs for external		
US10	Our university does external consulting on sustainability issues	Consultancy in sustainability for		
UC11	Our university activities in the greation of public policies at the local regional	Organizations		
0311	national or international level	Participation in policymaking		
US12	Our university communicates to the community the information on the sustainability practices adopted (i.e. through the institutional website, campaigns, posters, etc.)	Internal and external communication		
US13	Our university participates in sustainability networks	Networking for sustainability	Networking	Administrative
US14	Our university has inter-institutional agreements to develop collaborative activities in sustainability	Cooperation agreements		Subsystem
US15	Our University's Environmental Management Program includes aspects such as water consumption and reuse, waste minimisation and separation, and efficiency in energy consumption (air conditioning and lighting)	Environmental management program	Campus	
US16	The campus buildings have been designed and built under sustainability guidelines	Sustainable infrastructure-energy management		
US17	Our University's Landscape and Biodiversity program includes maintenance of gardens with integrated pesticide management; care, conservation and protection of ecosystems, fauna and flora	Landscape and biodiversity management		
US18	Our university promotes purchasing and consumption of organic food, locally	Sustainable food and dining Sustainable		
11010	produced, with green certifications or fairly marketed	purchasing Transport and commuting		
0319	own vehicles			
US20	Our university investments are socially and environmentally responsible	Financial resources-responsible investment	Strategy	
US21	Our university has a dependency that ensures equity, inclusion and human rights for	Human resources management	strategy	
	students and employees	(Affordability, access, development) Equity and inclusion		
US22	Students and employees participate in the university's well-being programs	University welfare		
US23	Induction programs to the institution include indications to the university's	University welfare		
1100.4	sustainability practice	way that shows that		
US24	Students participate in extracurricular activities that promote sustainability on campus, such as gardens or sustainable agriculture on campus, conferences or events, outdoor programs	Extracurricular activities in the campus		
US25	Health and prevention campaigns are carried out, such as safe work practices, risk or disease prevention, among others.	Health and safety		
US26	Information about our university is openly accessible	Open access to information	Governance	
US27	There is confidence in our university's decision-making bodies, such as Academic	Trust in decision-making bodies		
	Council, school Faculty or Council			
US28	Institution's values, principles, standards and norms of conduct are explicit in our university's regulations	Normativity		
US29	Our university has advisory and intervention mechanisms for cases of ethical problems and corruption	Ethics and corruption		
US30	Our university carries out Sustainability Reports	Reports	Assessment	
US31	Our University participates in sustainability rankings or league tables	Rankings	& Reports	
US32	The university has sustainability certifications in environmental, social or economic topics (i.e., ISO14000, carbon footprint, Global Compact, financial certification - credit risk, among others)	Reports		

Notes: US: University Sustainability.

The survey was written and distributed in Spanish.

5.2.3. Reliability analysis

This research used Cronbach's alpha coefficient and factor loadings to measure the sustainability measurement scale's reliability. Cronbach's $\alpha = 0.927$ indicated excellent reliability (Field, 2013). Although the individual component analysis showed a low value for component seven, all items in the survey were maintained because each factor had a Cronbach's close to or above 0.6 (Field, 2013).

Table 6 shows that eight components emerged from the EFA. The items clustering the first component grouped the items related to the academic subsystem of research and outreach and one item from the teaching theme. Component two represents the governance, component three the teaching aims, component four the campus operation, component five grouped the items for assessment and reports, component six clustered items about social health and security, component seven relates to strategy and



Fig. 3. Responses' frequencies for Universidad de Medellin and Universidad EAFIT- Medellin Colombia.

structure, and finally component eight clustered the networking items.

The component's mean and the item's load for each component suggest, in terms of university sustainability, the relevance of the assessment and report for the university's community (i.e. students, directives, academic and administrative staff), followed by the campus operation and the academic subsystem as the mission of the university and its critical contribution to sustainable development. The literature highly recognises the importance of the campus in the ESDU; in this research it also has a high component's mean, but its items had a moderate to light qualification (the reader can observe the mean's column in Table 6).

The consequential finding of this research is the high relevance of the social issues in the surveyed universities. Social health, justice and security are topics that do not appear in the latest literature reviews in ESDU worldwide (Findler et al., 2019; Hallinger and Chatpinyakoop, 2019), but they are in the CS literature and the topic of university social responsibility (Leal Filho et al., 2019). Items in components two and six are amongst the items with the highest individual mean and the lowest standard deviation, despite having a high component load mean. Therefore, these results could open a new research window to give an idea of the differences amongst research priority issues or needs for universities between developed and developing counties (Hallinger and Chatpinyakoop, 2019). Another relevant finding is the low qualification for strategy and structure, mainly for sustainability coordination. It does not seem clear whether there is a person or group that embraces sustainability holistically in these institutions or even if they have sustainable declarations or commitments. This findings support the analysis in section 5.2.1.

Finally, these results show that the instrument developed is a comprehensive measurement that could fit the universities' context holistically and support the construction of the university sustainability model with a whole institution perspective.

5.3. The model structure for university sustainability

The results of Table 6 fully proved the validity of the measurement scale. However, an EFA is not enough evidence to structure a model, since the thematic analysis suggested a theoretical structure for the USus model (Sarstedt et al., 2017). Thereof, Fig. 4 shows this theoretical model. However, it must be proved to avoid errors in its future analysis, such as error Type I and II reported by Diamantopoulos and Siguaw (2006). Authors suggest this analysis as further research with other statistical methods, such as structural equation modelling.

The model for USus allows one to understand the elements that compose the 'whole-institution perspective' of sustainability at universities, filling the gap found by Lozano (2018), Lukina et al. (2017) and Kapitulčinová et al. (2018). The first part of this perspective is to understand that it intrinsically includes the interconnectedness and interdependence of four components: the social, environmental, and economic components of sustainability (AASHE, 2017) and the components of the university system from the CS perspective (Engert et al., 2016; Lozano, 2018).

The model integrates ESDU in their university's missional

Table 6

Summary of exploratory factor analysis results for the SPSS University Sustainability questionnaire (N = 1799).

Structure Matrix

Item	Component load						Mean	St.		
	1	2	3	4	5	6	7	8		Dev
Consulting	.728	.184	.227	311	.472	.222	.207	430	1.696	2.112
Continuing education	.708	.144	.346	281	.388	.233	.335	163	1.888	2.085
Participation in policy	.686	.312	.134	352	.372	.170	.060	309	2.212	2.162
Academic programs	.633	.059	.542	217	.394	.289	.327	020	2.028	2.005
Communication	.607	.341	.315	402	.455	.377	.182	110	2.777	1.984
Interdisciplinary research	.437	.252	.435	352	.291	.406	.185	358	2.863	1.988
Internal regulations	.227	.757	.200	236	.203	.320	.095	065	3.886	1.685
Trust in decision bodies	.230	.750	.336	313	.302	.305	.081	114	3.477	1.779
Ethics and corruption	.275	.641	.314	377	.371	.088	.072	311	2.993	2.116
Open access to information	.220	.569	.249	344	.320	.297	.208	.087	3.615	1.753
Social services to the community	.411	.534	.126	257	.301	.399	174	.052	3.687	1.816
Learning	.232	.205	.861	296	.266	.249	.188	154	3.118	1.669
Skills	.143	.308	.806	259	.221	.209	.145	163	3.487	1.573
Campus as a learning lab	.479	.101	.719	355	.340	.344	.280	206	2.438	1.866
Buildings	.326	.215	.296	741	.320	.219	.256	245	2.761	1.996
Environmental management	.344	.270	.322	737	.433	.187	.178	165	2.764	2.048
Land and biodiversity	.220	.156	.167	646	.259	.486	.233	191	3.382	2.072
Transport	.247	.467	.360	645	.262	.260	090	047	3.494	1.619
Responsible investment	.260	.418	.253	566	.346	.280	.365	437	2.808	2.100
Equity-inclusion-HR	.242	.448	.281	509	.362	.272	.400	340	2.785	2.095
Purchasing and feeding	.154	.084	.304	498	.314	.440	.371	264	2.585	1.922
Sustainability rankings	.344	.160	.179	216	.855	.229	.175	261	1.645	2.155
Sustainability report	.446	.260	.235	331	.808	.168	.210	191	1.926	2.170
Sustainability certifications	.263	.201	.258	315	.792	.205	.217	278	1.685	2.153
Welfare	.282	.482	.221	284	.260	.713	.007	088	3.707	1.610
Extracurricular activities	.259	.196	.420	314	.359	.704	.294	234	2.982	1.864
Occupational health	.313	.502	.301	449	.303	.548	087	061	3.679	1.648
Induction	.290	.173	.336	400	.390	.501	.377	395	2.305	2.013
Sustainability coordination	.355	.210	.299	264	.389	.231	.765	191	2.269	2.087
Sus. In Strategic Planning	.315	.470	.296	417	.342	.257	.484	102	3.484	1.793
Cooperation agreements	.474	.163	.355	294	.516	.278	.209	755	1.747	2.123
Networking	.412	.163	.341	313	.578	.312	.236	691	1.893	2.144
Component mean	.361	.319	.339	.384	.393	.319	.212	.225		
Eigenvalues	10.136	2.096	1.570	1.207	1.032	.944	.902	.843		
Percentage of variance explained	31.676	6.550	4.906	3.773	3.225	2.949	2.817	2.634		
Reliability (Cronbach's Alpha)	.781	.746	.760	.788	.772	.686	.571	.807		

Note: component load >0.4 are in bold. St. Dev: Standard deviation.

functions for the academic subsystem. Here, it highlights all the research and improvements in teaching-and-learning and outreach with direct training in SD issues, which allow students 'to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future' (Leicht et al., 2018, p. 34). This subsystem directly impacts learners (Hallinger and Chatpinyakoop, 2019), with teaching-and-learning being one of the most current issues of interest among ESD literature with its component of competencies for sustainable development (Hallinger and Chatpinyakoop 2019). Research has a relevant contribution to sustainable development in two directions: the incorporation of sustainable development within the university system and the contribution of the university system to the achievement of sustainable development (Findler et al., 2019; Leicht et al., 2018; UNESCO, 2017).

The administrative subsystem tackles several aspects. One is the relation with the academic subsystem. This subsystem should serve the academic individuals (Arif, 2016; Gough and Scott, 2008; Miller, 2016); thus, it should envision and supply all the training, resources and capabilities to the students and academic and research staff to face the challenges to incorporate ESDU and have a campus that reflects its commitment with it. It means that the academic subsystem gives the inputs as well as the external environment and global trends (Kapitulčinová et al., 2018) to the administrative subsystem; hence the arrow from the academic to the administrative subsystem in Fig. 4. However, all the centres or dependences that provide the services must also incorporate sustainability

within them (i.e., human and ecological health, social justice, secure livelihoods, and economic issues (AASHE, 2017; GRI, 2016)). Another aspect of this subsystem is the management aspect. Sustainability management in universities is popular amongst publications about ESDU (Hallinger and Chatpinyakoop, 2019). It is mainly focused on campus operations, but rarely on issues of organisational management, such as the relationship of performance and sustainability. Campus operations act as a hidden curricula or informal learning in ESDU (Kapitulčinová et al., 2018). Tools such as STARS incorporate social issues in social health, justice and security (AASHE, 2017), and some works mention barriers and drivers for organisational change (Barth, 2013; Blanco-Portela et al., 2017; Hoover and Harder, 2015; Verhulst and Lambrechts, 2015). Nevertheless, the literature does not reference their benefits to financial or other issues that are considered in CS. Hence, topics such as governance, internal stakeholder engagement, human resources, assessment and communication, which are common in CS literature (GRI, 2016; Loorbach, 2010; Lozano, 2018), are not well considered in ESDU's literature (Findler et al., 2019; Hallinger and Chatpinyakoop, 2019). This model integrates these concepts into the administrative subsystem. Thus, one would expect that this subsystem gives the holistic view of the university as a system, which goes further than having a statement, a commitment, or a policy to operate the campus with environmental considerations.

The literature reports that CS measures the effect that economic,





social and environmental aspects (and their interrelationships) have on corporate performance (Polanco and Ramírez, 2017). Several researchers found that CS increases business performance (Annunziata et al., 2018; Engert and Baumgartner, 2016; Rajnoha et al., 2017). However, to measure this effect on the university performance, whether it is positive or negative, this performance should be understood from a 'whole-institution perspective' as well. This analysis can shape further research still unexplored in this type of organisation.

Broadly, this research contributes to the current discussion on how sustainability can be more holistically integrated within universities. This research is the first attempt to integrate CS in universities, thereby contributing to transcending ESDU into University Sustainability, which is not referenced yet as an organisational sustainability paradigm (Lozano, 2018).

5.4. Discussion of findings in the context of Latin American and private universities

Considering that the validation and frameworks proposed in this work were developed in private universities in Colombia, it was sought to discuss how the Colombian's reality could represent other realities. This analysis was done by cross-referencing the results and the new contribution bases and added values of this work, with future work suggested and findings of other authors and reported in the literature in both private universities and Latin-American universities. (previously reviewed in the introduction).

Into the Colombian universities' realities is the incorporation of sustainability in both subsystems, as could happen in other private worldwide universities. This trend could be seen in the Green-Metric structure and results, such as other assessments (Kapitulčinová et al., 2018). For the administrative subsystem, there are common realities, in several aspects reported in the literature, for private universities, such as in the environmental and the strategic-structure components. Leal Filho et al. (2020) found a weaker promotion of sustainable food and diet practices in Brazil, Mexico and other private universities worldwide. These authors suggested to identified the special features of these aspects to encompass them more on sustainability efforts. Another finding is the lack of assertiveness in transportation and commuting. Despite the efforts to promote cycling or other clean alternatives, it seems to be a trend in countries with Geographical difficulties such as Ecuador and Colombia permeated with the Andes and other mountains that make students and staff use their own vehicle (Velasco et al., 2018).

On the other hand, Govindaraju et al. (2018) found throughout perception research in private universities in Malaysia, the following five practices of sustainability, by order of importance: staff's motivational factors (rewards and promotion), staff's encouraging aspects, staff and student's welfare and wellbeing, training for academic and admin staff, and, staff and students health. In this research, Fig. 3 shows that occupational health, induction, welfare, and equity-inclusion-human resources, had a high score in the community's perceptions. It could suggest that the social components are a reality in private universities as an important aspect and form the appropriate group in the university sustainability model's strategic-and-structure component.

The literature reveals, such as this study did, that the high level of perception about sustainability in the administrative subsystem from private university's community is because of the active campus sustainability engagement by university management (Leal Filho et al., 2020). Therefore, the reality shows that universities need to decentralize sustainable plans and decision-making to students, staff, and faculty (Wang et al., 2020).

For the high positive aspects into the administrative subsystem such as governance and responsible investment, comprising mainly management of ethical and corruption aspects, the access to information, and the thrust in the decision bodies, no references were found in the literature in Latin American or private universities in developing countries in the context of sustainability integration.

About the academic subsystem, as this research showed, there is a weakness in research (Leal Filho et al., 2020) and a lack of academic programs in sustainability (Wang et al., 2020) in other private universities. Thereof private universities need to integrate into the curriculum and academic projects more sustainability-related context. Likewise. Blanco Portela et al. (2020) found that in Chile. Colombia and Perú, a barrier that needs to be overcome is the need to have stable teachers' teams to incorporate academic programmes in sustainability to encourage the changes to be genuinely structural and lasting over time. In these countries, it was found that despite institutional support from rectors, this challenge needs additional support from deans and academic authorities of departments to keep the academic staff motivated and interested in ESD transcending and reaching the classrooms. Similarly, Acosta et al. (2020) found in two private universities in Bogotá-Colombia into the environmental engineering undergraduate programs that a low percentage of the curricula (5%) in Colombia and Latin-America universities include aspects about environmental education and technical knowledge in sustainability technologies and management. Reinstorf et al. (2019) concluded that Ecuador and Cuba universities' higher education curricula do not include water resource management aspects from local-to-global scales.

The above findings could represent the Latin-American reality about the gap of a strategic, systemic appropriation and implementation of sustainability in the academic subsystem. However, similar results and suggestions are even reported in countries such as Turkey, where "sustainability needs to be integrated into teaching and curriculum through university policies and regulations" considering that "[private] universities show greater effort in sustainability reporting than public universities" (Son-Turan and Lambrechts, 2019, pp 1143).

Precisely, the communication of results in sustainability reports, certification and rankings emerged in this research as an opportunity. In the assessment study made by Velasco et al. (2018) arose the need for Latin-American universities to have a guideline for benchmarking that offers comparable results or clear instructions. Although the research was in Ecuador, the analysis covered the attempted methodologies reported in the literature for Latin-American countries referencing only three Countries: Brazil, Mexico, Colombia but all failed (Velasco et al., 2018).

Into the academic subsystem, some of the highest opportunities that emerged were the extracurricular activities and social services to the community, including policymaking. Velasco et al. (2018, pp734) suggested from their research that universities in Latina America "must be at the forefront for developing relevant technologies and policies and pushing for existing ones in the local context to be implemented". Other issues, such as cooperation agreements, were not found in the literature in Latin American or private universities in developing countries in the context of sustainability integration.

Finally, the results in the two Colombian universities agree with some authors' suggestions

previously reviewed in the introduction and disagrees with others. Expressly, they agree with Benayas and Blanco-Portela (2020) when they referred to Latin American universities to contribute to the regional and global agenda through sustainability. The comparative analysis of two Colombian universities conducted in this research (Berzosa et al., 2017) through a hybrid framework that considers different sustainability frameworks (Alonso-Almeida et al., 2015), gathering data between academic and administrative staff, and students in Colombian universities (Aleixo et al., 2018), as others authors suggested. The results reflect Colombian universities' cultural and social features and their impact on sustainable development (Findler et al., 2019) while recognized Colombian universities consumers as actives players (Guzmán-Valenzuela, 2016a,b).

On the other hand, the results and particularly its scope, do not match some authors' proposal. For example, during the sustainability implementation of this initial phase, local communities were not included, as Agostino and Dal Molin (2016) recommend. Moreover, the authors expect that the findings will support universities continuous improvement in the future, specifically, those related to ecological and social challenges (Casarejos et al., 2017), but they have not verified it yet (Alghamdi, den Heijer and de Jonge, 2017). Finally, we recognize the research results' limited scope (Escobar-Sierra, Lara-Valencia, & Valencia-DeLara, 2021) because it only considers two Colombian universities. However, this is the first Latin-American universities case, and with more empirical cases, it can be generalized (Hoon, 2013).

5.5. Limitation and further research

The measurement scale developed in this study demonstrated high reliability and assessed a holistic construct of sustainability in universities. The empirical validation used directors, administrative and teaching staff, and under and postgraduate students' perceptions of two private universities in Medellin, Colombia. These results could be helpful in understanding knowledge of ESDU in developing countries, where little research is reported (Hallinger and Chatpinyakoop, 2019). Despite that the instrument was made using international and proven standards, it could be improved by involving more universities in order to verify the results. Thus, the instrument could be applied to other universities, nationally and internationally, to verify its validity and reliability. Nevertheless, the measurement model can be proved to verify differences between universities and stakeholders.

The differences of the components' loading means, individual item's mean, responses frequencies, and the item's standard deviations suggest the relevance of research in the differences amongst the internal stakeholders (i.e. university's community). While universities worldwide are increasingly assuming a selfreflective stance regarding their role towards more sustainable societies, one starting point is to assess the meanings that enrolling students and permanent staff give to sustainability. This analysis could help in the understanding of the priorities, drivers and opportunities in implementing the university sustainability system in developing countries. From the sustainability perspective, a stakeholder analysis could help to assess staff functions and the perceptions of those functions by others. The results also suggest researching the differences between private and public university sustainability assessment, since this research only embraces two private universities.

It appears that Colombia's results could represent other realities in Latin-American, and other developing countries universities, in the social, strategic-structural component aspect in the administrative subsystem, the academic subsystem, and the differences between sustainability integration in private and public Colombian and Latin-American universities but further research is needed due to insufficient evidence in the literature.

This research is the first attempt to integrate and visualise the integration of sustainability from a whole-institution perspective in universities integrating EDSU and CS. However, the researchers may have missed some aspects, practices, issues or topics. The model presented is not a final model, but an attempt to integrate activities, frameworks and approaches found in the literature, and thus it should be proved. The empirical data of this research can be used with its limitation of the Colombian context. Sustainability is an evolving approach; therefore, new research findings (i.e. activities, tools, methods, frames or approaches) could improve the subsystems of university sustainability. The research motivates further study that can contribute to completing the USus concept or model and its measurement scale. Further research could also prove the interrelation of the USus components to find the incidence of sustainability in a university's performance.

Another suggestion for further research is to link this model with the implementation or contribution to the Sustainable Development Goals (SDG) in universities. Alternative representations of sustainability and SDGs may emerge top-down and bottom-up; if the university is not yet perceived as a community where sustainability can be enacted and not just taught, these representations could affect the way a new generation of students will face the challenges posed by sustainability, and show the importance of creating explicit space for open debate about these issues in universities, beyond the normal routines of academic courses.

6. Conclusion

This research aimed to propose an integration of sustainability throughout the organisational system, considering existing tools and frameworks, and proving a theoretical proposal in an empirical context. After thematic analysis, the University Sustainability (USus) concept was developed, complementing existing tools such as STARS and GRI. The measurement scale for USus had 32 items formed with the codes obtained, and it was validated.

USus integrated ESDU and CS concepts by considering the academic and administrative subsystems in the university's system. Thus, USus covered teaching-and-learning, research, and outreach from ESDU, which are in the academic subsystem. The administrative subsystem was comprised of campus operations and networking from ESDU, and strategy-structure and governance from CS. However, both subsystems shared the assessment-reports component.

The USus concept development is the originality and value of this research, supported by its (1) rigorous and eclectic procedures, using a sequential mixed method that combines positivism and interpretivism paradigms, (2) empirical verification, where researchers tested the proposed sustainability measurement scale in two Colombian universities, (3) potential implications for practitioners, as the developed sustainability measurement scale was empirically verified, and in the future could be applied in other universities, and (4) reliability of results, as the researchers empirically proved the theoretical proposal for USus with statistic techniques like EFA and alpha coefficient as facts that reinforce the empirical and theoretical contribution of this research. The consideration of corporate sustainability to understand the administrative subsystem, which is oriented to the organisational performance, is a noteworthy theoretical contribution that contributes to the originality and value of this research. Additionally, this research allowed for empirical evidence from the studied universities with the relevance of corporate sustainability and social issues within the developed university sustainability concept. These findings also contribute to understanding the priorities of integrating sustainability in Latin-American universities and private. Universities.

Some of these priorities comprise (1) the need of having a guideline for benchmarking that does offer comparable results or clear instructions, (2) the need of communicating the effort in the implementation and the results in sustainability reports, certification and rankings, (3) more programs in sustainability, motivated by deans and head of departments, empowering a stable academic staff which propose projects in a more sustainability-related context, (4) decentralize environmental management plans and sustainable decision-making to the entire university's community, (5) contribute with society developing relevant technologies and policies, (6) promotion of sustainable food and healthy diet practices and (7) assertiveness in transportation and commuting systems.

It is important to highlight the potential incidence of these research results to policymakers, who can introduce significant organisational changes according to the results from the USus Measurement Scale. Accordingly with this research, they could have an impact on the efforts of the administrative subsystem (i.e., its dependencies) by incorporating sustainability after considering its aims in the contribution to ESDU as an informal syllabus or program, and improving the performance of the university seen as a system, which means in the university's missional functions and their managerial components.

Finally, this study empirically validated an instrument for measuring sustainability from a whole-institution perspective at universities. Consequently, this measurement scale could help in future studies to improve the understanding of sustainable development implementation in higher education. This paper provides a starting point that regards universities as an organisational sustainability paradigm. However, further work is needed to understand the relationships among its components and other contributions in the universities' organisational aspects, such as performance.

CRediT authorship contribution statement

Paula M. Hernández-Diaz: Conceptualization, Software, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Visualization. **Jorge-Andrés Polanco:** Conceptualization, Methodology, Resources, Writing – review & editing, Supervision. **Manuela Escobar-Sierra:** Methodology, Software, Writing – review & editing. **Walter Leal Filho:** Validation, Writing – review & editing.

Declaration of competing interest

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

Acknowledgments

The authors would like to thank Universidad EAFIT and

Universidad de Medellín who supported this research project. They also want to thank all the valuable contributions and suggestions made by the reviewers that helped to improve this work.

References

- AASHE, 2017. STARS Technical Manual. Version 2.1. Administrative Update Three (2.1 ed.). Retrieved from. https://www.aashe.org/wp-content/uploads/2017/07/ STARS-2.1-Technical-Manual-Administrative-Update-Three.pdf.
- Acosta, P.M., Queiruga-Dios, A., Hernández Encinas, A., Acosta, L.C., 2020. Environmental education in environmental engineering: analysis of the situation in Colombia and Latin America. Sustainability 12 (18), 7239.
- Adomssent, M., Godemann, J., Michelsen, G., 2007. Transferability of approaches to sustainable development at universities as a challenge. Int. J. Sustain. High 8 (4), 385–402. http://doi.org/10.1108/14676370710823564.
- Agostino, D., Dal Molin, M., 2016. A grid approach to managing sustainability: evidence from a multiple Italian case study. Int. J. Sustain. High 17 (6), 875–894. https://doi.org/10.1108/IJSHE-11-2014-0160.
- Aleixo, A.M., Azeiteiro, U., Leal, S., 2018. The implementation of sustainability practices in Portuguese higher education institutions. Int. J. Sustain. High 19 (1), 146–178. https://doi.org/10.1108/IJSHE-02-2017-0016.
- Alghamdi, N., den Heijer, A., de Jonge, H., 2017. Assessment tools' indicators for sustainability in universities: an analytical overview. Int. J. Sustain. High 18 (1), 84–115. https://doi.org/10.1108/IJSHE-04-2015-0071.
- 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/10.1016/j.jclepro.2014.02.008.
- Amaral, L.P., Martins, N., Gouveia, J.B., 2015. Quest for a sustainable university: a review. Int. J. Sustain. High 16 (2), 155–172. https://doi.org/10.1108/IJSHE-02-2013-0017.
- Annunziata, E., Pucci, T., Frey, M., Zanni, L., 2018. The role of organizational capabilities in attaining corporate sustainability practices and economic performance: evidence from Italian wine industry. J. Clean. Prod. 171, 1300–1311. https://doi.org/10.1016/j.jclepro.2017.10.035.
- Arif, S., 2016. Leadership for change: proposed organizational development by incorporating systems thinking and quality tools. Bus. Process Manag. J. 22 (5), 939–956. https://doi.org/10.1108/BPMJ-01-2016-0025.
- Bansal, P., 2005. Evolving sustainably: a longitudinal study of corporate sustainable development. Strat. Manag. J. 26 (3), 197–218. https://doi.org/10.1002/smj.441.
- Barth, M., 2013. Many roads lead to sustainability: a process-oriented analysis of change in higher education. Int. J. Sustain. High 14 (2), 160–175. https://doi.org/ 10.1108/14676371311312879.
- Benayas, J., Blanco-Portela, N., 2020. Evolution of the actions of Latin American universities to move towards sustainability and the SDGs. In: Azeiteiro, U.M. de M., Davim, J.P. (Eds.), Higher Education and Sustainability Opportunities and Challenges for Achieving Sustainable Development Goals. Taylor & Francis Group, Boca raton, pp. 21–42.
- Beringer, A., Adomßent, M., 2008. Sustainable university research and development: inspecting sustainability in higher education research. Environ. Educ. Res. 14 (6), 607–623. http://doi.org/10.1080/13504620802464866.
- Berzosa, A., Bernaldo, M., Fernández-Sánchez, G., 2017. Sustainability assessment tools for higher education: an empirical comparative analysis. J. Clean. Prod. 161, 812–820. https://doi.org/10.1016/j.jclepro.2017.05.194.
- Blanco-Portela, N., Benavas, 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., Poza Vilches, M.D.F., Junyent Pubill, M., Collazo Expósito, L., Solís Espallargas, C., Benayas del Álamo, J., Gutiérrez Pérez, J., 2020. Estrategia de investigación-acción participativa para el desarrollo profesional del profesorado universitario en educación para la sostenibilidad:"Academy sustainability Latinoamérica"(ACSULA)". Profesorado 24 (3), 99–123.
- Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101. https://doi.org/10.1191/1478088706qp0630a.
- Bullock, G., Wilder, N., 2016. The comprehensiveness of competing higher education sustainability assessments. Int. J. Sustain. High 17 (3), 282–304. https://doi.org/ 10.1108/IJSHE-05-2014-0078.
- Casarejos, F., Gustavson, L.M., Frota, M.N., 2017. Higher Education Institutions in the United States: commitment and coherency to sustainability vis-à-vis dimensions of the institutional environment. J. Clean. Prod. 159, 74–84. https:// doi.org/10.1016/j.jclepro.2017.05.034.
- Chang, R.-D., Zuo, J., Zhao, Z.-Y., Zillante, G., Gan, X.-L., Soebarto, V., 2017. Evolving theories of sustainability and firms: history, future directions and implications for renewable energy research. Renew. Sustain. Energy Rev. 72, 48–56. https:// doi.org/10.1016/j.rser.2017.01.029.

Chiong, K., Mohamad, Z., Aziz, A.A., 2017. Factors encouraging sustainability integration into institutions of higher education. Int. J. Environ. Sci. Technol. 1–12.

- CNA, 2013. Lineamientos para la acreditación de programas de pregrado. Consejo Nacional de Acreditación-CNA, Bogotá,Colombia. Available at. www. mineducacion.gov.co/1621/articles-342684_recurso_1.pdf.
- Cortés-Pérez, H.D., Escobar-Sierra, M., Galindo-Monsalve, R., 2020. Influence of lifestyle and cultural traits on the willingness to telework: a case study in the

aburrá valley, Medell'\in, Colombia. Global Bus. Rev. https://doi.org/10.1177/0972150920916072, 0972150920916072.

- Conner, K.R., Prahalad, C.K., 1996. A resource-based theory of the firm: Knowledge versus opportunism. Organ. Science 7 (5), 477–501.
- Cortese, A.D., 2003. The critical role of higher education in creating a sustainable future. Plann. High. Educ. 31 (3), 15–22.
- Daddi, T., Todaro, N.M., De Giacomo, M.R., Frey, M., 2018. A systematic review of the use of organization and management theories in climate change studies. Bus. Strat. Environ. 27 (4), 456–474. https://doi.org/10.1016/j.jclepro.2018.02.232.
- Décamps, A., Barbat, G., Carteron, J.-C., Hands, V., Parkes, C., 2017. Sulitest: a collaborative initiative to support and assess sustainability literacy in higher education. Int. J. Educ. Manag. 15 (2), 138–152.
- Diamantopoulos, A., Siguaw, J.A., 2006. Formative versus reflective indicators in organizational measure development: a comparison and empirical illustration. Br. J. Manag. 17 (4), 263–282. https://doi.org/10.1111/j.1467-8551.2006.00500.x.
- Dillman, D.A., Hao, F., Millar, M.M., 2016. Improving the Effectiveness of Online Data Collection by Mixing Survey Modes. The SAGE handbook of online research methods, pp. 220–238.
- DiMaggio, P.J., Powell, W.W., 1991. The New Institutionalism in Organisational Analysis. The New Institutionalism in Organisational Analysis.
- Disterheft, A., Caeiro, S.S., Leal Filho, W., Azeiteiro, U.M., 2016. The INDICAREmodel-measuring and caring about participation in higher education's sustainability assessment. Ecol. Indicat. 63, 172–186.
- Drahein, A.D., De Lima, Da Costa, 2019. Sustainability assessment of the service operations at seven higher education institutions in Brazil. Journal of cleaner production 212, 527–536. https://doi.org/10.1016/j.jclepro.2018.11.293.
- Durieux, V., Gevenois, P.A., 2010. Bibliometric indicators: quality measurements of scientific publication. Radiology 255 (2), 342–351. https://doi.org/10.1148/ radiol.09090626.
- Dyllick, T., Hockerts, K., 2002. Beyond the business case for corporate sustainability. Bus. Strat. Environ. 11 (2), 130–141. https://doi.org/10.1002/bse.323.
- Engert, S., Baumgartner, R.J., 2016. Corporate sustainability strategy-bridging the gap between formulation and implementation. J. Clean. Prod. 113, 822–834. https://doi.org/10.1016/j.jclepro.2015.11.094.
- Engert, S., Rauter, R., Baumgartner, R.J., 2016. Exploring the integration of corporate sustainability into strategic management: a literature review. J. Clean. Prod. 112, 2833–2850. https://doi.org/10.1016/j.jclepro.2015.08.031.
- Escobar-Sierra, M., Valencia-DeLara, P., Vera-Acevedo, L.D., 2018. A new corporate entrepreneurship knowledge schema as a research field. Acad. Enterpren. J.
- Escobar-Sierra, M., Lara-Valencia, L.A., Valencia-DeLara, P., 2021. 'Step-by-step' method to conduct applied research in organizational engineering and business management (Método 'paso a paso' para la investigación aplicada en el ámbito de la ingeniería organizacional y la gestión empresarial). Cult. Educ. https:// doi.org/10.1080/11356405.2020.1859735.
- Fadeeva, Z., Mochizuki, Y., 2010. Higher education for today and tomorrow: university appraisal for diversity, innovation and change towards sustainable development. Sustain. Sci. 5 (2), 249–256.

Field, A., 2013. Discovering Statistics Using IBM SPSS Statistics. Sage.

- Fierro, E., Mercado, P., 2012. La innovación organizativa y sus predictores desde la Teoría de Recursos y Capacidades. Administración y Organizaciones 15 (28), 93–115.
- Findler, F., Schönherr, N., Lozano, R., Reider, D., Martinuzzi, A., 2019. The impacts of higher education institutions on sustainable development: a review and conceptualization. Int. J. Sustain. High 20 (1), 23–38. https://doi.org/10.1108/ IISHE-07-2017-0114.
- Fischer, D., Jenssen, S., Tappeser, V., 2015. Getting an empirical hold of the sustainable university: a comparative analysis of evaluation frameworks across 12 contemporary sustainability assessment tools. Assess Eval. High Educ. 40 (6), 785–800.
- Freeman, R.E., Wicks, A.C., Parmar, B., 2004. Stakeholder theory and "the corporate objective revisited. Organ. Sci. 15 (3), 364–369.
- Gauthier, J., 2013. Institutional theory and corporate sustainability: determinant versus interactive approaches. Organ. Manag. J. 10 (2), 86–96. https://doi.org/ 10.1080/15416518.2013.801741.
- Gough, S., Scott, W., 2008. Higher Education and Sustainable Development: Paradox and Possibility. Routledge.
- Govindaraju, B., Jeyasingam, J., Habib, M.M., Letchmana, U., Ravindran, R., 2018. Factors that contribute to the achievement of sustainability in private universities of Malaysia. Int. J Sup. Chain. Mgt 7 (2), 32–41.
- Guzmán-Valenzuela, C., 2016a. Unfolding the meaning of public(s) in universities: toward the transformative university. High Educ. 71 (5), 667–679. https:// doi.org/10.1007/s10734-015-9929-z.
- GRI, 2016. Global reporting initiative. Sustainability reporting guidelines. Retrieved from. https://www.globalreporting.org/standards/gri-standards-downloadcenter/.
- GRI, 2019. Sustainability Disclosure Databased. Research for Resport & organization: University. Retrieved October 11, 2019, from. https://database. globalreporting.org/search/.
- Guzmán-Valenzuela, C, 2016b. Unfolding the meaning of public (s) in universities: toward the transformative university. High Educ. 71 (5), 667–679.
- Haffar, M., Searcy, C., 2017. Classification of trade-offs encountered in the practice of corporate sustainability. J. Bus. Ethics 140 (3), 495–522. https://doi.org/10.1007/ s10551-015-2678-1.
- Hahn, T., Pinkse, J., Preuss, L., Figge, F., 2015. Tensions in corporate sustainability: towards an integrative framework. J. Bus. Ethics 127 (2), 297–316. https://

P.M. Hernández-Diaz, J.-A. Polanco, M. Escobar-Sierra et al.

doi.org/10.1007/s10551-014-2047-5.

- Hallinger, P., Chatpinyakoop, C., 2019. A bibliometric review of research on higher education for sustainable development. Sustainability 11 (8), 2401. https:// doi.org/10.3390/su11082401, 1998–2018.
- Hernández-Sampieri, R., Fernández-Collado, C., Baptista Lucio, P., 2014. Metodología de la investigación (6ta ed.). McGraw-Hill, México.
- Hoon, C., 2013. Meta-synthesis of qualitative case studies: an approach to theory building. Organ. Res. Methods 16 (4), 522–556. https://doi.org/10.1177/ 1094428113484969.
- Hoover, E., Harder, M.K., 2015. What lies beneath the surface? The hidden complexities of organizational change for sustainability in higher education. J. Clean. Prod. 106, 175–188. https://doi.org/10.1016/j.jclepro.2014.01.081.
- Isaksson, R., Johnson, M., 2013. A preliminary model for assessing university sustainability from the student perspective. Sustainability 5 (9), 3690–3701. https://doi.org/10.3390/su5093690.
- Kapitulčinová, D., AtKisson, A., Perdue, J., Will, M., 2018. Towards integrated sustainability in higher education-Mapping the use of the Accelerator toolset in all dimensions of university practice. J. Clean. Prod. 172, 4367–4382. https:// doi.org/10.1016/j.jclepro.2017.05.050.
- Kopnina, H., Meijers, F., 2014. Education for sustainable development (ESD) Exploring theoretical and practical challenges. Int. J. Sustain. High 15 (2), 188–207. https://doi.org/10.1108/IJSHE-07-2012-0059.
- Larrán, M., Herrera, J.H., Cejas, M.Y.C., Andrades, F.J., 2015. An approach to the implementation of sustainability practices in Spanish universities. J. Clean. Prod. 106, 34–44. https://doi.org/10.1016/j.jclepro.2014.07.035.
- Leal Filho, W., 2011. About the role of universities and their contribution to sustainable development. High Educ. Pol. 24 (4), 427–438.
 Leal Filho, W., Doni, F., Vargas, V.R., Wall, T., Hindley, A., Rayman-Bacchus, L., et al.,
- Leal Filho, W., Doni, F., Vargas, V.R., Wall, T., Hindley, A., Rayman-Bacchus, L., et al., 2019. The integration of social responsibility and sustainability in practice: exploring attitudes and practices in Higher Education Institutions. J. Clean. Prod. 220, 152–166. https://doi.org/10.1016/j.jclepro.2019.02.139 hattp//doi.org/
- Leal Filho, W., Manolas, E., Pace, P., 2009. Education for sustainable development: current discourses and practices and their relevance to technology education. Int. J. Technol. Des. Educ. 19 (2), 149–165. https://doi.org/10.1007/s10798-008-9079-z.
- Leal Filho, W., Kovaleva, M., Fritzen Gomes, B., Fudjumdjum, H., Emblen-Perry, K., Platje, J., et al., 2020. Sustainability practices at private universities: a state-ofthe-art assessment. Int.I J. Sust. Dev. World 1–15.
- 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 (1), 93–108. https://doi.org/10.1080/1943815X.2017.1362007.
- Leicht, A., Heiss, J., Byun, W.J., 2018. Issues and Trends in Education for Sustainable Development, vol. 5. UNESCO Publishing.
- Lewis, D.R., Hendel, D.D., Kallsen, L., 2007. Performance indicators as a foundation of institutional autonomy: implications for higher education institutions in Europe. Tert. Educ. Manag. 13 (3), 203–226. https://doi.org/10.1080/ 13583880701502158.
- Lloret, A., 2016. Modelling corporate sustainability strategy. J. Bus. Res. 69 (2), 418–425.
- Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. Governance 23 (1), 161–183. https://doi.org/10.1111/j.1468-0491.2009.01471.x.
- Lozano, R., 2006. A tool for a graphical assessment of sustainability in universities (GASU). J. Clean. Prod. 14 (9–11), 963–972. https://doi.org/10.1016/j.jclepro. 2005.11.041.
- Lozano, R., 2012. Towards better embedding sustainability into companies' systems: an analysis of voluntary corporate initiatives. J. Clean. Prod. 25, 14–26. https:// doi.org/10.1016/j.jclepro.2011.11.060.
- Lozano, R., 2015. A holistic perspective on corporate sustainability drivers. Corp. Soc. Responsib. Environ. Manag. 22 (1), 32–44. https://doi.org/10.1002/csr.1325.
- Lozano, R., 2018. Proposing a definition and a framework of organisational sustainability: a review of efforts and a survey of approaches to change. Sustainability 10 (1157).
- Lozano, R., Carpenter, A., Huisingh, D., 2015. A review of "theories of the firm" and their contributions to Corporate Sustainability. J. Clean. Prod. 106, 430–442. https://doi.org/10.1016/j.jclepro.2014.05.007.
- Lozano, R., Lozano, F., Mulder, K., Huisingh, D., Waas, T., 2013a. Advancing higher education for sustainable development: international insights and critical reflections. J. Clean. Prod. https://doi.org/10.1016/j.jclepro.2013.03.034.
- Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., Lambrechts, W., 2013b. 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.
- Lukina, A., Skorobogatykh, I., Potravnyy, I., Kuznetsov, V., 2017. The strategy of green university: Russian experience of implementation. In: Management of Large-Scale System Development (MLSD), 2017 Tenth International Conference (Pp. 1–5).
- Melewar, T.C., Akel, S., 2005. The role of corporate identity in the higher education sector. Corp. Commun. Int. J. 10 (1), 41–57. https://doi.org/10.1108/ 13563280510578196.
- Melewar, T.C., Foroudi, P., Dinnie, K., Nguyen, B., 2017. The role of corporate identity management in the higher education sector: an exploratory case study. J. Market. Commun. 1–23. https://doi.org/10.1080/13527266.2017.1414073.

- Miller, B.A., 2016. Assessing Organizational Performance in Higher Education. John Wiley & Sons.
- Montiel, I., Delgado-Ceballos, J., 2014. Defining and measuring corporate sustainability: are we there yet? Organ. Environ. 27 (2), 113–139. https://doi.org/ 10.1177/1086026614526413.
- Müller-Christ, G., Sterling, S., van Dam-Mieras, R., Adomßent, M., Fischer, D., Rieckmann, M., 2014. The role of campus, curriculum, and community in higher education for sustainable development-a conference report. J. Clean. Prod. 62, 134–137.

Penrose, E.T., 2009. The Theory of the Growth of the Firm. Oxford university press.

- Polanco, J., Ramírez, F., 2017. Evaluación de la sostenibilidad en empresas de energía. Una investigación aplicada a centrales de generación hidroeléctrica. Sello Editorial Universidad de Medellín, Medellín.
- QAA-HEA, 2014. Education for Sustainable Development: Guidance for UK Higher Education Providers. QAA.
- Rajnoha, R., Lesnikova, P., Krajčík, V., 2017. Influence of business performance measurement systems and corporate sustainability concept to overall business performance: "save the planet and keep your performance. Econ. Manag. https://doi.org/10.15240/tul/001/2017-1-008.
- Razak, D.A., Sanusi, Z.A., Jegatesen, G., Khelghat-Doost, H., 2013. Alternative university appraisal (AUA): reconstructing universities' ranking and rating toward a sustainable future. In: Sustainability Assessment Tools in Higher Education Institutions. Springer, pp. 139–154.
- Reinstorf, F., Schneider, P., Tejeda, R.R., Roque, L.S., Hampel, H., Vazquez, R.F., 2019. Water management and climate change in the focus of international master programs in Latin America and the carribian. In: Handbook of Climate Change and Biodiversity. Springer, Cham, pp. 1–23.
- Rieckmann, M., 2012. Future-oriented higher education: which key competencies should be fostered through university teaching and learning? Futures 44 (2), 127–135. https://doi.org/10.1016/j.futures.2011.09.005.
- Roca, L.C., Searcy, C., 2012. An analysis of indicators disclosed in corporate sustainability reports. J. Clean. Prod. 20 (1), 103–118. https://doi.org/10.1016/ j.jclepro.2011.08.002.
- Sarstedt, M., Ringle, C., Hair Jr., J.F., 2017. Partial least squares structural equation modeling. In: Homburg, C., Klarmann, M., Vomberg, A. (Eds.), Ebook Handbook of Market Research. Springer International Publishing. https://doi.org/10.1007/ 978-3-319-05542-8_15-1.
- Sayed, A., Kamal, M., Asmuss, M., 2013. Benchmarking tools for assessing and tracking sustainability in higher educational institutions: identifying an effective tool for the University of Saskatchewan. I Int. J. Sustain. High 14 (4), 449–465
- Shi, H., Lai, E., 2013. An alternative university sustainability rating framework with a structured criteria tree. J. Clean. Prod. 61, 59–69. https://doi.org/10.1016/ j.jclepro.2013.09.006.
- Shute, S.J., Smith, P.J., 1993. Knowledge-based search tactics. Inf. Process. Manag. 29 (1), 29–45. https://doi.org/10.1016/0306-4573(93)90021-5.
- Son-Turan, S., Lambrechts, W., 2019. Sustainability disclosure in higher education. Int. J. Sustain. High 20 (7), 1143–1170.
- Starik, M., Kanashiro, P., 2013. Toward a theory of sustainability management: uncovering and integrating the nearly obvious. Organ. Environ. 26 (1), 7–30. https://doi.org/10.1177/1086026612474958.
- Suwartha, N., Sari, R.F., 2013. Evaluating UI GreenMetric as a tool to support green universities development: assessment of the year 2011 ranking. J. Clean. Prod 61, 46–53.
- UNESCO, 2017. Education for Sustainable Development Goals: Learning Objectives. UNESCO, Paris.
- Upward, A., Jones, P., 2016. An ontology for strongly sustainable business models: defining an enterprise framework compatible with natural and social science. Organ. Environ. 29 (1), 97–123. https://doi.org/10.1177/1086026615592933.
- Urquiza, F., Sáez-Navarrete, C., Rencoret, S., Ishanoglu, V., 2015. Adaptable model for assessing sustainability in higher education. J. Clean. Prod 107, 475–485.
- Vargas, V.R., Lawthom, R., Prowse, A., Randles, S., Tzoulas, K., 2019a. Implications of vertical policy integration for sustainable development implementation in higher education institutions. J. Clean. Prod. 235, 733–740. https://doi.org/ 10.1016/j.jclepro.2019.07.022.
- Vargas, V.R., Lawthom, R., Prowse, A., Randles, S., Tzoulas, K., 2019b. Sustainable development stakeholder networks for organisational change in higher education institutions: a case study from the UK. J. Clean. Prod. 208, 470–478. https://doi.org/10.1016/j.jclepro.2018.10.078.
- Velasco, A., Valencia, M., Morrow, S., Ochoa-Herrera, V., 2018. Understanding the limits of assessing sustainability at Universidad San Francisco de Quito USFQ, Ecuador, while reporting for a North American system. I Int. J. Sustain. High 19 (4), 721–738. https://doi-org.ezproxy.eafit.edu.co/10.1108/IJSHE-04-2017-0054.
- Verhulst, E., Lambrechts, W., 2015. Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective. J. Clean. Prod. 106, 189–204.
- Vildåsen, S.S., Keitsch, M., Fet, A.M., 2017. Clarifying the epistemology of corporate sustainability. Ecol. Econ. 138, 40–46. https://doi.org/10.1016/ j.ecolecon.2017.03.029.
- Waas, T., Verbruggen, A., Wright, T., 2010. University research for sustainable development: definition and characteristics explored. J. Clean. Prod. 18 (7), 629–636. https://doi.org/10.1016/j.jclepro.2009.09.017.
- Wang, J., Yang, M., Maresova, P., 2020. Sustainable Development at Higher Education in China: A Comparative Study of Students' Perception in Public and Private Universities. Sustainability 12 (6), 2158.

P.M. Hernández-Diaz, J.-A. Polanco, M. Escobar-Sierra et al.

- Welford, P.R., 1993. Breaking the link between quality and the environment: auditing for sustainability and life cycle assessment. Bus. Strat. Environ. 2 (4), 25–33. https://doi.org/10.1002/bse.3280020404.
- Wiek, A., Withycombe, L., Redman, C.L., 2011. Key competencies in sustainability: a reference framework for academic program development. Sustainability Science 1–16. https://doi.org/10.1007/s11625-011-0132-6.
- Wissema, J., 2010. Leading the third generation university. *Towards a comprehensive* management theory of the 3GU. Wissenschaftsmanagement 5, 42–46.
- Yarime, M., Tanaka, Y., 2012. The issues and methodologies in sustainability assessment tools for higher education institutions: a review of recent trends and future challenges. J. Education Sustain. Develop. 6 (1), 63–77.
- Yuan, X., Zuo, J., Huisingh, D., 2013. Green Universities in China-what matters?
 J. Clean. Prod 61, 36–45. https://doi.org/10.1016/j.jclepro.2012.12.030.
 Zhao, W., Zou, Y., 2015. Green university initiatives in China: a case of Tsinghua
- Zhao, W., Zou, Y., 2015. Green university initiatives in China: a case of Tsinghua University. Int. J. Sustain. High 16 (4), 491–506. https://doi.org/10.1108/IJSHE-02-2014-0021.