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Holistic integration of sustainability at universities: Evidences from Colombia

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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.

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, Godemann, & Michelsen, 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, & Pace, 2009) (Cortese, 2003; Fadeeva & 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 & Chatpinyakoop, 2019; Lozano, 2018; Müller-Christ et al., 2014; Waas, Verbruggen, & Wright, 2010).

Other concepts referenced in literature, such as 'green university' (Yuan, Zuo, & Huisingh, 2013), 'sustainable university' (Amaral, Martins, & Gouveia, 2015) or 'university sustainability (Isaksson & Johnson, 2013; Shi & 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., Kaplan & Norton, 2005; Lebas & Euske, 2006). Some tools are based on environmental aspects of campus operations (e.g., Kamyabi & Devi, 2012; Liao & Wu, 2009) and others integrate academic, research and outreach aspects (e.g., Bititci, Carrie, & McDevitt, 1997; Kaplan & Norton, 2005; MacDougall & Pike, 2003).

Therefore, ESD seems to be more related to sustainability practices, and universities should have a more integrated organizational structure and strategy towards sustainability (Beringer & Adomßent, 2008; Lukina, Skorobogatykh, Potravnyy, & Kuznetsov, 2017; Zhao & 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, Lozano, Mulder, Huisingh, & Waas, 2013). These absences may be partly due to the fact that each university assumes different priorities in the integration of sustainability (Beringer & Adomßent, 2008). It could also be caused by the complex conditions of its social, economic, political and cultural environment (Kopnina & 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, AtKisson, Perdue, & Will, 2018), and engage sustainability in and outside of universities (Lozano, Lozano, et al., 2013; Lukina et al., 2017).

Gough & 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 & 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, 2016; Melewar & Akel, 2005). Thus, they tend to adopt strategies and structures from the productive sector (Arif, 2016; Lewis, Hendel, & Kallsen, 2007; Melewar, Foroudi, Dinnie, & Nguyen, 2017). This sector has adopted corporate sustainability (CS), applying it to the entire organizational system. CS contributes to sustainable development while increasing its long-term economic performance (Annunziata, Pucci, Frey, & Zanni, 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 (Benayas & Blanco-Portela, 2020). The collaboration of local communities during the sustainability implementation ((Agostino & Dal Molin, 2016). The addition of professors, administrative staff, and students during the conceptualization and implementation of universities (Aleixo, Azeiteiro, & Leal, 2018). Adopting assessment tools that support universities and their continuous improvement (Alghamdi, den Heijer, & de Jonge, 2017). The integration of sustainability assessment tools in a comparative empirical analysis (Berzosa, Bernaldo, & Fernández-Sanchez, 2017). The commitment of universities to overcome social and ecological challenges, meet human rights, and preserve the earth (Casarejos, Gustavson, & Frota, 2017). The execution of a compared analysis considers different sustainability frameworks (Alonso-Almeida, Marimon, Casani, & Rodriguez-Pomeda, 2015). The comprehension of universities' cultural and social impacts on sustainable development (Findler, Schönherr, Lozano, Reider, & Martinuzzi, 2019). Finally, Latin American universities have active consumers that concern about universities actions (Guzmán-Valenzuela, 2016).

Thus, the question that emerged in this research was: How can universities integrate sustainability throughout their organizational 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, Escobar-Sierra, & Galindo-Monsalve, 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 & 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.

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.

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 & Gevenois, 2010). Figure 1 shows the map of knowledge for the universities' performance (Top Figure 1), classified by year (Bottom Figure 1) and co-occurrence of terms in the selected databases.
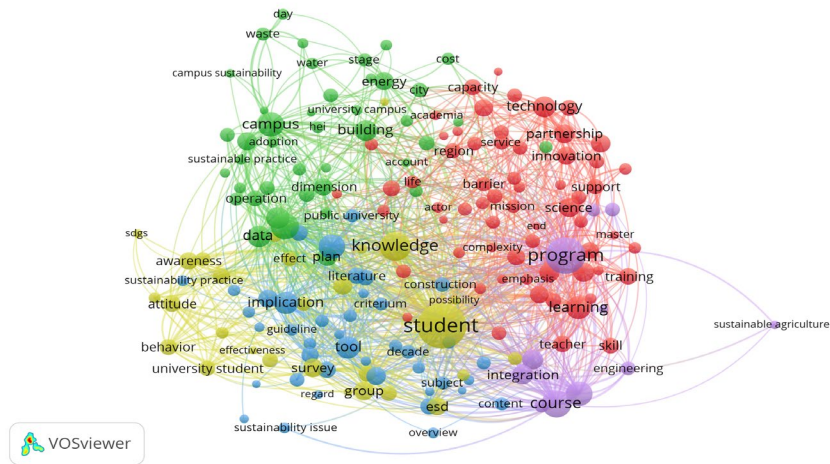
Top Figure 1: a network visualization
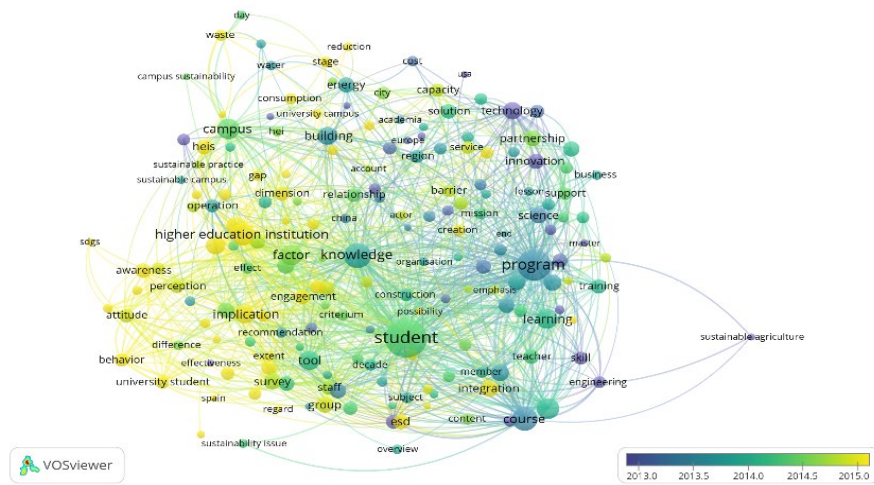
Bottom Figure 1: overlay visualization by average
publication year

Figure 1. Map of knowledge for the incorporation of sustainability in universities.

Top: Network visualization. Bottom: overlay visualization by average publication year.
Source: Prepared by authors using VOS viewer® software.

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 Figure 1). However, an overlapping occurred in three of them, conducting a definition of three final clusters, coinciding with Hallinger & Chatpinyakoop (2019) results. The first cluster corresponds to academic aspects (red and purple in Top Figure 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 Figure 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 Figure 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 Figure 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 word 'integration' in title, abstract or keywords. Table 2 summarises the result of the content analysis of the 130 resulting articles that emerged from the search regarding the incorporation of sustainability in universities.

Table 2. Integration of sustainability in universities

Searching keyword	Emerged categories	Emerged codes	Total papers	Total papers per category
INTEGRATION[a]	Teaching & Learning	Integration into curricula [c]	42	70
		Academic programs	3	
		Suitable pedagogy [c]	13	
		Learning Outcomes	9	
		Teacher training	1	
		Experience on campus	2	
		Voluntary programs	1	
	Research	Solutions of SD problems in ESDU	2	4
			1	
		Interdisciplinary	1	
	Outreach	Alumni	2	4
		Community outreach [c]	3	
	Management	Campus management [c]	6	51
		Availability of social capital [c]	3	
		Awareness [c]	4	
		Institutional commitment	6	
		Declarations/policy	6	
		Barriers & drivers for implementation	6	
		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.] of sustainability in universities. [b.] from Kapitulčinová et al. (2018); [c.] accordingly with the eight factors of Chiong, Mohamad, & Aziz (2017).

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.

2.2 Sustainability assessment tools for universities

Several of the found works compared sustainability assessment tools (Alghamdi, den Heijer, & de Jonge, 2017; Berzosa, Bernaldo, & Fernández-Sánchez, 2017; Fischer, Jenssen, & Tappeser, 2015; Yarime & Tanaka, 2012), with 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, Kamal, & Asmuss, 2013). It covers management, academia, environment and engagement aspects. It has quantitative measurement and a qualitative component, allowing for self-management and not just a comparison (Berzosa et al., 2017). Some rate STARS as one of the most transparent, comprehensive and detailed tools (Casarejos, Gustavson, & Frota, 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 (del Mar Alonso-Almeida, Marimon, Casani, & Rodriguez-Pomeda, 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 & Wilder (2016) found GASU as the best alternative for the evaluation of sustainability in universities.

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	X	X	X	X	X
Adaptable model for assessing sustainability in HEIs -**AMAS**					X
Alternative University Appraisal-**AUA**	X	X	X	X	X
Benchmarking Indicators Questions-Alternative University Appraisal-**BIQ-AUA** (2)	X	X	X	X	X
Education for Sustainable Development and Global Citizenship-**ESDGC**-Framework					X
Graphical Assessment of Sustainability in Universities-**GASU**-					X
Global Reporting Initiative-**GRI**- reporting standards					X
INDICARE model				X	X
Sustainability Assessment Questionnaire-**SAQ**-(1)	X	X	X	X	X
Sustainability Tool for Assessing Universities' Curricula Holistically-**STAUNCH**	X				X
Sustainability Literacy test- **Sulitest** (3)	X				
Sustainability Tracking and Assessment Rating System **(STARS)**	X	X	X	X	X
Sustainability University Model-**SUM**- (2)					X
Sustainable campus assessment system-**SCAS**-(4)					X
University environmental management system-**UEMS** (2)					X
The green plan (2)					X

The program Sustainability Assessment Tool V2-**Sustain-Tool** (1)	X	X	X	X	X
Uncertainty-based quantitative assessment of sustainability for HEIs -**UDSiM** model					X
Unit-Based Sustainability Assessment Tool -**USAT**					X
University Environmental management System-**UEMS** (2)					X
GreenMetric-UI's GreenMetric University Sustainability Ranking-**GM**- (2)					X

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

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, Lukman, Lozano, Huisingh, & Lambrechts, 2013). Therefore, this research built its theoretical foundation choosing the following administrative theories that structure CS.

3. **Theoretical Foundation**

Dyllick & 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, Pinkse, Preuss, & Figge, 2015; Lozano, 2012, 2015; Roca & Searcy, 2012; Starik & Kanashiro, 2013; Vildåsen, Keitsch, & Fet, 2017; Welford, 1993).

CS's temporal aspect, seen as future performance, is associated with the corporation's governance (Polanco & 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, Carpenter, & Huisingh, 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, Todaro, De Giacomo, & Frey, 2018; Gauthier, 2013; Lloret, 2016; Montiel & Delgado-Ceballos, 2014; Polanco & Ramírez, 2017; Starik & Kanashiro, 2013; Upward & Jones, 2016). Table 4 shows how each theory could contribute to sustainability in universities.

Table 4. Theories supporting the University Sustainability 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 & Prahalad, 1996; Penrose, 2009)
	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).	(Fierro & Mercado, 2012)
ST	It allows one to recognise the stakeholder's relationship	(Freeman, Wicks, & Parmar, 2004)
	Allows managers to understand, holistically, how to interact with groups that influence or are influenced by the university. This understanding could generate a greater centralised control in the university.	(Lozano et al., 2015)
IT	It supports the university's political position and how it associates with organisations and government to fulfil its functions	(DiMaggio & Powell, 1991; Gauthier, 2013)

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

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.

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, Fernández-Collado and Baptista Lucio, 2014). The qualitative phase used the theoretical thematic analysis method for social sciences. 'This is a method for identifying, analysing and reporting patterns (themes) within data' (Braun & 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 distribution. Mixing modes of the online data collection was done to improve answering effectiveness (Dillman, Hao, & Millar, 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 & Johnson (2013) only tested students, while Shi & 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. Figure 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 & Scott, 2008).

The academic subsystem is shaped by teaching and learning, research, and extension or outreach, as Gough & 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 & 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 configured 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, Caeiro, Leal Filho & Azeiteiro, 2016). This last-mentioned process includes the skills in sustainability, such as those defined by Rieckmann (2012), Barth (2013) and Wiek, Withycombe, & Redman (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 & Chatpinyakoop, 2019).

Research: embraces new knowledge and technological development, which contribute to solving problems in social welfare, 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, organisations, 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 (AASHE, 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, Lukman, et al., 2013)

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, Azeiteiro, & Leal (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, Sanusi, Jegatesen, & Khelghat-Doost, 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, & 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. Well-being 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 & 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 & Ramírez, 2017) at the university. Committees, workshops, norms, agreements, protocols, and policies, amongst others, materialise in governance (Jorge, Madueño, Cejas, & Peña, 2015). This component has been researched and implemented in a minor way in universities (Jorge et al., 2015; Vargas, Lawthom, Prowse, Randles, & 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. Figure 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 & 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 & Zou, 2015) and to obtaining sustainability in a more integrated, organisational structure (Amaral, Martins, & Gouveia, 2015; Lukina et al., 2017).

Figure 2. Thematic map for USus concept

THEMES	SUB-THEMES	CODES	STANDARDS: STARS*|GRI**/GASU***

UNIVERSITY SUSTAINABILITY

ESD → Academic Subsystem

TEACHING & LEARNING
- Academic programs — AC3/AC4
- Curricula integration — AC1/AC6| GASU-CU1,CU3
- Academic processes — AC7 GASU-CU4,CU5
- Learning outputs-Skills — AC2 GASU-CU7
- Campus as learning laboratory — AC8

RESEARCH
- Address sustainability understanding — AC10| GASU-RE13
- Interdisciplinarity — GASU-RE4,RE5
- Solve SD challenges — AC9| RE2,RE6,RE7,RE11,RE12

EXTENSION-OUTREACH
- Continuing education in sustainability — EN12| GASU-SE4,SE5
- Programs for external sector interaction — EN10| GASU-SE2
- Participation in policy making — EN14| GRI415-1
- Service to Community — EN13| GRI413-1,2/GASU-SE1
- Internal and external communication — EN5
- Alumni program — EN12
- Consultancy in sustainability for Organizations — EN10

Administrative Subsystem ← CS

STRATEGY AND STRUCTURE
- Sustainability in strategic planning — PA2| GRI102-11,14,15
- Sustainability in Organizational structure — PA1/PA5| GRI102-10
- Financial resources-responsible investment — PA8/PA9| GRI201-1,2,3,4/203-1,2
- Human resources management — PA7/EN9| GRI404-1,2/202-
  (Affordability, access, development) — PA11/EN11| 1,2/402-1

NETWORKING
- Networking for sustainability — AC5
- Cooperation agreements — EN11

CAMPUS
- Environmental management program — OP3/OP5| GRI302-1,2,3,4,5
- Sustainable infrastructure-energy management — OP7/OP8|
- Landscape and biodiversity management — OP9/OP10| GRI304-1,2,3,4
- Sustainable food and dining — OP11-OP14| GRI204-1/308-1,2/414-1,2
- Sustainable purchasing — OP15-OP18|
- Transport and commuting — OP19- GRI301-1,2,3/306-2,4/303-1,2,3/305-
- Equity and inclusion — OP23/OP1/OP2| 3,4,5,6,7/306-1,3,5/305-1,2
- Health and safety — GRI405-1,2/406-1/407-1/408-1/409-
- University welfare — PA5/PA6| 1/410-1/411-1/412-1,2,3
- Extracurricular activities in campus — OP3/OP4/OP5| GRI302-1,2,3,4,5
  OP7/OP8|
  OP9/OP10| GRI304-1,2,3,4

GOVERNANCE
- Trust in decision-making bodies — GRI102-16,17/205-1,2,3/206-1
- Normativity — PA3| GRI102-18-39
- Ethics and corruption — GRI102-40-44
- Relationship with external stakeholders — GRI418-1/419-1
- Open access to information — PA10| GRI417-1

ASSESSMENT AND REPORTS
- Assessments
- Reports — EN15/EN6| GRI102-45-55
- Rankings

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 GRI102-General disclosures, Series GRI200-Economic, GRI300-Environmental, GRI400-social Standards. GASU comprises Curriculum-CU, Research-RE and Community activity and service -SE

5.2 The Sustainability measurement scale for universities

Codes determined by thematic analysis (Figure 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.

Table 5. USus Measurement Scale

Code	Item	Relation with themes in Figure 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 Organizational structure		
US3	In our academic programs, students acquire sustainability skills such as systemic thinking, critical thinking, teamwork, solving sustainability problems, a vision of the future, self-awareness or interdisciplinary work.	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 sustainable development	Interdisciplinarity Solving SD challenges and Address sustainability understanding	Research	
US8	There is an offer of continuing education courses in sustainability	Continuing education in sustainability	Outreach	
US9	Our university provides services to the community to improve their quality of life (e.g., legal office, business office, etc.)	Service to Community Programs for external sector interaction		
US10	Our university does external consulting on sustainability issues	Consultancy in sustainability for Organizations		
US11	Our university participates in the creation of public policies at the local, regional, 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 Subsystem
US14	Our university has inter-institutional agreements to develop collaborative activities in sustainability	Cooperation agreements		
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		

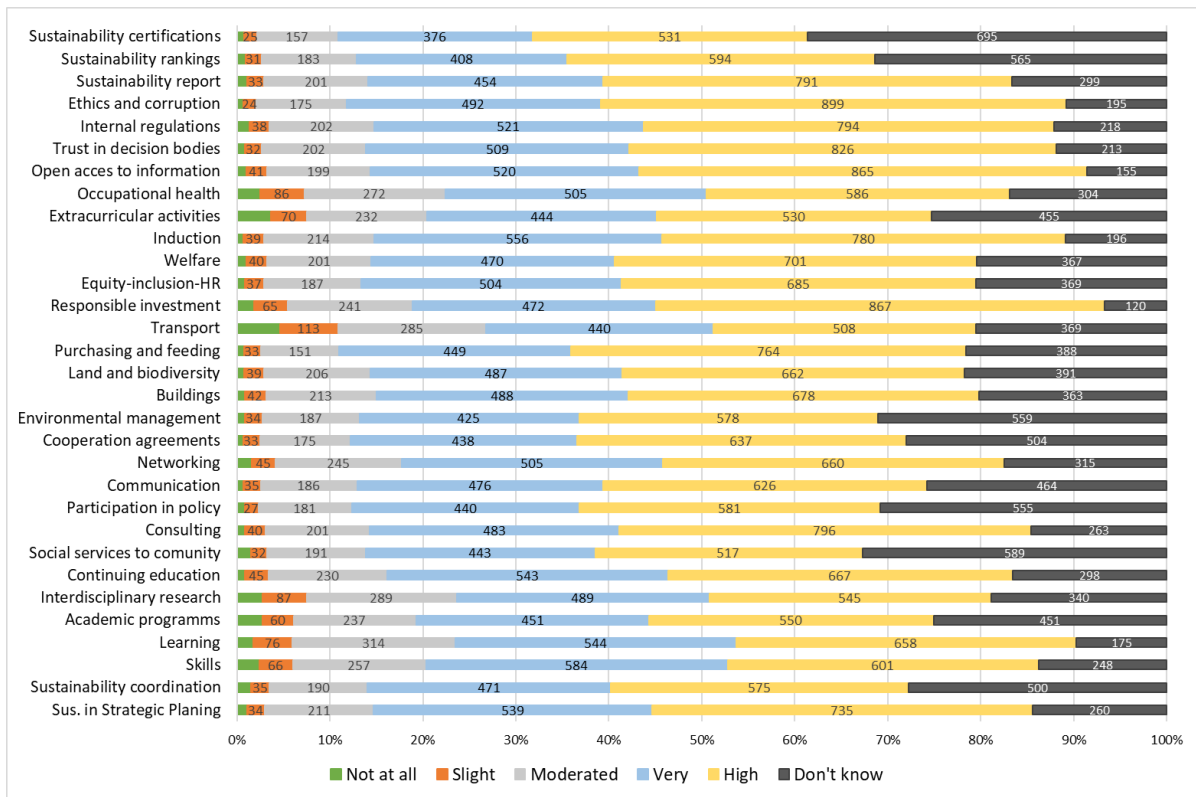| Code	Item	Relation with themes in Figure 2		
US18	Our university promotes purchasing and consumption of organic food, locally produced, with green certifications or fairly marketed	Sustainable food and dining Sustainable purchasing		
US19	Our university encourages the use of public transport and bicycle to reduce the use of own vehicles	Transport and commuting		
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 students and employees	Human resources management (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 sustainability practice	University welfare		
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 Council, school Faculty or Council	Trust in decision-making bodies		
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 & Reports	
US31	Our University participates in sustainability rankings or league tables	Rankings		
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.

5.2.1 Responses' Frequencies

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

Figure 3. Responses´ frequencies for Universidad de Medellin and Universidad EAFIT- Medellin Colombia.

Legend: Not at all | Slight | Moderated | Very | High | Don't know

Item	Slight	Moderated	Very	High	Don't know
Sustainability certifications	25	157	376	531	695
Sustainability rankings	31	183	408	594	565
Sustainability report	33	201	454	791	299
Ethics and corruption	24	175	492	899	195
Internal regulations	38	202	521	794	218
Trust in decision bodies	32	202	509	826	213
Open acces to information	41	199	520	865	155
Occupational health	86	272	505	586	304
Extracurricular activities	70	232	444	530	455
Induction	39	214	556	780	196
Welfare	40	201	470	701	367
Equity-inclusion-HR	37	187	504	685	369
Responsible investment	65	241	472	867	120
Transport	113	285	440	508	369
Purchasing and feeding	33	151	449	764	388
Land and biodiversity	39	206	487	662	391
Buildings	42	213	488	678	363
Environmental management	34	187	425	578	559
Cooperation agreements	33	175	438	637	504
Networking	45	245	505	660	315
Communication	35	186	476	626	464
Participation in policy	27	181	440	581	555
Consulting	40	201	483	796	263
Social services to comunity	32	191	443	517	589
Continuing education	45	230	543	667	298
Interdisciplinary research	87	289	489	545	340
Academic programs	60	237	451	550	451
Learning	76	314	544	658	175
Skills	66	257	584	601	248
Sustainability coordination	85	190	471	575	500
Sus. in Strategic Planing	34	211	539	735	260

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 Figure 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 cooperation agreements, the participation in management and all 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 & 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 & Ramírez, 2017) and ESDU, respectively (Hallinger & Chatpinyakoop, 2019; Kopnina & Meijers, 2014; Leicht, Heiss, & Byun, 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 & Searcy, 2017) and to fulfil the challenges that universities have in contributing to the achievement of sustainable development (Findler, Schönherr, Lozano, Reider, & 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.

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

Structure Matrix

Item	Component load								Mean	St. Dev
	1	2	3	4	5	6	7	8		
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.

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 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 & 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 & 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, Ringle, & Hair Jr, 2017)). Thereof, Figure 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 & 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, Rauter, & Baumgartner, 2016; Lozano, 2018).

The model integrates ESDU in their university's missional 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 & 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 &

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).

Figure 4. Model for USus
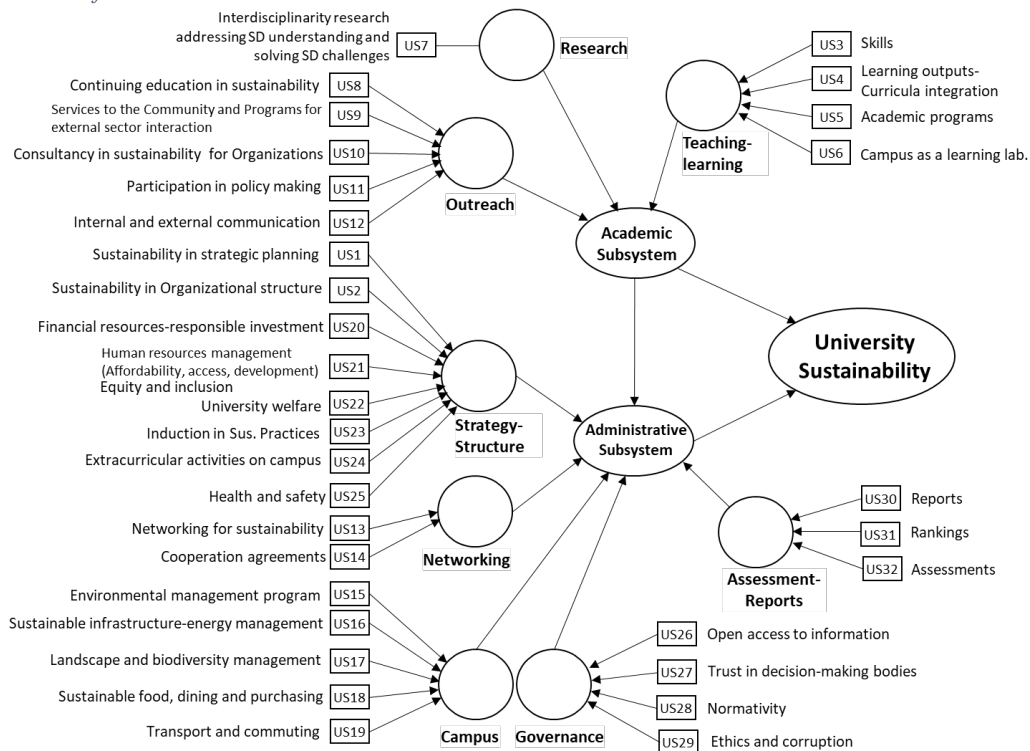
The administrative subsystem tackles several aspects. One is the relation with the academic subsystem. This subsystem should serve the academic individuals (Arif, 2016; Gough & Scott, 2008; Miller, 2016); thus, it should envision and supply all the training, resources and capabilities to the students 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 Figure 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 & 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, Benayas, Pertierra, & Lozano, 2017; Hoover & Harder, 2015; Verhulst & 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 & 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 & Ramírez, 2017). Several researchers found that CS increases business performance (Annunziata et al., 2018; Engert & 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 GreenMetric 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 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, Figure 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 et al., 2020). Therefore, the reality shows that universities need to decentralize sustainable plans and decision-making to students, staff, and faculty (Wang, Yang and Maresova; 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 et al., 2020) and a lack of academic programs in sustainability (Wang, Yang and Maresova, 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 & 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, Bernaldo, & Fernández-Sanchez, 2017) through a hybrid framework that considers different sustainability frameworks (Alonso-Almeida, Marimon, Casani, & Rodriguez-Pomeda, 2015), gathering data between academic and administrative staff, and students in Colombian universities (Aleixo, Azeiteiro, & Leal, 2018), as others authors suggested. The results reflect Colombian universities' cultural and social features and their impact on sustainable development (Findler, Schönherr, Lozano, Reider, & Martinuzzi, 2019) while recognized Colombian universities consumers as actives players (Guzmán-Valenzuela, 2016).

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 & 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, Gustavson, & Frota, 2017), but they have not verified it yet (Alghamdi, den Heijer, & 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 & 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 self-reflective 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.

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