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LINKING PERFORMANCE WITH SUSTAINABILITY IN PUBLIC UNIVERSITIES. THEORETICAL FRAMEWORK AND BIBLIOMETRIC ANALYSIS

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ABSTRACT. Linking university performance to sustainability is possible through the university's third mission: environmental responsibility. To better understand the concepts, practices and challenges of sustainability, the role of literature is crucial; therefore, this paper reviews the existing literature on academic performance and sustainability using a bibliometric analysis for articles published in the Web of Science database between 2009 and 2023. This research intends to contribute to recent stream of research on sustainability implementation by identifying the relationship between performance and sustainability in university missions. To date, there have been only a few bibliometric analyses the relationship between performance and sustainability in the public higher education sector. However, no one has discussed the perspective of the link between performance and sustainability through the university mission, and this research intends to fill this gap. The results show that in the last three years, the interest in performance and sustainability has led to an increase of up to 66% in articles on sustainability and performance in the public university system. Spain appears to be the main contributor to the research articles related to the area of interest. Research in the public university system on concepts related to sustainability and performance is still at an early stage, yet has seen considerable progress over the past few years.

Keywords: performance, sustainability, public university, bibliometric analysis, theoretical framework

JEL classification: A11; O20; Q01.

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Introduction

Public universities are an example of excellence and performance in the public sector. Sustainability education in public universities is crucial to educate future leaders with responsibility (Atstaja *et al.,* 2017; Nyerere *et al.,* 2021; Mohammadi *et al.,* 2023). Performance of a university depends on three key factors: effectiveness, efficiency and economy (Gebczynska & Brajer-Marczak, 2020; Geng & Zhao, 2020). Efficiency refers to the ability to achieve more with less within existing resources (Mikusová, 2017). Effectiveness refers to meeting stakeholder expectations while increasing the overall performance of the institution (Vo & Laking, 2020). Economy refers to achieving a decrease in the cost of resources and, at the same time, the consistency of quality standards applied. Strategic perspective, resource organization and the power to adapt to the ever-changing requirements of the university educational system are some of the important elements for universities to achieve these goals (Atstaja *et al.,* 2017). To ensure accountability and quality assessment universities are required to prioritize performance above all other assets by gaining good positions in international rankings. Fulfilling the expectations of all stakeholders (this includes the following categories: teachers, students, alumni, university leaders, local community and stakeholder groups) is vital to achieve this goal (Alarcón-del-Amo *et al.,* 2016). It is absolutely imperative that sustainability becomes a broad global priority, which can be seen in the 17 Sustainable Development Goals (SDGs) – visible as a cradle-to-grave approach to sustainability (Menon & Suresh, 2020).

The link between performance and sustainability can be observed by looking at the missions of higher education institutions (Secundo *et al.,* 2016). Teaching and research can be linked to the performance concept, while environmental responsibility can be linked to the sustainability concept. Despite this, few studies have been able to link performance and sustainability at the university level. According to Hamdan *et al.* (2023), sustainability is identified at the university level in a few academic areas. The study of Hamdan *et al.* (2023) assessed the sustainability performance of two universities in the United Arab Emirates using the DMAIC methodology. A link between academic performance and sustainability was found by Atici *et al.* (2020) using the Green Metric ranking

system. The connection between university mission statements and sustainability practices of higher education institutions in 347 universities is examined by Lopez & Martin, (2018) through the investigation of link between the content of university mission statements and sustainability practices. Research results show that the higher the number of terms used in university mission statements, the more statistically likely these universities are to achieve higher sustainability ratings.

Aung & Hallinger (2023) suggest that universities can change their practices by refocusing on their mission and by strengthening the involvement of their stakeholders. Mohammadi *et al.* (2023) conducted a study that identified six critical factors leading to effective integration of sustainability in universities. These factors include culture of academia, leadership, education, attitude, and commitment. Blasco *et al.* (2019) found a positive correlation between the environmental and economic dimensions of sustainability in universities. This suggests a lack of an integrated approach to sustainability. Higher education institutions that integrate sustainability at all levels perform better. Therefore, the study aims to fill this gap and focuses on the detection of the advancement process of the research field through the application of bibliometric analysis tools. Consequently, the present study is an extension of previous bibliometric analyses of sustainability in specific fields such as management (Henehen *et al.,* 2019; Frizon & Eugénio, 2022; Blasco-Blasco *et al.,* 2021). The article aims to explore the trends and models of knowledge development in the public higher education area with respect to performance and sustainability, and their connection through university missions.

The originality of study lies in the fact that it attempts to establish a connection between performance and sustainability within the missions of universities (education, research and environmental responsibility). The results show that performance can be linked to sustainability through the third mission of the university (environmental responsibility), together with the implementation of sustainability practices at the university level, which bring great benefits to all stakeholders and favour the performance of the university.

The study has four parts: introduction, state-of-the-art related to performance and sustainability, results, conclusions. The empirical study examines the relationship between university performance and sustainability.

State-of-the-art

The focus of the search has been on articles that are research on performance and sustainability in the university system. Sustainability requires an integrated approach (Michelsen, 2015). It depends on the interaction of economic

development, social well-being and environmental protection, with the active involvement of society and the academic community (Asrar-Ul-Haq *et al.,* 2017). Higher education institutions are essential for enhancing students' comprehension of sustainability and converting that knowledge into impactful actions (Atstaja *et al.,* 2017; Bak & Cheba, 2017). In the past hundred years, there has been a notable rise in the study and implementation of sustainability (Lozano *et al.,* 2017; Filho *et al.,* 2016).

Performance in public universities related to sustainability

University performance is understood as the ability to achieve predefined objectives and to respond to the diverse expectations of stakeholders, represented by groups of individuals and interests that have the power to influence or can be influenced by the achievement of the institution's objectives. The capacity to address the requirements and anticipations of the community, represented by various interest groups, is made possible by indicators (groups from the university's internal or external environment) (Bonaccorsi *et al.,* 2017).

The performance of public universities, especially with regard to sustainability, has multiple valences and can be assessed from different perspectives, including human resource management, governance, strategic implementation of sustainability initiatives and operational performance. Governance structures within public universities play an important role in achievement of sustainable performance (Asrar-Ul-Haq *et al.,* 2017). A direct link between sustainability strategies and the performance of public universities, and empirical evidence suggests that a strong sustainability strategy has a positive impact on the performance of public universities. Empirical studies have shown that a strong commitment to sustainability can lead to better institutional outcomes for the following reasons, as these strategies can provide a significant explanation for variations in academic performance. Public universities' sustainability performance is determined by the level at which higher education institutions incorporate sustainability methods into their personnel management, governance, policy implementation and operational processes (Lopez & Martin, 2018; Filho *et al.,* 2016). These elements are interrelated and each contributes to the institution's capacity to perform effectively according to sustainability standards and goals (Mohammadi *et al.,* 2023). Researchers have adopted a variety of approaches to the performance of universities, including traditional and competency-based assessment, innovative methods and performance indicators that are responsive to current educational requirements (Portela *et al.,* 2012). Performance measurement and reporting is considered a legitimate response to the demand for accountability in the public sector. However, there is no single set

of criteria on this issue, and the approach and measurement of performance varies according to the institutional, cultural and historical context of each country (Nistor *et al.,* 2017) explained in the literature through the lens that university sustainability performance must be tailored to specific environments in order to improve implementation of sustainable practices (Schlickmann & Bortoluzzi, 2023). The public sector's sustainability is crucial because resources are finite and demands continue to grow, representing a major difference that must not be overlooked.

Sustainability in a public university related to performance

Contemporary societies are concerned about sustainability due to an unbalanced relationship between human needs and natural resources (Borland *et al.,* 2019). Strategies and governance rules have been put in place to achieve sustainability - sustainable educational institutions are implementing concrete actions and aligning themselves with the third mission of universities (Lopez & Martin, 2018). Framing sustainability at the university level involves embodying a vision and practices modified for sustainability. Research domains in the field of sustainability in higher education include the university curriculum, teaching and research programmes, university partnerships (Scott, 2015; Paletta & Bonoli, 2019).

The sustainability practices of public universities affect their overall performance in several ways. They play a important role in the dissemination of sustainability knowledge and its integration into their core activities. The way universities approach sustainability education, training and student engagement has a significant impact on their contribution to the Sustainable Development Goals (SDGs) and their performance in this area. Increasingly, university performance is measured against sustainability initiatives and outcomes. Student assessment and participation in sustainability can improve the sustainability performance of academic institutions. Sustainability practices encompass not only environmental management, but also social responsibility and economic viability, which can affect the performance of public universities in different ways (Filho *et al.,* 2016). Sustainability is integrated into many aspects of university life, from operational efficiency and resource management to developing curricula and engaging with the community. A commitment to sustainability can therefore be seen both as a strategic priority and a performance indicator for public universities. Sustainability can enhance the accountability, transparency and credibility of universities, leading to better stakeholder engagement. Research shows a correlation between universities with higher sustainability indices and higher performance indices. Economic and social

dimensions have a positive impact on performance. Focusing on sustainability within a university's strategic framework can yield beneficial effects on educational, research and third mission performance (Blasco *et al.,* 2019).

Sustainability reporting and performance are essential for public universities (Zorio-Grima *et al.,* 2018). It is a demonstration of social responsibility and a source of example for other institutions interested in the topic. The evaluation of sustainability performance ensures that universities have access to improve their practices and impacts at the university level, but also at the level of society. University education, reporting and performance are interdependent and promote a sustainable university and societal environment (Paletta & Bonoli, 2019). Universities are increasingly being recognised for the efforts they are making to integrate sustainability into the way they are organised and managed (León-Fernández & Domínguez-Vilches, 2015) Research has examined sustainability in universities. It has highlighted the commitment and responsibility of stakeholders to promote sustainable economic growth, ensure social equity and protect the environment (Lopez & Martin, 2018).

Universities are key players in the promotion of sustainable development. Financial and non-financial sustainability reporting also quantifies and communicates the sustainability performance of higher education institutions, including their contribution to environmental support measures, policy initiatives, technological innovation and social programmes. There is a clear direct link between these and the promotion of sound sustainability practices that improve both the reputation and financial results and performance of universities (Paletta & Bonoli, 2019).

It is worth noting that An internet-based questionnaire (Global Survey on Sustainable Publishing and Research in Higher Education) shared with participants of the European School of Sustainability Science and Research, which received 103 responses from researchers in more than 40 countries, highlighted three academic trends: in terms of research, it was observed that those conducting autonomous research outnumber those conducting research at university and departmental level; regarding the inherent worth of sustainability studies in tertiary education, it is not as developed as anticipated; the subjects discussed are extensive and span multiple disciplines. (Leal Filho *et al.,* 2023).

The mission of a university is a statement of its core values and purpose. It guides how it works and what it aims to achieve. When it comes to sustainability, the integration of this concept into the university mission can have a significant effect on the institution's performance in terms of environmental, social and economic sustainability. Research suggests that there is a link between the mission statements of the universities and their sustainability practices. (Hart *et al.,* 2016; Demele *et al.,* 2021) Institutions with explicit mission statements are more likely to implement comprehensive sustainability initiatives in areas such

as education, research and community engagement (Lopez & Martin, 2018). For example, when a university's mission emphasises interdisciplinary sustainability education, this often leads to the development of academic programmes and research initiatives with a focus on sustainable development. Furthermore, a mission that includes sustainability can enhance the university's social responsibility and economic performance (Hart *et al.,* 2016).

To summarise, a university's engagement to sustainability in its mission statement can be a strong driver of its overall sustainability performance (Centobelli *et al.,* 2019; Demele *et al.,* 2021) By embedding this commitment at the heart of their strategic planning and institutional ethos, universities can ensure that their efforts to achieve sustainability are deeply rooted and aligned with their educational and societal goals and objectives.

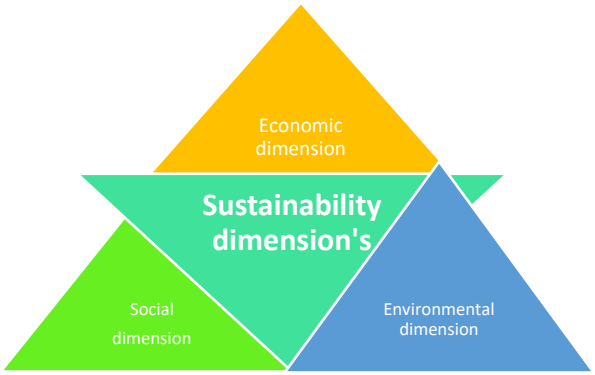

Figure 1. Sustainability Dimensions (source: Mohammadi *et al.,* 2023)

Sustainability is commonly described through three core dimensions, often known as the three pillars: environmental, economic, and social sustainability (Mohammadi *et al.,* 2023). Environmental sustainability refers to the obligation of preserving natural resources and safeguarding worldwide ecosystems to promote health and wellness, both now and in the future. Economic sustainability includes methods that promote enduring economic advancement while avoiding detrimental effects on the community's social, environmental, and cultural dimensions. Social sustainability is about identifying and managing the impact of activities on people and society (Murga-Menoyo, 2014). These dimensions are interconnected and balance each other to achieve sustainable development (Figure 1).

Sustainability in universities is also evident through the cross-cutting skills that students completing higher education programs acquire. institutions can acquire, regardless of the study programme they have chosen (Membrillo-Hernández *et al.,* 2021). This process (e.g. in the USA, 2361 academic programs on sustainability were recorded in 872 higher education institutions (Vincent, 2017)) was declassified in the study (Brundiers & Wiek, 2017) on teaching and learning of professional competencies in sustainability. Studies that have followed the transition of universities towards sustainability include Aleixo *et al.* (2018), which states that universities in Portugal have had a greater involvement of sustainability in its social dimension; that of Cebrián *et al.* (2019), which addressed existing theoretical frameworks on sustainability competences, while also identifying appropriate tools to be able to assess sustainability competences in the context of ESD. Aleixo *et al.* (2021) discussed universities' engagement with sustainability dimensions, guiding universities in transitioning to sustainability and contributing to understanding sustainability in universities. Similarly, Redman *et al.* (2021), through a systematic review of 75 studies presenting the use of an assessment tool, has provided a framework for the assessment of sustainability competencies by highlighting an overview of sustainability based on assessment tools. Furthermore, 12 core competencies for sustainability are presented by Pálsdóttir & Jóhannsdóttir (2021) who present the competencies that need to be promoted through teaching and learning in universities. Therefor, it can be concluded that sustainability competencies are not acquired by themselves in teaching and learning spaces and more involvement and attention are needed, as it is still unclear whether sustainability is a university competency or not (Membrillo-Hernández *et al.,* 2021).

As a result of the theoretical framework, the research questions are:

Research Question 1: Which are the trends of research publications on performance and sustainability in public higher education institutions?

Research Question 2: Which authors have emerged as the most productive contributors to the literature on performance and sustainability in public universities?

Research Question 3: Which are the most cited papers and which countries and journals have the most important publications in the field?

Research Question 4: Which are the main research topics related to performance and sustainability in public universities?

Methodology

The objective of the research is to address the inquiry by examining the organization of academic writings concerning performance and sustainability within public universities. The methodology used for this purpose is a bibliometric analysis, which allows a systematic review of the literature and the identification of the correlation between performance and sustainability in public universities (Merigó *et al.,* 2016; Secinaro, 2022; Pillai *et al.*, 2021). The ISI Web of Science database was used to obtain bibliographic data, as it is one of the most important databases of scientific information worldwide. The search focused for articles in English and used a selection of Web of Science categories, choosing SSCI. Other categories were excluded (e.g. A&HCI) from the search because there were targeted articles embedded in this specific category. In the search string below, the search was set based on the topic (title, abstract, keywords) attached to each article, as shown in Table 1.

In addition, it was decided to collect theoretical and empirical articles, as these were appreciated for their high level of academic, theoretical and methodological review. Therefore, conference papers, book citation index, book reviews and review articles (De Waele *et al.,* 2021; Stefanescu, 2021) were excluded, resulting in 99 published articles. The publications were then extracted from the Clarivate Analytics Web of Science database to perform an output analysis of the identified records and obtain the results (final sample of 99 articles). Bibliographic software was used to calculate the top-ranked records: countries, authors, institutions, institutions, journals, keywords and relevant topics.

The search is restricted in time to the years 2009-2023. It starts with 2009, since a search of the Web of Science database identified an article from 2007, but the content did not match. In 2008, no article was published that matched to the search key and the Web of Science SCCI category selected in the preparatory stage of the article extraction from the database. Of course, it seems interesting that no scientific article matching criteria was identified, and it was a surprise. One explanation for this may lie in the SSCI category chosen or perhaps in not including conference papers in search, and the citation index of books, book reviews, and review articles were excluded (of which there were 6 on a closer query of the database). Another explanation could lay in the SSCI category selected or perhaps in the fact that it was chosen not to include conference articles, book citation index, book reviews, and review articles. Consequently, the relevant period for analysis is between 2009 and 2023.

Table 1. Search protocol

Criteria	**Details**
Timespan	2009–2023
Document Type	Article
Database	Social Science Citation Index (SSCI)
Fields	Topic (title, abstract, keywords)
Key-terms	Performance* AND Sustainability* AND Public Higher Education*

Source: Authors' elaboration

Steps involved in conducting a bibliometric analysis are presented below:

- 1st step - general information to discover trends and geographical distribution (Fauzi *et al.*, 2024; Barrera-Rodríguez *et al.,* 2023);
- 2nd step - leading journals, authors and papers to investigate Top Journals, Authors and Papers - descriptive analysis and most productive/used developments to obtain an analysis and ranking of research journal productivity/productivity and relevance of cited articles; simultaneously displaying key elements/followed graph to determine how journals, authors, key article terms and reference journals are connected, three field Plot (Wang *et al.,* 2019);
- 3rd step- network analysis: Word Cloud, Trend topics, Co-occurrence network, Thematic map, Historical direct citation to highlight the connections between keywords, author diaries, thematic mapping and historical exposition (Stefanescu, 2021).

Results and Discussions

The analysis performed using bibliometric methods provides important perspectives on the discussions regarding sustainability reporting, particularly in public sectors. This methodical approach enabled us to thoroughly investigate the area and create new insights that add to earlier conversations about nonfinancial reporting in public domains, grounded in a well-organized review of existing literature (Cebrián *et al.,* 2019; Lozano *et al.,* 2017; Menon & Suresh, 2020). Additionally, grasping the scientific production output within a specific area is essential for comprehending the development of the literature. By identifying historical patterns, avenues for future research can be suggested.

Research Question 1: Which are the trends of research publications on performance and sustainability in public higher education institutions?

The analysis of the registered articles was performed using R Studio and Bibliometrix, with the Shiny package used for its interactive features. A longitudinal approach encompassing 15 years, analyzing Web of Science articles and publication fluctuations on performance and sustainability in the public university system. Between 2009 and 2023, the number of related articles fluctuated, increasing from 1 in 2009 to 19 in 2020. The methodology focused only on academic articles and a part of the SSCI category, explaining the lack of publications in 2010 and 2011. The top year was 2020, highlighting significant potential for further research in this area.

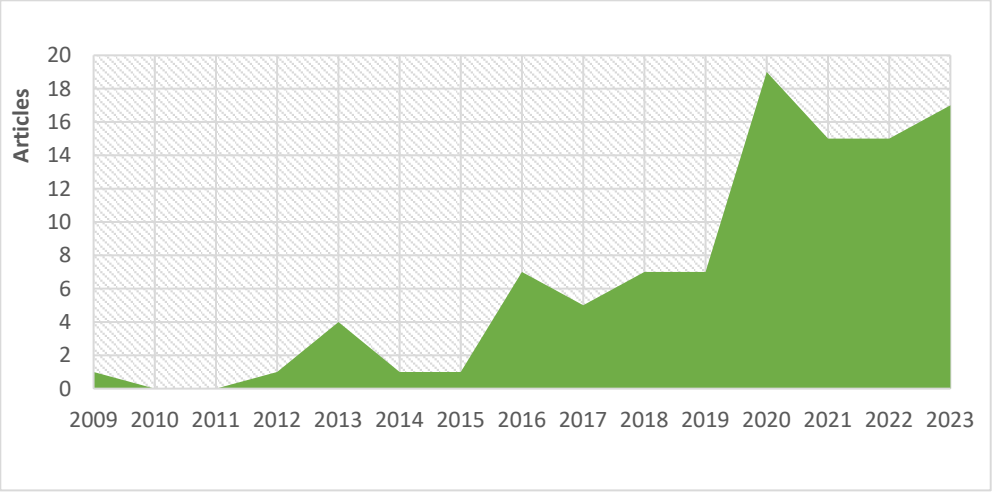

Figure 2. Anual scientific production (no. of papers)
Source: Authors' elaboration

In terms of authorship (see Figure 3), a total of 318 authors were identified as producers of the 99 articles. 9 articles (7.89%) were signed by a single author and 90 by two or more authors. The rate of coauthorship is thus an average of 3.36 authors per scientific or scholarly article. This reflects the importance of performance and sustainability in the public university system, a relatively high number per article and the growth of the literature community. Collaboration between researchers is necessary for the development of any field. It facilitates scientific progress because it encourages researchers to share knowledge and pool useful resources to develop successful collaborations.

Figure 3. Authorship
Source: Database Web of Science

The literature's geographical spread regarding sustainability reporting within the public sector is illustrated in Table 2, highlighting the ten leading nations that have conducted extensive research on this subject, with their findings being frequently referenced. The tally of publications and citations was determined by considering the participation of authors hailing from each nation. When authors represented multiple countries, each individual received a single point. Most of the contributions in the analyzed studies originated from Spain and Italy, comprising 20.20% of the total, whose researchers stand out in terms of research, performance and sustainability for their significant contributions in various fields, investing in research and development projects and achieving outstanding results in areas such as the social sciences. Both countries have demonstrated a strong commitment to innovation and sustainability, contributing to global progress in these areas. In terms of citations, the most cited country is Portugal (305), closely followed by the United Kingdom (297) and Malaysia (207).

Table 2. The most productive and cited countries (no. papers)

Country	Papers	Citation	Avg.
Spain	12	176	14.67
Italy	10	170	17.00
Brazil	8	21	2.62
China	7	107	113.37
USA	7	175	25.00
Malaysia	6	207	34.50
UK	6	297	49.50
Portugal	6	305	50.83
Australia	4	83	20.75
Saudi Arabia	4	103	25.75

Source: Authors' elaboration

The academic affiliation of the researchers is further presented in Table 3, which shows all universities with researchers who have released over two papers utilizing the fractional counting approach. It is also evident that most of these researchers are from Spain and Italy, which are the top two nations regarding productivity per country. The findings verify the national origins of the authors with the highest productivity.

Note that Table 2 and Table 3 have an interesting result to show: among the most productive countries there are also emerging economies, such as China, Brazil and Saudi Arabia. In conclusion, there is diversity in terms of the nationality of the authors, the focus of the literature analysed is on a relatively a small number of countries and the majority of the papers are collaborative papers with only a few single authors (9 papers).

Table 3. The most productive universities (number of authors)

University affiliation	Country	No.	University affiliation	Country	No.
Columbia University	USA	8	Cranfield University	UK	3
University of Lisbon	Portugal	5	Colorado State University	USA	3
Polytech University Valencia	Spain	5	University Fed Rio Grande Du Sul	Brasilia	3
King Faisal University	Saudi Arabia	4	Rey Juan Carlos University	Portugal	3
University Salermo	Italy	4	University of Beira Interior	Spain	3
Jazan University	Saudi Arabia	4	University Extremadura	Spain	3

Source: Authors' elaboration

Main journals, authors and papers

The majority of the scientific research output (84.61%) in the top three journals comes from the top ten contributors, as shown in Table 4. The International Journal of Sustainability in Higher Education is the most cited journal with 429 citations. It should be noted that sustainability, which has been evaluated with a five-year impact factor since 2016, has the highest number of articles published. In terms of citations, the Journal of Cleaner Production leads with 429 citations, while the International Journal of Sustainability in Higher Education is in second place with 212 citations. The remaining nine journals contribute almost half of the total number of articles analysed and focus mainly on research on public higher education or sustainability issues. It is also worth noting that out of the 52 journals, 44 (84.61%) published only one paper on this

topic. The remaining nine journals cover about half of the total papers analysed. Furthermore, these journals focus either on research in public higher education institutions or focus directly on sustainability issues.

Table 4. Top most productive journals.

Journals	Journal category	No. of articles	H-Index	Citations
Sustainability	Env.St.	26	136	212
Internaţional Journal of Sustainability în Higher Education	Education (Edu.)	11	23	206
Journal of Cleaner Production	Env.Sc.	7	182	429
Sustainable Development	Env.St.	3	81	25
Journal of Management Development	Env.St./Manag./ Bus./Fin.	2	69	37
Journal of Public Budgeting, Accounting & Financial Management	Pub./Fin.	2	19	34
Higher University Policy	Education	2	47	25
Administrative Sciences	Pub.	2	28	16
International Journal of Productivity and Performance Management	Manag.	2	10	17
Internaţional Journal of Sustainable Management	Env.St.	2	31	17

Note: Env.St. = Environmental Studies; Env.Sc. = Environmental Sciences; Manag = Management; Bus = Business; Fin = Finance; Pub. = Public administration
Source: Authors' elaboration

It is important to highlight the wide variety of journals that aim to publish research focused on performance and sustainability within the public sector (Table 5). A review of the Web of Science classifications reveals that, since a multidisciplinary journal can fit into various categories, the predominant one is "Green and Sustainable Science and Technology," which accounts for nearly all published articles. This is hardly surprising, as this category encompasses journals that concentrate specifically on the overall theme of sustainability, such as Sustainability, International Journal of Sustainability in Higher Education, Journal of Cleaner Production, Sustainability Accounting Management and Policy Journal, and Sustainable Development. Furthermore, one identified top three journals that feature the greatest number of published works. Regarding the other categories found in the Web of Science, there is an interesting distribution with relatively low percentages. This confirms that

performance and sustainability in the public university system have a higher concentration in the first three journals, which deal exclusively with this type of approach, but also the fact that it appeared in other categories of journals it means that topic is treated multidisciplinary.

Table 5. More usual categories of Web of Science in the researched topic

Web of Science Categories	**Frequency**	**%**
Green and Sustainable Science and Technology	50	50.50
Environmental Sciences	35	35.35
Environmental Studies	27	27.27
Education & Educational Research	20	20.20
Management	17	17.17
Business, Economics	13	13.13
Engineering environmental	7	7.07
Development studies	4	4.04
Public Environmental & Occupational health	4	4.04
Business Finance	2	2.02

Source: Authors' elaboration

Although the subject matter may initially seem broad due to its focus on the complex concepts of performance and sustainability, the scope is actually quite narrow, as it pertains specifically to the public sector. However, there is a strong interest in addressing this topic, as evidenced by the presence of numerous articles on the subject in journals that are not specifically dedicated to either performance or sustainability. This suggests that the intersection of performance and sustainability in the public sector is an increasingly important topic that is being approached from a multidisciplinary perspective.

Table 6. Top cited journals

Journals	**Category**	**Citations**
Journal of Cleaner Production	Env. St.	429
Sustainability	-	212
International Journal of Sustainability in Higher Education	Edu	206
Journal Business Ethics	Env Sc	92
Intellectual Capital	-	55
Higher Education	Edu	44
Meditari Account Res	-	42
Journal of Public Budgeting Accounting & Financial Management	Pub/fin.	17
International Journal of Sustainable Development	Env. St.	17

Source: Authors' elaboration

Research Question 2: Which authors have emerged as the most productive contributors to the literature on performance and sustainability in public universities?

To analyse the main researchers who have impacted the research on performance and sustainability within public sector universities, one reviewed the count of published articles and their citations (Table 8). A total of 318 authors have made contributions to this area (averaging 3.36 authors for each paper) (Figure 2). The majority of the papers (over 90%) resulted from co-authorship, and nearly half of the collaborative works (42.42%) were created through partnerships among researchers from various countries. The highest level of collaboration (four papers) was observed between scholars from Italy and Australia. Additionally, there is notable diversity in the backgrounds of the authors, with contributors hailing from 30 different nations. Nonetheless, the existing literature is predominantly focused within a limited number of countries and authored by a small group of individuals.

Therefore, the leading researchers are primarily located in countries like Peru, Spain, Italy, Portugal, the United States, and China. The key figures adding to the research on performance and sustainability in public sector universities are Moussa and Nicolo, each having produced three papers, with Moussa associated with Peru and Nicolo with Italy. When it comes to author influence, Mousa holds the highest position as the researcher with the most significant H-Index of 17, closely followed by Nicolo and Leitao, who both have an H-Index of 16. As for the author Nicolo G., he continues to lead as the individual researcher boasting the highest H-Index at 17.

Table 7. Top productive authors

Author	Papers	Citations	H-Index	Period	Country
Mousa M.	3	62	16	2020 - 2023	Peru
Nicolo G.	3	57	17	2020 - 2023	Italy
Alves H.	2	55	n/a	2020 - 2023	Portugal
Alyoussef I.Y.	2	55	6	2021 - 2021	Saudi Arabia
Blasco N.	2	45	7	2019 - 2021	Spain
Brusca I.	2	17	10	2019 - 2021	Spain
Bucatea-Manea-Tonis R.	2	29	9	2020 - 2020	Romania
Dougherty KJ	2	21	11	2012 - 2013	USA
Klein LL	2	n/a	6	2023 - 2023	Brazil
Labrador M.	2	28	5	2019 - 2021	Spain
Leitao J.	2	11	16	2020 - 2023	Portugal
Natao RS	2	29	7	2012 - 2013	USA
Vega B.	2	61	6	2012 - 2013	USA
Yusliza MY	2	16	16	2020 - 2023	Malaysia

Source: Authors' elaboration

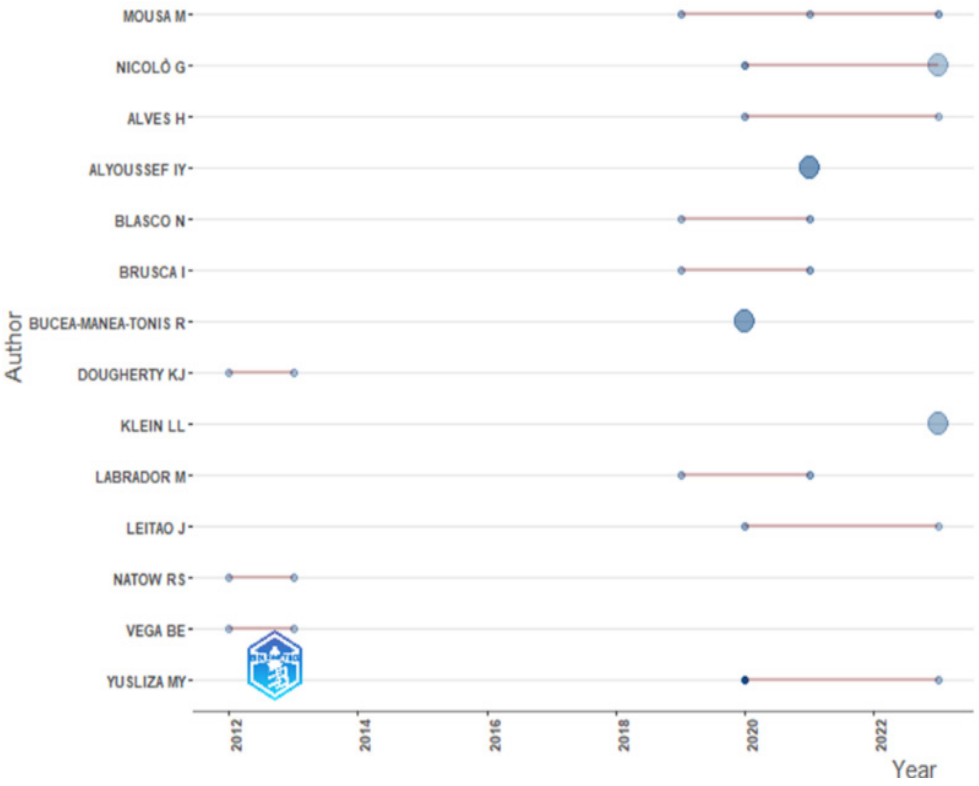

Figure 4. Top 10 authors' production over time
Source: Authors' elaboration

The examination of key articles in the field concerning performance and sustainability within public universities centered on the annual citation counts (Table 8), as this indicates the influence of the papers while considering the specific timing of citation reception. Findings reveal that the paper by Purcell *et al.* (2019), which received 110 citations across all databases, advocates for universities to act as leaders in sustainability. This perspective suggests that universities can further their efforts to meet the Sustainable Development Goals (SDGs) by collaborating with faculty, administrative personnel, students, as well as engaging with a broader group of stakeholders and alumni, who are essential in forging new pathways for society while fostering global citizenship and contributing knowledge and innovation. The Journal of Cleaner Production stands out as the most frequently cited and the third most prolific journal, having published the three leading cited papers.

Research Question 3: Which are the most cited papers and which countries and journals have the most important publications in the field?

Purcell *et al.* (2019), with 110 citations, with "Universities as the engine of transformational sustainability towards delivering the sustainable development goals: 'Living labs' for sustainability", published in the International Journal Sustainability in Higher Education, presents universities as promoters of societal transformation through sustainability, and university performance factors are an important component in aligning universities with sustainability and the SDGs.

Yuan *et al.* (2013), the second runner-up, collected 91 citations with the paper "Green Universities in China - What Matters?" published in the Journal of Cleaner Production, in which she approached Green University from the students' perspective and conducted a critical evaluation of the Green University from the perspective of teachers' performance, graduates' performance, and students' parents' educational achievement (educational attainment). The elements that affect the situation were classified into seven distinct groups: governance frameworks, ecological sustainability, responsible educational programs, innovation and research, personnel growth and incentives, opportunities for students, and community accountability. The findings establish a standard for enhancing the sustainability efforts of 'eco-friendly universities' both in China and globally.

Miotto *et al.* (2020), ranked third, collected 70 citations with the paper "Reputation and legitimacy: Key factors for Higher Education Institutions' sustained competitive advantage", published in the Journal of Business Research, in which university reputation has an impact on legitimacy, which is seen and measured through several pragmatic, moral and cognitive areas of legitimacy, as well as performance, innovation, services and university climate. The findings of this research indicate that both legitimacy and reputation play crucial roles in the success and sustainability of institutions of higher learning. and are actively categorised considering the organisational competitive environment. The advantage of legitimate and highly rated institutions with a good reputation is easier access to resources.

Caeiro *et al.* (2020), who collected 54 citations, with the paper "Sustainability Assessment and Benchmarking in Higher Education Institutions-A Critical Reflection" published in the journal Sustainability Basel, presents a critical analysis of sustainability assessment tools and their effective implementation, selecting two sustainability assessment tools namely Sustainability Tracking, Assessment & Rating System Reporting Tool and Green Metric for the two southern European universities at which the empirical analysis was conducted. The study contributes to encourage higher education institutions to increase their sustainability performance.

As posited by Manes-Rossi *et al.* (2020), who collected a further 54 citations, the paper "Nonfinancial reporting formats in public sector organisations: a structured literature review", published in the Journal of Public Budgeting, Accounting & Financial Management, conducted a literature review pertaining to sustainability reporting performance. This review presented the dimensions of internal and external performance, thus emphasising the importance of performance.

Wolff *et al.* (2017), who collected 51 citations with the article "High Performance Education fails in Sustainability?" - A reflection on Finnish primary teacher education, published in the journal Education Sciences, deals with the conflict between academic performance and sustainability in education. The overall conclusion of this article is that it is absolutely necessary to find a balance between academic performance and sustainable education.

In the paper "Higher education students' perceptions of sustainable development in Portugal", Aleixo *et al.* (2021) collected 36 citations. The paper was published in the Journal of Cleaner Production. Aleixo *et al.* (2021) study provides a complex view on students' perceptions of sustainability in higher education institutions. Social and environmental performance is an area of interest for students. The study concludes that the students surveyed stated that they adopt sustainability behaviours.

Gebreiter (2022) who collected 30 citations with the paper "A profession in peril? University corporatization, performance measurement and the sustainability of accounting academia", published in the journal Critical Perspectives on Accounting, treats performance from the point of view of the profession while emphasizing its role at the institutional level.

Sassen *et al.* (2018), who collected 20 citations with the paper "Characteristics of UK higher education institutions that disclose sustainability reports" published in the International Journal of Sustainability in Higher Education, addresses the issue of sustainability reporting by trying to determine the benefits of sustainability reporting for a higher education institution in terms of institutional performance and what determines it. The results of this study show us that sustainability reporting depends on institutional size, university finances, internal and external motivations and stakeholder concerns.

De Lima *et al.* (2016), who collected 14 citations with the paper "A sustainability evaluation framework for Science and Technology Institutes: An international comparative analysis", published in the Journal of Cleaner Production. The paper presents and develops a sustainability reporting framework that include social, economic and environmental concerns.

Table 8. Most influential publications by number of citations

Authors	Article title	Journal	Total citations
Purcell *et al.* (2019)	"Universities as the engine of transformational sustainability to achieve sustainable development goals: 'Living labs' for sustainability"	International Journal Sustainability in Higher Education	110
Yuan *et al.* (2013)	"Green Universities in China – what matters?"	Journal of Cleaner Production	91
Miotto *et al.* (2020)	"Reputation and legitimacy: Key factors for sustained competitive advantage of higher education institutions"	Journal of Business Research	70
Caeiro *et al.* (2020)	"Sustainability Assessment and Benchmarking in Higher Education Institutions-A Critical Reflection"	Sustainability	54
Manes-Rossi *et al.* (2020)	"Non-financial reporting formats in public sector organizations: a structured literature review"	Journal of Public Budgeting, Accounting & Financial Management	54
Wolff *et al.* (2017)	"High performance education fails in sustainability?-A reflection on Finnish primary teacher education"	Education Sciences	51
Aleixo *et al.* (2021)	"Higher education students' perceptions of sustainable development in Portugal"	Journal of Cleaner Production	36
Gebreiter (2022)	"A profession in peril? University corporatization, performance measurement and the sustainability of accounting academia"	Critical Perspectives on Accounting	30
Sassen *et al.* (2018)	"Characteristics of UK higher education institutions that disclose sustainability reports"	International Journal of Sustainability in Higher Education	20
de Lima *et al.* (2016)	"A sustainability evaluation framework for Science and Technology Institutes: An international comparative analysis"	Journal of Cleaner Production	14

Source: Authors' elaboration

Moreover, despite the existence of numerous public sector journals, the papers that received the highest citations predominantly came from publications in the "Education" category, whereas the journals that published the most cited articles were from the "Science/Environment" category. This situation emphasizes the significance and relevance of performance and sustainability within the public university system, indicating that these subjects are increasingly being discussed in journals that do not focus exclusively on a specific discipline.

Ultimately, the studies that received the most citations were predominantly focused on subjects concerning sustainability and effectiveness within the public higher education arena.

Top journals, authors and keyword relations

In order to investigate the links between the main scientific fields, it was visualised using Three Field Plots. These allowed us to simultaneously analyse the main elements in the selected fields (journals, authors, keywords of articles, cited journals) and interpret how they are connected. Figure 5 visualises the relationships between keywords (left side), authors (middle side) and journals (right side) to show the representative researchers in the field of performance and sustainability in public universities, the fields that are frequently explored and the fields in which the most articles are published.

The analysis shows that in addition to the theme of performance and sustainability in the public university system, which was the central theme of this study, the authors also paid attention to corporate responsibility, which, although specific to the private sector, is also integrated into the statutes of public institutions. Most of their academic work has been disseminated through leading production sources (Sustainability, International Journal of Sustainability in Higher Education, Journal of Cleaner Production and Meditari Accountancy Research), where universities have often been the subject of research.

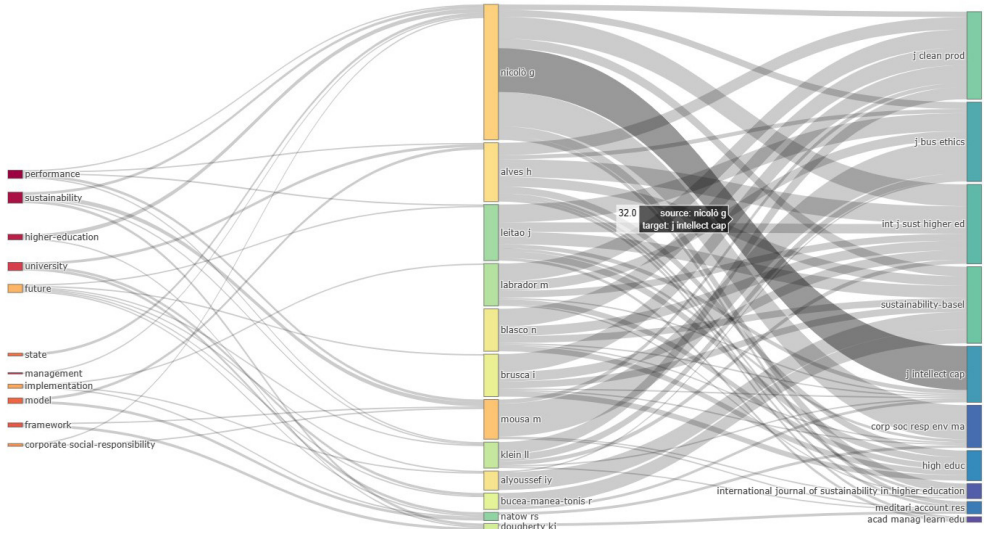

Figure 5. Three field plot: keywords_authors -journals' relations.
Source: Authors' elaboration

Research Question 4: Which are the main research topics related to performance and sustainability in public universities

The first step was to examine the words and keywords that were most frequently in use during the chosen time period. This helped to identify the thematic trends that were related to the topic at hand. Next, it was carried out a more detailed analysis by Grouping the most frequently used keywords. This allowed the examination of the co-occurrence networks that were created, and organised them thematically. Finally, it was analysed the intellectual structure of the topic. This was done by carrying out a co-citation analysis, including historiographical references Words, keywords analysis.

Words and keywords analysis

The "Word Cloud" emphasizes the frequently used terms in the analyzed literature by adjusting their size in the visual representation, illustrating how often specific words appear in the selected documents (Di Vaio *et al.*, 2021). The central terms for this bibliometric analysis include "performance," "sustainability," and "higher education." Additionally, terms like "framework," "impact," "implementation," and "management" were also prevalent in several papers (Figure 6).

Figure 6. Word Cloud
Source: Authors' elaboration

Following this, an analysis of the frequency of the word segment from the selected papers was conducted (Table 9). Keywords from the authors, words from the abstracts, and titles are viewed as key terms for the subjects under examination (Nájera-Sánchez, 2020).

Table 9. Top words

Keywords	**No.**	**Words in Abstracts**	**No.**	**Words in Titles**	**No.**
performance	39	sustainability	267	sustainability	44
sustainability	29	education	228	education	43
higher education	21	study	182	sustainable	23
university	19	public	167	public	19
future	12	performance	163	universities	17
management	11	research	144	institutions	15
model	9	universities	148	performance	15
implementation	9	sustainable	130	university	15
framework	9	institution	116	development	13
corporate social responsibility	9	students	110	analysis	11

Source: Authors' elaboration

As per Fauzi *et al.* (2024) findings, this study examines a limited yet significant selection of articles, with Figure 7 illustrating the gradual increase in the most commonly utilized keywords by writers throughout the years, derived from bibliometric analysis. These keywords emphasize crucial topics within the articles and are employed by authors, editors, and publishers. Performance and sustainability in the higher education system are increasingly evident, according to an analysis of academic papers. The study found that terms such as 'education', 'scholarship', 'development', 'research', 'institutions' and 'analysis' were frequently used in abstracts and titles. The importance of having as much knowledge as possible about university sustainability and how to implement it was also highlighted by the frequent use of the words 'research' and 'implementation'. The research shows that sustainability, together with performance in the university system, are becoming concepts that are revealed both theoretically and practically through the implementation of different strategies, as evidenced by the changes in the frequency of keywords over time. It is worth noting that the analysis was limited to a specific set of materials.

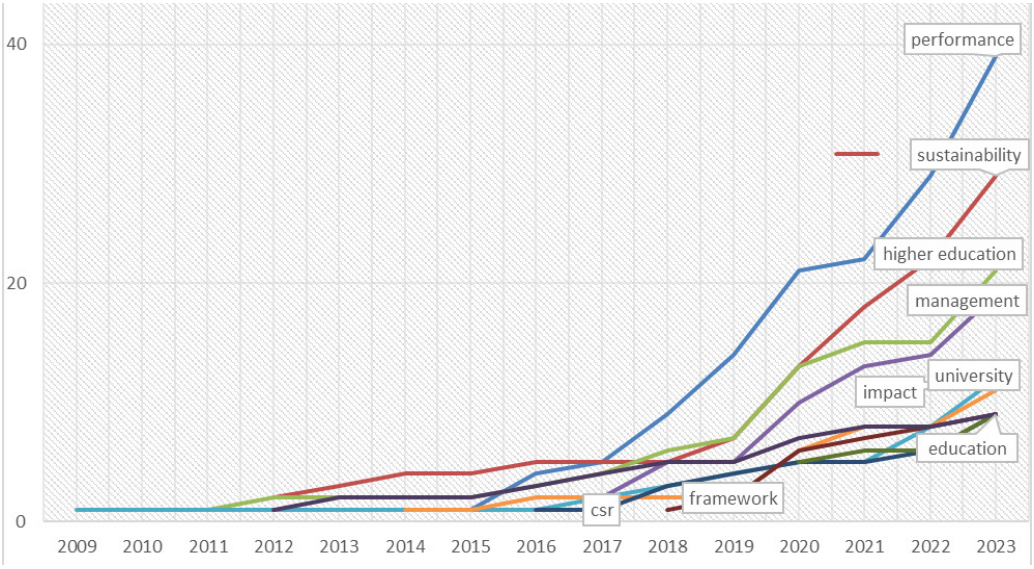

Figure 7. Word dinamics
Source: Authors' elaboration

Interestingly, the terms "performance" and "sustainability" have seen significant growth in popularity over the recent years. This could be attributed to the fact that universities that excel are those that effectively combine their three primary missions in their operations. Conversely, institutions are both encouraged and mandated to incorporate sustainability throughout all areas of their work (such as research, education, and, more recently, environmental stewardship), which has sparked interest among researchers, including those studying universities viewed as entities in the public sector. It is evident that the primary focus of the examined works revolves around performance and sustainability, two ideas that have been explored over time, either broadly within the public sector or, more recently, in higher education in particular. However, even if the approach of researchers to performance and sustainability in the higher education system has increased, it still leaves room for future studies. It's worth noting that the word "governance" appeared 20 times in 2023. This could be attributed to the importance of the sharing of responsibilities at the university level and to the positive impact that the principles of governance have on the formation of culture (Oliveira *et al.,* 2020).

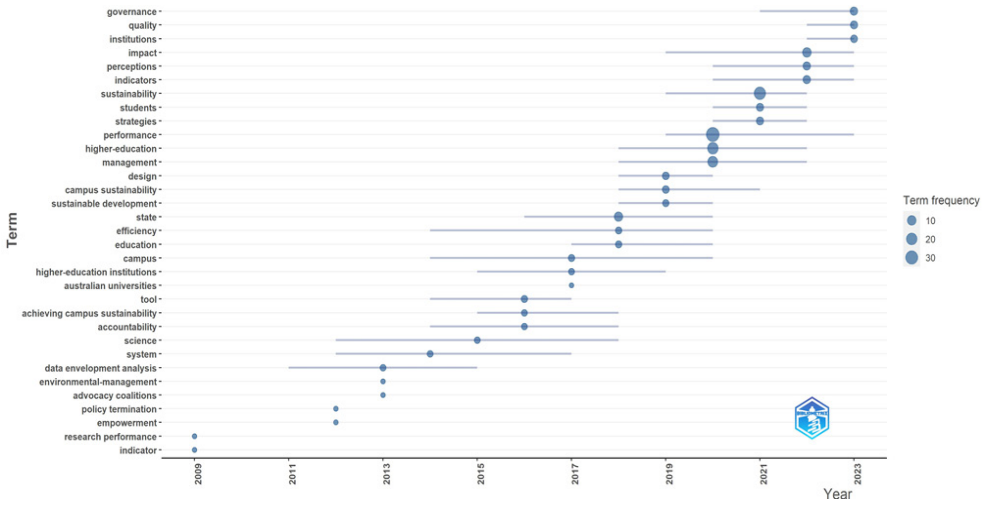

Figure 8. Trend topic
Source: Authors' elaboration

Co-keywords analysis

A network analysis of the keywords from authors was utilized to explore the primary research domains in the literature concerning performance and sustainability in public universities (Figure 9). This approach facilitated the identification of the links among concepts in a specific research area, allowing for an understanding of how academic work has progressed around certain subjects. In Figure 9, the dimensions of the circles illustrate their significance relative to the frequency of the keywords, which were determined using a centrality metric; therefore, bigger circles indicate associations with a greater number of papers.

The network of keyword co-occurrence emphasizes the strong connections among the topics explored in this study, illustrating how these connections manifest, and expanding the perspective on the ideas of "performance and sustainability within the public university framework.

To recognize the patterns in a particular research domain, the connections among these patterns and how central they are were investigated using word analysis techniques. To highlight the expansion of the pattern within the entire scientific discipline and its significance, the size reflects the total contribution of every keyword. The mapping considers the theme's significance in the research area (centrality) as well as its evolution (density) (Stefanescu, 2021).

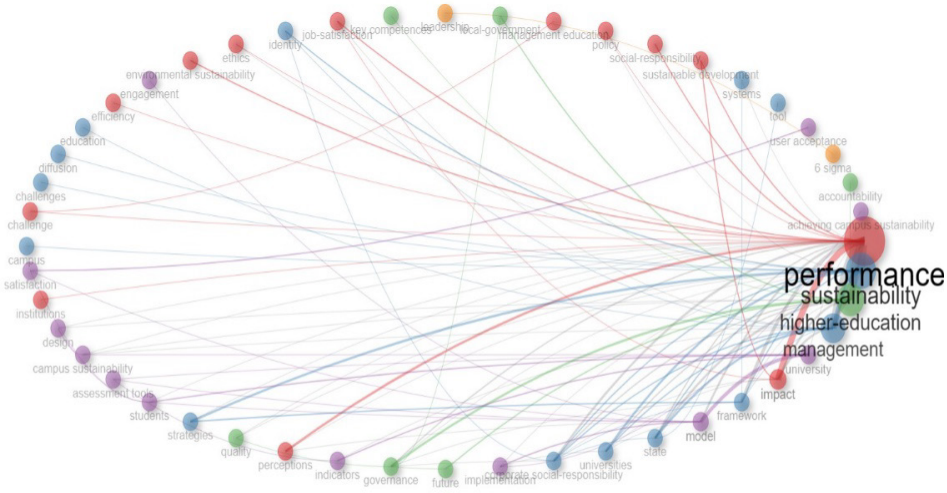

Figure 9. Keyword co-occurrence network
(clustering algorithm Louvarien, network layout -circle)
Source: Authors' elaboration

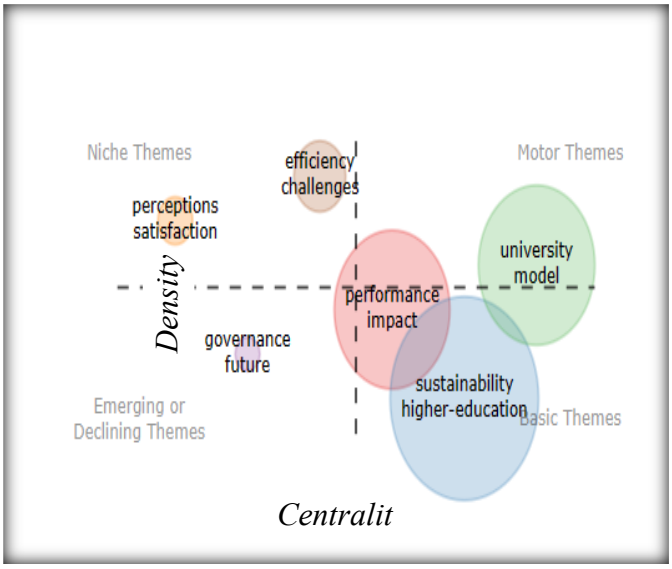

Figure 10. Thematic map
Source: Authors' elaboration

Co-citation analysis

The academic framework is constructed through a historical framework of direct references (Figure 11). It offers a timeline of significant studies by researchers concerning the chosen subject and outlines its historical evolution annually, relying on different connections. The points indicated by the referenced articles and the lines representing the direct references were arranged on a directed graph according to the year of publication, shown on the x-axis (Stefanescu, 2021).

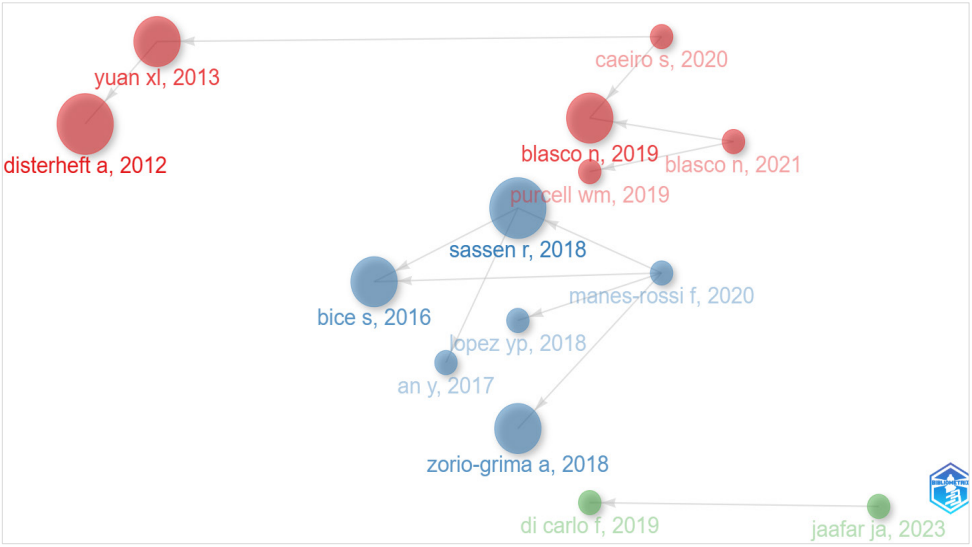

Figure 11. Historical direct citation
Source: Authors' elaboration

The papers represented on the map show the topicality of the sustainability and performance of the public university system; the map highlights, on the one hand, the names of the authors and, on the other hand, the themes addressed. Three lines of research have thus emerged:

(1) The first line of research attached to the first red cluster are the authors: Disterheft *et al.* (2012), Yuan *et al.* (2013), Blasco *et al.* (2019), Blasco-Blasco *et al.* (2021), Purcel *et al.* (2019), Caeiro *et al.* (2020). It was recognizable through the understanding that followed the primary elements of the "sustainability" subject, which examined the connections related to how universities contribute to promoting sustainability, efforts and practices aimed at sustainability within higher education establishments. This knowledge has

been acquired and has established the groundwork for changes within the educational framework. As a result, universities are now making efforts to contribute to the achievement of the sustainable development goals (Blasco *et al.,* 2019).

(2) The second line of research attached to blue cluster are the authors Lopez & Martin (2018), Zorio-Grima *et al.* (2018), Bice & Coates (2016), Sassen *et al.* (2018), Manes-Rossi *et al.* (2020) it was possible to identify it, knowing that traced the main foundations of the 'approaching performance and sustainability in public higher education' connecting with the mission statements and their impact on sustainability performance (Lopez & Martin, 2018).Academic performance is related to sustainability through learning about sustainability and adapting to technology, which can affect academic and research satisfaction and performance (Brusca *et al.,* 2019). Exploring the connection between performance, sustainability practices, and their impact on public universities (Zorio-Grima *et al.,* 2018).

(3) Third line of research attached to green cluster are the authors Di Carlo *et al.* (2019), Jaafar *et al.* (2023), approached the university public system which is subject to societal pressure to be efficient and sustainable. There is also the problem of financing the public university system and the connection with financial sustainability.

Conclusions

The pressure of responsibility from the interested parties on public higher education is also determined by the primordial role of universities in society, also a growing need for responsibility included in the form of the university mission. Researchers in the field have begun to pay more and more focus to sustainability issues and how to implement them at the level of public higher education.

The research was carried out to investigate how performance correlates with sustainability within the public university framework. In contrast to earlier research that primarily examined a single concept or performed a regulated literature analysis, this document sought to present an all-encompassing understanding of performance and sustainability, concentrating specifically on the public university sector.

This research employs bibliometric analysis to explore the realm of science. It offers both factual information and conceptual examination of the topic at hand, minimizing the biases found in narrative or systematic reviews. Utilizing bibliometric analysis facilitates a clear review process grounded in quantitative measures like articles, contributors, publications, references, and scientific mapping.

This study concentrated on the progression of the ideas surrounding performance and sustainability within public higher education and pinpointed the key journals, the most active researchers, and the prominent articles in this field, enabling researchers to chart the frameworks of the conceptual and intellectual landscape of the research community. This has yielded important revelations regarding the prevalent themes and collaborative efforts, aiding the comprehension of the evolution of the subject. In summary, the analytical overview indicates that investigations into the public university system are still nascent, yet have shown considerable expansion over the past few years. The results show that in the last three years, the interest in performance and sustainability has led to an increase of up to 66% in articles on sustainability and performance in the public university system.

The descriptive analysis shows that, despite the current high level of interest in the concepts of performance and sustainability in the public university system, research is still at a relatively early stage, with fluctuating growth in recent years. The trend points to further efforts to explore new avenues of research or to deepen existing ones. The scientific landscape was completed by authors from different regions of the world, but mainly from Europe (e.g. Spain and Italy) and China or the USA. The work of these researchers has been published in a variety of journals, not only those directly concerned with issues of sustainability and performance in public higher education, educational studies and ethics, but also in other economic fields (finance, management). This indicates a broad interest in the topic of performance and sustainability in public higher education and underlines its importance.

The results of the leading authors during the period analysed show us the extent, quality, potential and active role in the knowledge and implementation of performance and sustainability at the higher public level and the promotion of sustainability reporting in the public sector. Although there was initially little interest in the topic, there has been an increase in the relevance of the issue over time. Lately, the attention given to the subject has resulted in a large number of articles.

The network analysis provides valuable information that paves the way for future research in the field. Academic literature has responded to the need for a better understanding of the concepts discussed and the role of educational and public institutions in achieving performance and implementing sustainability. Over time, this field of study has evolved, and there is a call for more research to focus on these concepts in the context of public higher education.

The framework illustrates three avenues of investigation, indicated by the key terms and associated topics recognized, centering on “sustainability,” “performance,” and “university system.” Additionally, the thematic diagram

verifies that these avenues are pertinent to the area of study while also promoting potential future research on "isolated" and "emerging" topics, like corporate governance, which has yet to achieve significant importance in the examined domain.

All the outcomes referenced previously hold both theoretical and practical significance. These findings are pertinent for scholars who aim to further engage in critical discussions about sustainability reporting within the public sector. In this context, one can suggest that future studies focus on the quality, applicability, and effects of disclosed information that could facilitate the establishment of a suitable reporting structure for the public sector, alongside thorough investigations into the factors influencing sustainability reporting and their potential effects on establishing and achieving objectives. Additionally, the conclusions drawn from this paper are beneficial for policymakers in enhancing support for sustainability efforts and organizations involved in these initiatives.

The contribution to the development of the studied research field is as follow: first of all, by revealing the evolution of performance and sustainability concepts integrated into university missions. Secondly, synthesizing the most influential journals, the most cited and recognized authors and the most important articles in the specialized literature, the evolution of key -terms with the support of bibliometric analysis.

The limitations of the present study are: first, the analysed documents were limited to articles present in a single database Web of Science. As a result, it excluded some types of publications such as books, chapters, and articles that could have impacted the research results. However, this choice was made to ensure high-quality research standards, greater precision, and a lower degree of subjectivity, as justified in previous studies (Stefanescu, 2021).

The study's focus was on descriptions and trends of the dataset, including work citations, author citations, relevant sources, domains, and affiliations. However, there were some characteristics of the bibliometric analysis did not examine (social structure of collaboration networks and world maps). Nonetheless, since the study aim was to identify the relationship between performance and sustainability in the public university system, both the selected sample and the scope of the bibliometric analysis objectively answered the research questions proposed in this study.

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