Mapping Higher Education Sustainable Supply Chain Management: A Systematic Review with Bibliometric and Network Analyses

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Abstract

Purpose: This study aims to comprehensively examine the integration of sustainable supply chain management in higher education institutions through bibliometric analysis and systematic literature review. It deeply explores the theoretical foundations and practical applications of Higher Education Sustainable Supply Chain Management (HESSCM) across different cultural contexts, so as to fill the gap in cultural adaptability research in this field and provide theoretical support and practical guidance for universities to more effectively implement sustainable supply chain management globally. **Design/methodology/approach:** This study examines 59 peer-reviewed articles through bibliometric analysis to explore research focus, collaboration patterns, and geographical distribution, alongside a systematic literature review. This systematic review examines the theories and practical applications of HESSCM, comparing Eastern examples from China, Indonesia, Oman, and Vietnam with Western cases from Spain, Italy, Germany, and Latin America, while considering environmental concerns, a human-centered approach, technology integration, and institutional challenges in educational innovation. **Findings:** A novel theoretical 3 layers framework that consist drivers (Regulatory, Stakeholder and Technology), practices (sustainable procurement, resource usage and educational innovation) and performances (environment, society, economy and education quality outcomes). Different patterns appear between Eastern & western organizations. The eastern one pays attention to its technology integration such as China's Metaverse Integration Evaluation system as well as operational effectiveness including the carbon footprint evaluation of university cafeteria operations; the west is interested in stakeholder interests with university – community cooperation efforts and thorough environmental review incorporating UN Sustainable Development Goals into supply chain logistics instruction. Bibliometric analyses showed huge gaps among the research areas of focus and the cooperation actions undertaken by academics from Asia and those from Western countries; meanwhile scholars from Africa and the Middle East did very

few research. **Research limitations/implications:** The study exhibits geographical bias, with East Asia overrepresented and Africa, the Middle East, and other developing countries underrepresented. Some methods have limitations, such as the constraints of bibliometric analysis, potential bias favoring published positive results over unpublished ones, language barriers, and databases that exclude non-English literature. These limitations indicate directions for future research. Expand geographical coverage; employ both quantitative and qualitative research methods, including quantitative and case-study approaches; conduct a longitudinal study on HESSCM evolution; develop standardized context-sensitive evaluations; carry out surveys or interviews to address implementation challenges. **Practical implications:** The study provides evidence-based recommendations for educational leaders and policymakers. Institutions must implement HESSCMs through a staged and context-specific approach, considering local laws, institutional capabilities, and stakeholder conditions. Investment in technological infrastructure such as AI and IoT is essential. It is necessary to measure sustainability, for instance, through a carbon footprint evaluation system. Additionally, effective communication is crucial, and channels must be established for stakeholder participation to ensure the integration of traditional projects with green initiatives. Policy makers must create flexible regulations that connect global sustainability standards with the needs of diverse communities and establish pathways for learning and information exchange from the successful practices of other organizations. **Originality/value:** This article contributes to the literature in three distinct ways. Initially, This study create a comprehensive HESSCM framework that considers cultural and institutional contexts, integrates material resources with non-material education, and distinguishes the educational supply chain from the commercial supply chain. The second point concerns the identification of key success factors for implementation across different regions, such as Eastern institutions that emphasize technological effects and standardization, in contrast to Western institutions that prioritize involvement approaches and stakeholder cooperation. Thirdly, this study provides evidence-based recommendations for educators and policymakers to address geographic bias.

Keywords: Higher Education, Sustainable Supply Chain Management, Digital Transformation, Cultural Differences, Sustainable Performance

Introduction

Higher education institutions (HEIs) increasingly face the imperative of resolving concerns regarding sustainability in addition to maintaining educational effectiveness and operational efficiency. According to a recent study, such universities contribute a significant level of greenhouse gas emissions, with 94% of such contribution being through indirect emissions linked with value chains (Barton et al., 2025). Such a high level of contribution to the environment underlines a critical imperative for such universities to implement methodologies for sustainability, specifically in terms of value chain management and institution operations. Higher Education Sustainable Supply Chain Management (HESSCM) comes in as a key yet underexploited mechanism for improving institution effectiveness. Despite its long-standing role in enhancing organizational sustainability, its use in improving the performance in terms of sustainability in universities is not yet coherent and uniform. HESSCM comes in as a unifying model that integrates conventional approaches to supply chain management with specific requirements for sustainability in educational settings, such that direct and indirect concerns regarding the environment in academia receive proper consideration (Ahmad Mustaffa et al., 2023).

The higher education supply chain (HESC) is a complex network of organizations, processes, and assets extending beyond traditional procurement and logistics operations (Mohamed et al., 2023). According to Su et al. (2021) and ITESCM frameworks concur that such a procession involves: (1) Input processes, including student and faculty recruitment and procurement of assets; (2) Central operations, including instruction, research activity, and campus administration; (3) Output processes, including graduate employment, information dissemination, and community service contribution; and (4) Support operations, including administration, campus infrastructure, and information technology infrastructure. Integration of sustainability in HESSCM holds potential for significant improvements in terms of environment, society, and economy (Khaw et al., 2024).

Although numerous universities have started several sustainability programs Martínez-Acosta et al. (2023); Rosi and Obrecht (2023), these programs often lack integration in an overall model for a complete supply chain. For instance, Lang et al. (2024) showed that most universities prefer having discrete, standalone programs for sustainability over a whole institution model (Aboelmaged et al., 2024). Despite significant achievement in sustainable operations in universities and studies in supply chain management, a strong lack of integration in operational processes in supply chains with overall institution performance in terms of sustainability continues (Sreenivasan et al., 2023). Earlier studies have not utilized bibliometric analysis and systematic review techniques with an integration view (Barton et al., 2025; Lang et al., 2024; Sreenivasan et al., 2023).

The presents study overcomes these current gaps through a mixed-methods approach combining bibliometric analysis with a systematic review of current literature. In an in-depth probe, it clarifies the intellectual development of university sustainable performance, in terms of Higher Education Supply Chain Management (HESSCM), in contrast with emerging studies that exclusively focus on individual factors, such as environmentally friendly procurement Oestreich et al. (2024) and compost disposal (Alazaiza et al., 2024). Employing both thematic and bibliometric analysis through R studio, through a blending of theoretical underpinnings with empirical observations, this study enriches its investigation of academic institution practice and performance in terms of sustainable supply chain management (Le et al., 2023).

For a deeper understanding of the emerging field of HESSCM, the current study aims to explore a range of key research questions. It seeks to theorize and map HESSCM in terms of its position in the university system, develop a strong theoretical model with its key requirements and dimensions underpinning institutionality, and explore significant trends and trends through network, bibliometric, and theme analysis. In addition, through such an investigation, it seeks to explore practice and performance variation in terms of region, specifically between Eastern and Western regions, and factors contributing to such variation. By studying these questions through a mixed-methods analysis combining bibliometric analysis, systematic review, and qualitative analysis, through a blending of theory and practice, current study aims to make HESSCM a standalone field of academic inquiry and contribute useful insights for university administration in a range of cultural settings.

Literature Review

Higher Education Supply Chain Management (HESCM)

The Higher Education Supply Chain Management (HESCM) model is a key model for understanding and strengthening an efficient network of processes, assets, and parties in educational environments. Sreenivasan et al. (2023) state that HESCM is a complete model that transcends conventional procurement and logistics operations, including the whole of educational service delivery and value creation. In its model, universities have been seen as individual service providers, with dissemination and development of capacity being an integral part of supply chain processes (Oestreich et al., 2024). In drawing insights from modern frameworks Gök et al. (2024) state that HESCM stands out in its consideration for intangible assets and educational achievement, in contrast with conventional supply chain management, whose sole concern is tangible goods. In its model, HESCM is seen to necessitate a blending of academic success with operational effectiveness in a quest to maintain educational service delivery quality.

The essential processes of Higher Education Supply Chain Management (HESCM) can be grouped into four interrelated but discrete dimensions (Syed et al., 2024). Student recruitment, faculty recruitment, and procurement of resources form a base for educational delivery in the initial processes. Instruction, research, and campus administration form a backbone of operations in the middle, converting these inputs into educational value (Trevisan et al., 2024). Output processes include graduate employment, information dissemination, and community service, and supporting operations including administration, campus management, and information technology services, working together to enable efficient working of the whole system. This panoramic view of HESCM is a model for educational institutes to follow a systemic approach in managing processes and assets towards overall educational objectives (Lin & Yu, 2024). The model identifies institution-specific factors in education, with success not measured in terms of operational effectiveness alone, but through academic achievement and its impact at a social level.

Sustainability in Higher Education Supply Chain

The ecological impact of higher educational institutions has become increasingly salient, particularly with regards to value chain-related activities. A comprehensive study by García-Alaminos et al. (2022) showed that 94% of a university's greenhouse gas emissions can indirectly be linked to its value chain-related operations; therefore, necessitating an imperative for university value chain sustainability (Bathla et al., 2023). For real-life application in university value chain operations, a variety of key operational areas have been considered for incorporation of programs towards sustainability. Specifically, in relation to campus meal service operations, Lin and Yu (2024) determined significant financial and environmental savings derived through programs for minimizing food loss in university meal service operations in university cafeterias. According to its report, not only did such programs contribute towards minimizing environmental impact, but operational efficiency improvements through a move towards environmentally friendly service delivery processes ensued as well.

Similarly, Wang et al. (2024) concluded that food purchasing in an institution in a food service sector profoundly impacts the environment, and food loss and food waste reduction strategies have larger greenhouse savings over conventional forms of practice towards

sustainability, such as packaging minimization and locally buying. Adoption of sustainable supply chain practice in higher education varies geographically a lot. Integration of sustainability in curriculums in higher education in nations in a region in the Middle East was researched through a systemic review conducted. Khai Loon Lee et al. (2023) In their study, high variation in countries in terms of practice towards sustainability was observed, with an observation that certain regions have a high preference for a specific dimension, such as transportation efficiency, over a whole range of approaches towards a value chain (Aung & Hallinger, 2023). The results of the study showed that integration of sustainability in higher education doesn't necessarily comply with national performance in terms of sustainability, thus suggesting a complex relationship between institution practice and overall evaluation of environmental performance. Overall, these studies reiterate the urgency for a long-term strategy dealing with sustainability in value chains in higher education, taking into consideration both immediate operational and overall systemic consequences in a whole value chain.

Integration Challenges and Research Gaps
Despite increased awareness regarding sustainability in value chains in relevant higher education, significant impediments in practice for full coordination of methodologies remain present. Huang et al. (2022) mentioned that even many universities have embraced a variety of such sustainability programs, but such programs lack integration in a single value chain model, and therefore such interventions become fractured and less effective in practice. Widespread use of single, disconnected approaches towards sustainability, in contrast to an overall integration, is a key constraint in present practice (Tominaga et al., 2021). Most institutions prefer putting discrete programs for sustainability, such as conservation of energy and minimizing waste, in practice, ignoring integration in a value chain (Basu et al., 2016). All such fractured approaches will deliver fewer effective results and will not maximize synergistic improvements in an institution's value chain.

The present scenario of studies is characterized by a range of critical gaps in studies and frameworks. There is a strong lack of frameworks that effectively integrate supply chain approaches with institution performance indicators in relation to sustainability. For instance, there is a strong lack of studies focused on analyzing successful case studies in a variety of institution settings (Alazaiza et al., 2024; Aung & Hallinger, 2023; Barton et al., 2025; Su et al., 2021). In addition, a significant distance between theoretical frameworks and real-life implementations, specifically in relation to specific concerns in managing sustainable supply chains in Higher Education, can be seen. In addition, current studies refer to a critical necessity for an integral theoretical model that can make institutions implement sustainable supply chain approaches, with consideration for complex relationships between academic aims, operational effectiveness, and environment accountability. Such a theoretical model should not only include ecologic concerns but social and financial dimensions of sustainability in Higher Education, too. Identified gaps refer to a critical necessity for developing an integral model with an effective role in closing the distance between individual, discrete approaches and coherent methodologies in managing a Higher Education supply chain environment.

Theoretical Framework
Higher Education Sustainable Supply Chain Management (HESSCM) is a critical practice combining approaches for sustainability with conventional techniques specifically designed

for supply chain management in Higher Education's specific environment. Building upon Jin et al. (2024) theoretical model for educational supply chains, Liu et al. (2022), focus on sustainability, Higher Education Sustainable Supply Chain Management (HESSCM) can be defined as a deliberate and systemic integration of sustainable development aims in planning, operational effectiveness, and governance of key supply chain operations in universities and colleges. HESSCM involves the delivery of goods, information, and service between providers and receivers, and entails a delicate balance between stewardship for the environment, social accountability, financial viability, and maintenance of academic performance. Unlike traditional supply chains focused solely on physical products, HESSCM incorporates tangible resources such as facilities and materials and intangible elements like knowledge transfer and skill development (Kiet et al., 2024). It also recognizes the multi-stakeholder nature of higher education institutions and their unique role in fostering sustainable development through teaching, research, and community engagement (Lang et al., 2024). The proposed HESSCM framework consists of three interconnected layers: drivers that motivate sustainable practices, core practices that implement sustainability principles, and performance dimensions that measure outcomes, all contributing to the overarching goal of achieving sustainability in higher education supply chain management while maintaining academic excellence and operational efficiency.

HESSCM Framework Components
The HESSCM model proposed involves three interconnected layers. The first layer focuses on both external and internal drivers, while the second layer emphasizes key HESSCM practices, and the third layer identifies performance dimensions. As the connecting platform through all layers, human-centric sustainability ensures incorporation of stakeholders, development of professionals, and social accountability. It integrates sustainability actions with individual and community requirements, creating a balance between operational and social consequences.

External and Internal Drivers
Higher education institutions face several key factors that impact the practice and implementation of higher education sustainable supply chain management (Kiet et al., 2024). All these factors can be grouped into three general categories: the regional policy and regulatory environment, demand from stakeholders, and a need for a digital transformation. Regional policy and regulatory environment form a key driving force for HESSCM practice. According to Jin et al. (2024) universities in China face obstacles in practicing sustainable procurement through uncertain policies and a lack of additional specific requirements for sustainability. Effectiveness in terms of sustainability programs is often boosted through incentives and public-private collaborations, creating environments conducive to practicing sustainable operations (Salinas-Navarro et al., 2024).

Stakeholder demand is also a key driving force for HESSCM practice. Durán-Sandoval et al. (2024) emphasized service gaps in relation to service delivery, impacting university stakeholders' satisfaction, in terms of students' and faculty requirements in particular. In addition, industries' requirements and integration with the labor market have a critical role to play; Al Harrasi et al. (2024), showed that a lack of coordination between educational output and requirements in industries creates a demand for curricula and skill development reform programs. Additionally, Lang et al. (2024) showed that community participation

through participatory forums and collaboratively generated knowledge promotes participatory governance and empowers community representatives.

Digital transformation is a key driving force in re-engineering higher education supply chain management practice. According to a study by. Han et al. (2024) IoT and AI-powered model improvements enable efficient scheduling and personalized delivery of educational processes in universities and colleges. As a result, incorporation of such technology creates a demand for cutting-edge educational tools, Wang et al. (2024) investigating synergies pertaining to the metaverse for driving digital transformation and immersive experiences in universities and colleges (Khaw et al., 2024). In short, these factors form a multi-faceted model in which overall HESSCM practice must be designed and implemented. Interaction and contribution of these factors direct the university and college strategic path towards attaining sustainability in supply chain operations, with individual practice and performance discussed in detail in subsequent sections.

Core HESSCM Practices
The HESSCM model's middle layer contains the key practices that are followed by universities and colleges in order to achieve sustainable supply chain management, which are classified into three main areas: sustainable operation (procurement, logistic etc.), resource optimization, and education innovation (Kiet et al., 2024). Sustainable operation, like sustainable procurement, a basic practice, entails issues like green supplier selection and supply chain optimization, as per Jin et al. (2024), who focused on strategies for Chinese institutions. Similarly, Al Harrasi et al. (2023) demonstrated that local sourcing strategies bolster regional economies and lower transport emissions, although waste minimization has an even better environmental effect. Resource optimization is another basic sphere, with K. L. Lee et al. (2023) showing how the use of technology and digital logistics promotes efficiency and cost savings through data-driven approaches. García-Alaminos et al. (2022) showing that 94% of a university's carbon footprint is due to indirect emissions in the upstream value chain, with implications for the necessity of energy conservation and waste reduction measures. In addition.

Additionally, Durán-Sandoval et al. (2024) tackled food waste issues in university cafeterias and suggested mitigation solutions based on enhanced infrastructure and operational efficiency. Educational innovation represents the third pillar, and Salinas-Navarro et al. (2024) demonstrated how experiential learning models can successfully incorporate sustainability concepts in supply chain management education. This was also complemented by Terrón-López et al. (2020) who employed project-based learning in engineering for building sustainability competencies, whereas Pudjiarti et al. (2024) emphasized the role of university-industry collaboration in driving innovation performance and sustainable practice adoption. Such intersecting practices facilitate the successful deployment of sustainable supply chain management in institutions of higher learning, entailing meticulous consideration of institutional context, resources, and stakeholder expectations within overall sustainability goals.

Performance Dimensions
HESSCM's effectiveness can be measured by four intertwined performance dimensions environmental, social, economic, and educational quality outcomes - that cumulatively form

a comprehensive model to measure sustainable supply chain activities in universities. Environmental performance emphasizes minimizing carbon footprints and optimizing resources since, Liu et al. (2022) stipulated that 94% of university emissions are indirect, thus requiring a lifecycle effect evaluation. The paper integrates food waste minimization and circular economy strategies, applied by Durán-Sandoval et al. (2024) to cafeteria management, and green campus initiatives and environmental responsibility, as demonstrated by Le et al. (2023) through waste reduction and energy conservation programs. Social performance is focused on social responsibility and societal engagement, Lang et al. (2024) in the form of co-production of knowledge between universities and societies, and gender equity and diversity actions as portrayed by Berra and Cavaletto (2020) in addressing STEM gender disparities and promoting inclusive education.

Furthermore, the research conducted by Liestiandre et al. (2024) work highlights service quality with regards to student and employee wellbeing, satisfaction, and welfare. Economic performance is concerned with operational efficiency and cost-effectiveness, as demonstrated by Al Harrasi et al. (2024) via digital logistics, university competitiveness, and graduate employability, researched by Al Harrasi et al. (2023) and industry relevance and revenue growth, demonstrated by Pudjiarti et al. (2024) knowledge management and collaboration. Improved knowledge and skills in alignment with industry demands, as pinpointed by Alazaiza et al. (2024) employment competitiveness, examined by Cammarano et al. (2022), and innovativeness and problem-solving ability, as emphasized by Huang et al. (2022) for the aims of university-industry partnerships, constitute quality education and sustainable talent development for tertiary education. The four dimensions are strongly interrelated because environmental actions often produce economic benefits and support social impacts, and improved quality of education results in sustainability innovation and supports economic outcomes. The integrated approach ensures that HESSCM programs collectively enable institutional sustainability goals.
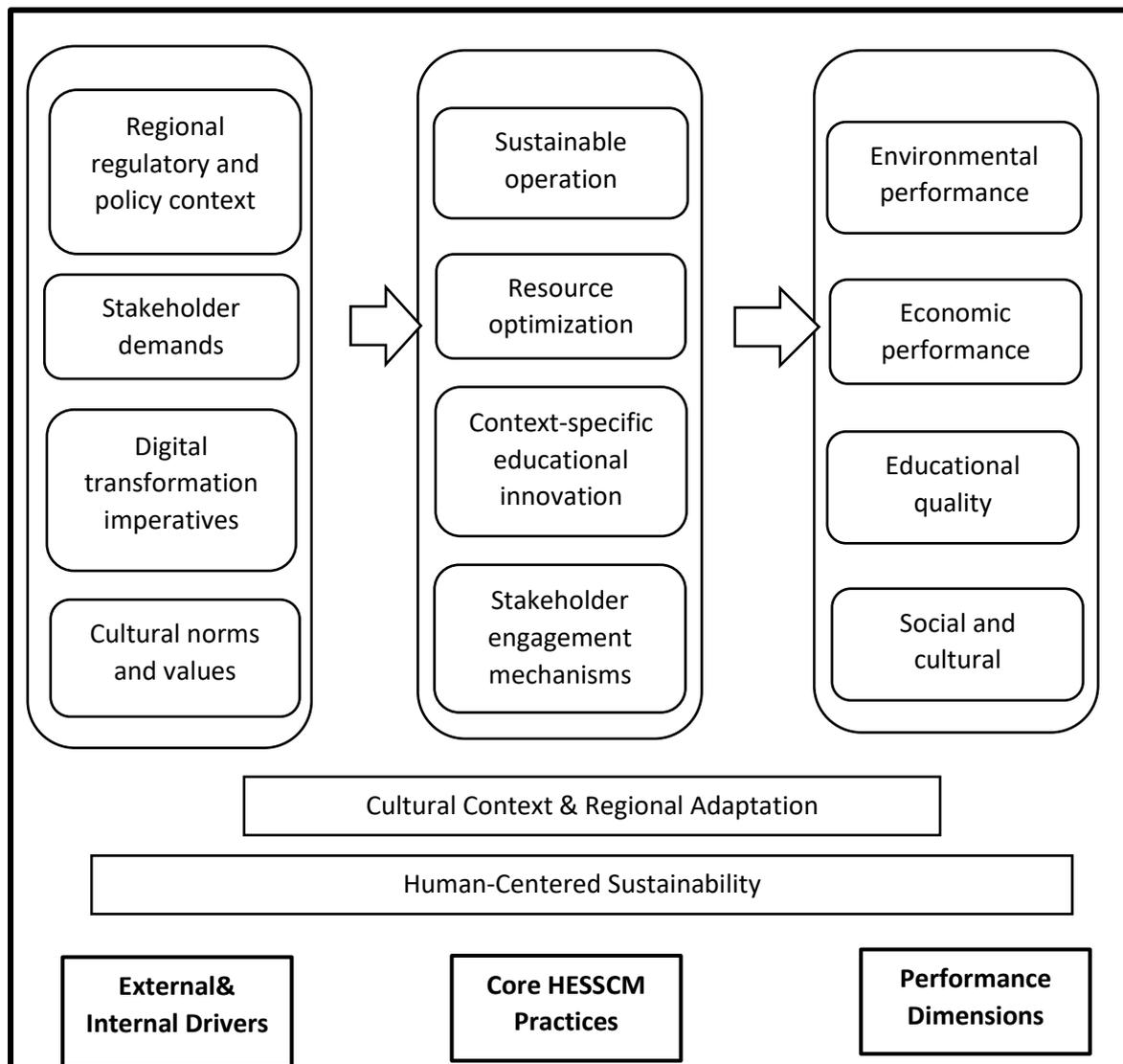
Figure 1: Conceptual Framework of Study

Methods

Systematic Literature Review

Systematic literature review (SLR) provides "explicit and reproducible methods to identify, select, and critically appraise relevant research, and to collect and analyze data from studies included in the review" (Idrees et al., 2023). This methodological approach has proven effective for synthesizing research evidence while minimizing bias Rojas-Sánchez et al. (2023), particularly in emerging fields such as sustainability in higher education. Following established SLR protocols Hosseinnia Shavaki and Ebrahimi Ghahnavieh (2023), this study employs a structured approach comprising database selection, keyword identification, article screening, and content analysis. Figure 1 presents the detailed methodological framework used to examine sustainable performance through supply chain management in higher education.

Keywords and Data Source Selection

This study utilizes Scopus as the primary data source. Scopus, being one of the largest peer-reviewed literature abstract and citation databases globally, offers superior data quality and

coverage advantages. Compared to Web of Science, Scopus demonstrates enhanced journal coverage and timely literature updates, particularly in interdisciplinary research domains (Von Berlepsch et al., 2024). The selection of appropriate keywords is crucial for identifying relevant articles in the field of higher education sustainable performance and supply chain management.

To ensure comprehensive coverage, we developed keyword combinations across four main categories: (1) higher education terms (e.g., "higher education", "university", "universities", "college", "tertiary education"); (2) sustainability terms (e.g., sustainable* OR "sustainable development" OR "green campus" OR "Environmental" OR "Social" OR "Economic*" OR " Operational"); (3)performance terms (e.g., "performance" , "assessment" , "measurement" , "efficiency" , "effectiveness") and (4) supply chain terms (e.g., "supply chain", "supply chain management", "SCM", "educational supply chain"). These keyword combinations are presented in Figure 1.
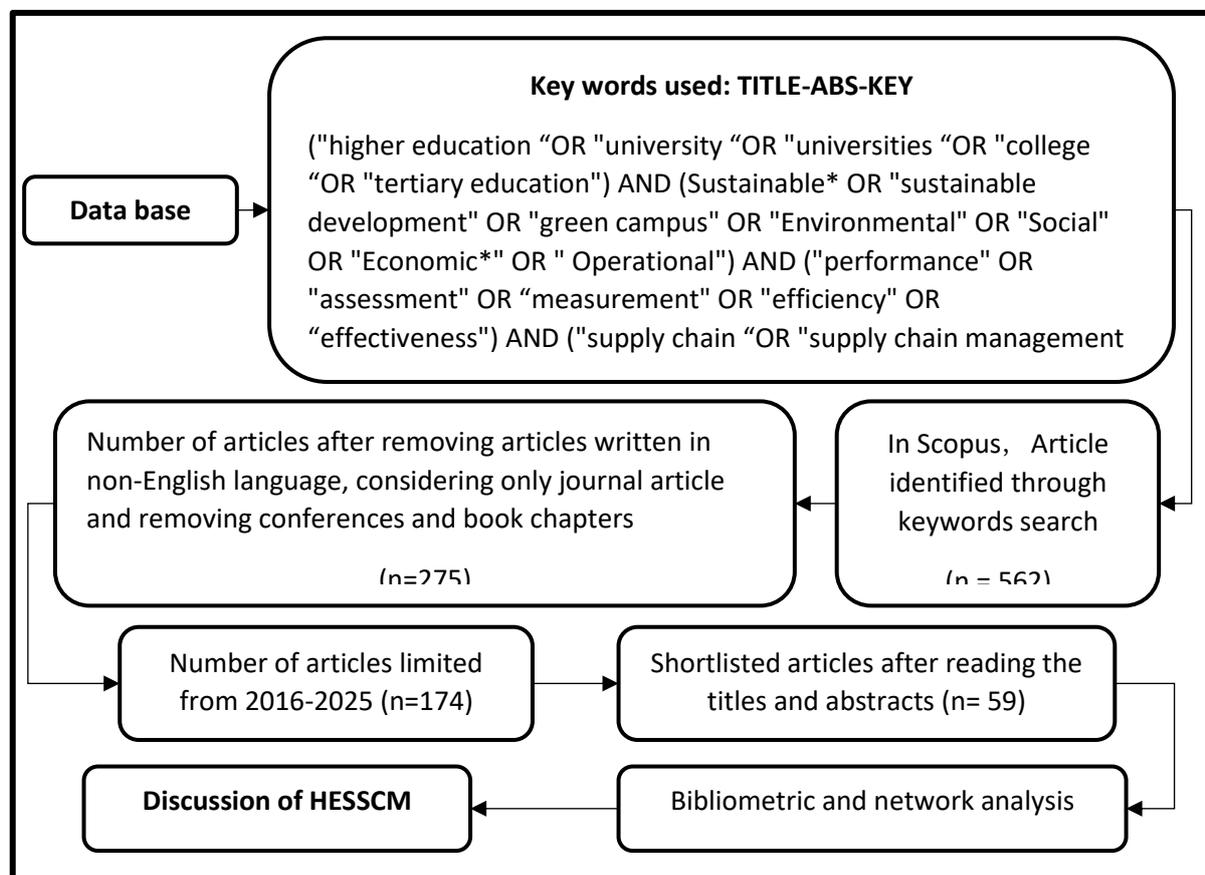
Figure 2 Methodology

Inclusion and Exclusion Criteria
Initial database search using keyword combinations yielded 562 articles. To ensure the quality and relevance of the selected literature, we established specific inclusion and exclusion criteria. For inclusion, articles must:
1. Should be published in peer-reviewed journals
2. Should focus on sustainable performance in higher education context
3. Should contain supply chain management elements
4. Should be written in English.

5. Should not be any form of conference papers, book chapters, and working papers as they typically undergo less rigorous peer review processes.

Following this filtering process, 275 articles can be filtered. Over this time period (2016-2025), Higher Education Sustainable Performance was largely shaped by disruptive events and innovations, notably the COVID-19 pandemic and the rapid upsurge of AI and big data. COVID-19 was a catalyst for accelerated digital change and adaptation within higher education, compelling institutions to reimagine sustainable practice and resilience approaches. At the same time, innovations in big data and artificial intelligence have reconfigured educational planning, resource management, and decision-making, reflecting demands for data-driven sustainable solutions within tertiary education. The era thus provides singular insight into the way in which these variables separately and together shaped and still affect sustainable performance. 174 papers published from 2016 to 2025 were shortlisted spanning the past evolution and contemporary trends in the sector.

Through systematic title and full-text review, the articles were screened for relevance to sustainable higher education performance from a supply chain management perspective. This rigorous screening process yielded the final sample of 59 articles that had made significant theoretical and practical contributions to the field of research with a sound foundation for further network and bibliometric analysis.

Bibliometric And Network Analyses

A bibliometric analysis helps examine publication patterns and research impact in academic fields. Our study analyzed 59 articles related to sustainable performance in higher education through supply chain management, utilizing software R Studio for comprehensive bibliometric analysis. The findings reveal several significant patterns worth exploring in detail.

Descriptive analyses of review articles

Table 1 provides detailed information about the published review articles obtained from Scopus. We began by identifying keywords, and the materials were restricted solely to review articles, encompassing assessments and systematic literature reviews, among others. A total of 59 papers are examined from 2016 to 2024. The results reveal the use of 457 unique keywords and 158 author-specific keywords. The evaluation period was 28 years, beginning in 1996 and ending in 2024. The findings reveal 35 sources for these works, with word development being the predominant source; the most referenced work garnered 136 citations.

Table 1 Descriptives analysis of the articles

Description	Results
Documents	59
Sources	35
Keywords	457
Period	2016-2024
Authors Keywords	158
Most cited paper	136
Most productive source	International Journal of Sustainability in Higher Education

Source: Author

Most productive source

In the conducted bibliometric analysis, the local academic impact of authors table 2 is examined by measuring their H-index. The data reveals a hierarchical distribution of academic influence among the researchers. Md. Mamun Habib and John Jeyasingam are identified as the leading figures with an H-index of 4 each, demonstrating significant scholarly impact. They are followed by Govindaraju Basu and Uvarani Letchmana, both with an H-index of 3. Furthermore, other authors such as Christopher Mejia-Argueta, and David Ernesto Salinas-Navarro are noted with an H-index of 2, while Paulus Aditjandra, Badriya Al Balushi, Jouhara Al Habsi, and Nasser Al Harrasi are each recorded with an H-index of 1. This stratified distribution underscores a well-defined academic leadership structure within the research team, illustrating the influence of individual researchers' contributions to their respective fields.

Table 2: Most productive Authors

Journal Name	H-index	g-index
Md. Mamun Habib	4	5
John Jeyasingam	4	4
Govindaraju Basu	3	3
Uvarani Letchmana	3	3
Christopher Mejia-Argueta	2	2
David Ernesto Salinas-Navarro	2	3
Paulus Aditjandra	1	1
Badriya Al Balushi	1	2
Jouhara Al Habsi	1	2
Nasser Al Harrasi	1	1

Source: Author

Most Cited Articles

Table 3 presents the compilation of documents along with the corresponding citation counts. The table indicates that Tominaga et al. (2021) article published in the International Journal of Sustainability in Higher Education has garnered the most citations. The title of this document is "Critical analysis of engineering education focused on sustainability in supply chain management: an overview of Brazilian higher education institutions." Other highly referenced publications include those by de Andrade et al. (2018) in Journal of Cleaner Production. The research by Kucukvar et al. (2016) was published in Sustainability. Table 3 presents the aggregate count of publications by both solo and collaborative authors. The list is shown in the table in descending order

Table 3: Top 10 most cited articles

Document title	Author	Citations	Journal
Critical analysis of engineering education focused on sustainability in supply chain management: an overview of Brazilian higher education institutions	Tominaga et al. (2021)	136	International Journal of Sustainability in Higher Education
A proposal of a Balanced Scorecard for an environmental education program at universities	de Andrade et al. (2018)	81	Journal of Cleaner Production
Life cycle assessment and optimization-based decision analysis of construction waste	Kucukvar et al. (2016)	67	Sustainability

recycling for a LEED-certified university building			
Institutional sustainable purchasing priorities: Stakeholder perceptions vs environmental reality	Pullman and Wikoff (2017)	44	International Journal of Operations & Production Management
Maturation of sustainability in engineering faculties – From emerging issue to strategy?	Hugé et al. (2018)	31	Journal of Cleaner Production
SDG-Oriented Supply Chains: Business Practices for Procurement and Distribution	Cammarano et al. (2022)	28	Sustainability
Performance measurement of an Indian higher education institute: a sustainable educational supply chain management perspective	Jauhar et al. (2018)	23	International Journal of System Assurance Engineering and Management
Public sector supply chain management: A Triple Helix approach to aligning innovative environmental initiatives	Abd Razak et al. (2016)	20	Foresight and STI Governance
Preparing sustainable engineers: A project-based learning experience in logistics with refugee camps	Terrón-López et al. (2020)	18	Sustainability
Student resistance to a mandatory learning management system in online supply chain courses	Strang and Vajjhala (2017)	17	Journal of Organizational and End User Computing

Source: Authors

Most Productive Source

Table 4 enumerates the eight basic sources of productivity. Only 35 of the 59 published review articles are found in indexed journals. Only 8 journals comprise 18.60% of all papers within the same discipline. This section lists studies pertaining to productive sources linked to microfinance journals. Table 4 illustrates the most prolific sources according to citation metrics associated with microfinance journals. The table displays the list in descending order.

Table 4: Most productive sources

Journal Name	No of Articles	Citation
International journal of supply chain management	11	49
Sustainability	07	132
Journal of Cleaner Production	03	123
Journal of infrastructure, policy and development	02	16
International journal of production and operations management	01	44
International journal of quality and reliability management	01	23

Source: Authors

Most Productive Global Source based on Author's

The analysis of global citations depicted in the table showcases a pronounced emphasis on sustainability, waste management, and clean production within the research community. PINTO RS's 2018 paper in Waste Management leads with 136 citations, indicating a significant

impact and interest in sustainable waste management practices in higher education. This is followed by DE ANDRADE GUERRA JBSO's 2018 publication in the Journal of Cleaner Production, receiving 81 citations, further underscoring the academic focus on sustainable practices in higher education. Subsequent publications such as KUCUKVAR M's 2016 article in Sustainability with 67 citations, and PULLMAN M's 2017 piece in the International Journal of Operations & Production Management with 44 citations, illustrate sustained interest and ongoing research in sustainability across different facets of production and operations in higher education. The citation trends highlight the scholarly community's engagement with topics that blend environmental concerns with operational and production efficiency in higher education, reflecting a robust discourse in the fields of technology forecasting and system assurance related to sustainability from 2016 to 2024.
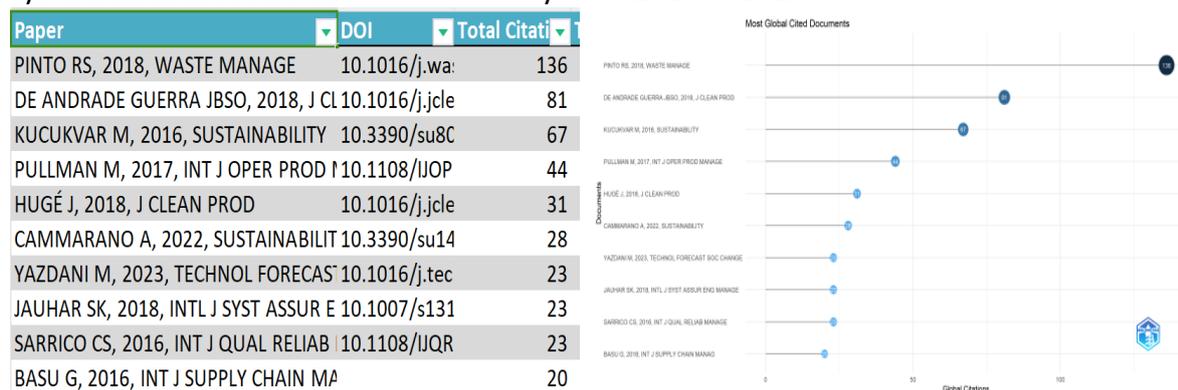

Paper	DOI	Total Citati
PINTO RS, 2018, WASTE MANAGE	10.1016/j.was	136
DE ANDRADE GUERRA JBSO, 2018, J Cl	10.1016/j.jcle	81
KUCUKVAR M, 2016, SUSTAINABILITY	10.3390/su8C	67
PULLMAN M, 2017, INT J OPER PROD	10.1108/IJOP	44
HUGÉ J, 2018, J CLEAN PROD	10.1016/j.jcle	31
CAMMARANO A, 2022, SUSTAINABILIT	10.3390/su14	28
YAZDANI M, 2023, TECHNOL FORECAS	10.1016/j.tec	23
JAUHAR SK, 2018, INTL J SYST ASSUR E	10.1007/s131	23
SARRICO CS, 2016, INT J QUAL RELIAB	10.1108/IJQR	23
BASU G, 2016, INT J SUPPLY CHAIN MA		20

Figure 2: Global citations

Most Productive Country

Table 5 delineate two key aspects of scholarly output and impact by country. Table 5 dataset reveals the frequency of scientific production by region, with the USA leading with 25 publications, followed closely by Malaysia with 24, and China with 21. This ranking continues with Brazil, Indonesia, Mexico, Spain, the UK, Oman, and Italy, showing a diverse geographical representation in research output. Figure 6 dataset provides insight into the most cited countries, highlighting the total citations (TC) and average article citations. Portugal emerges as the most influential with 136 total citations, with an average citation count per article of 136, indicating high impact research concentrated in fewer publications. The USA follows with a substantial 129 total citations but a lower average of 18.4 per article, suggesting a broader but less concentrated citation impact. Brazil and Italy also show significant citation metrics, with Brazil's publications receiving an average of 48 citations per article, underscoring their impactful contributions to the field. It is a pity that Malaysia and China, who appear in Table 5, don't show big influence in scholarly world.

Table 5: Authors affiliated country

Country	Articles	Total Citation	Average Article Citations
USA	25	136	13.6
Malaysia	24	31	5.2
Brazil	15	96	4.8
Indonesia	13	31	3.1
Mexico	12	19	4.8
Spain	11	18	1.8
United Kingdom	11	19	4.8
China	21	30	6.00
Italy	09	36	1.8

Source: Author
Thematic Map
This thematic map figure 3 provides a visual representation of the relevance and development density of various research topics within the academic domain. The "Motor Themes" in the top right quadrant, such as food supply, waste management, and carbon footprint, are marked by high relevance and development density, indicating they are at the forefront of academic research trends and interests. In contrast, the "Niche Themes" in the top left quadrant, although highly developed, have limited relevance, suggesting they hold in-depth research value within specific fields. The "Basic Themes" in the bottom right quadrant, like supply chain management, are characterized by high relevance, signifying their foundational importance to academic research, despite their relatively lower development density. The bottom left quadrant may contain emerging or declining topics, signaling to researchers the potential academic value or the necessity for transformation. This map serves as a strategic reference for topic selection and research direction in academic journal publications.
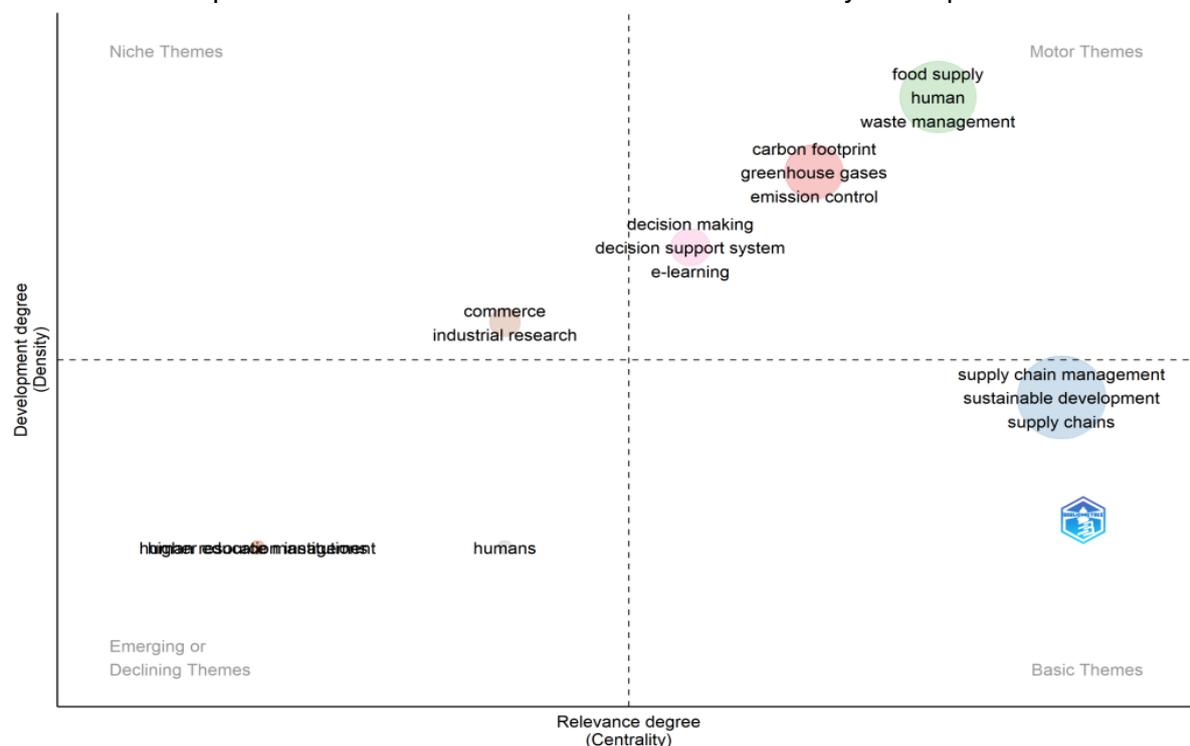

Figure 3: Thematic Map

Analysis of influential Keywords
Figure 4, a word cloud image, identifies the themes and their comparative importance in the research landscape. The frequent use of words like "supply chain management," "sustainable development," and "sustainability" indicates their foundational influence on the discourse. The occurrence of "higher education," "food waste," and "carbon footprint" indicates an integrative strategy of tackling environmental problems, pedagogy, and operational efficiencies in academic and institutional settings. The use of terms like "e-learning" and "decision support system" suggests the incorporation of technology innovations in enhancing education outcomes and decision-making. At the same time, "waste management" and "greenhouse gases" imply an interest in minimizing environmental impacts through systematic approaches. In addition, the co-occurrence of "human," "humans," and "student" with "higher education institutions" and "universities" highlights the anthropocentric focus of

these discussions, recognizing the role of people and educational institutions in developing sustainable practices and environmental stewardship.

Figure 4: Word Cloud

The three-field plot illustrates the complex interconnections among cited literature, authors, and thematic fields of the Higher Education Sustainable Supply Chain Management research domain. It explains how seminal works and writers are related to general research topics that are central to developing knowledge in the discipline. Particularly noteworthy, the account outlines general thematic areas like Higher Education, Educational Innovation, Sustainability, and COVID-19 effects on supply chain operations. The themes reflect a collective scholarly emphasis on infusing sustainable values into education systems and supply chain operations of higher education institutions.
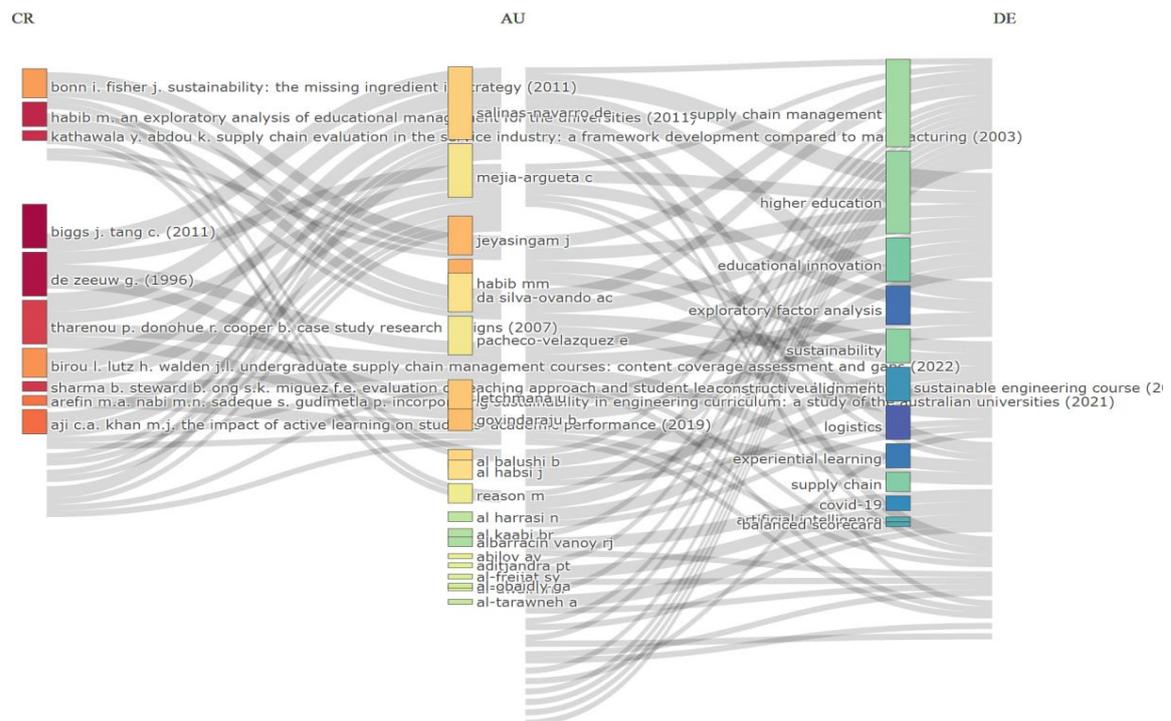
Figure 5: Three Field Plot

The bibliometric analysis reveals several prominent researchers who have made significant contributions to the field. For example, Salinas-Navarro et al. (2022) focused on supply chain management education through experiential learning, while Govindaraju et al. (2019) examined sustainable practices and performance in private universities. The work of Basu et al. (2016) on educational supply chain management models has been influential in developing sustainability frameworks for higher education institutions. This network of research demonstrates the evolution of scholarship that increasingly integrates sustainability principles with educational supply chain management.

The country collaboration map reveals distinct geographical patterns and research networks in the field of sustainable performance in higher education with the supply chain management perspective. The visualization demonstrates a clear East-West divide in research collaboration patterns. Eastern clusters are primarily centered around China, Malaysia, and other Southeast Asian countries, while Western clusters are dominated by the United States and European nations. The map shows varying degrees of collaboration intensity, represented by the thickness of connecting lines between countries. While there are some cross-regional collaborations between Eastern and Western institutions, these connections appear relatively limited. Strong collaborative networks are evident within the Eastern region, particularly between China and Southeast Asian countries. Similarly, Western countries display robust internal collaboration networks. This geographical distribution of research partnerships suggests regional preferences in research focus and methodological approaches, reflecting distinct cultural and institutional contexts in HESSCM implementation and study.
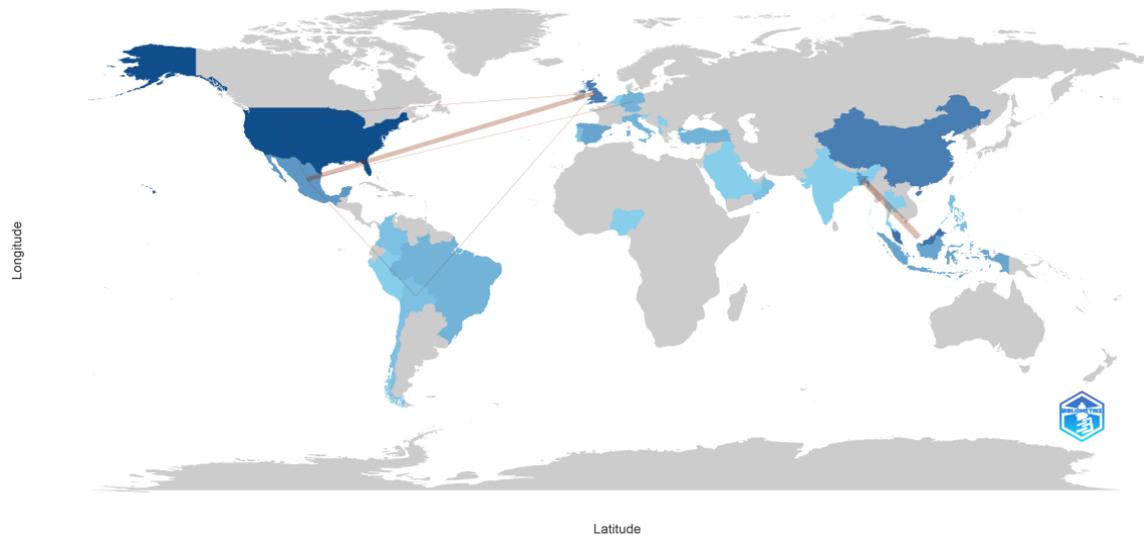
Figure 6: Country Collaboration Map

Network analysis

Vosviewer is a widely used software tool for constructing and visualizing bibliometric networks (van Eck & Waltman, 2010). In this study, Vosviewer (version 1.6.19) was configured with specific parameters for the bibliometric analysis. For the keyword co-occurrence analysis, all keywords were selected as the unit of analysis and fractional counting method was applied. From the total 457 keywords identified, a threshold of minimum 2 occurrences were applied, resulting in 58 keywords meeting the threshold criteria for network visualization. For network visualization, the association strength normalization method was employed, with attraction and repulsion parameters set to 4 and 0 respectively. The clustering resolution was set to 1.00 with a minimum cluster size of 2, and the merge small clusters option was enabled.
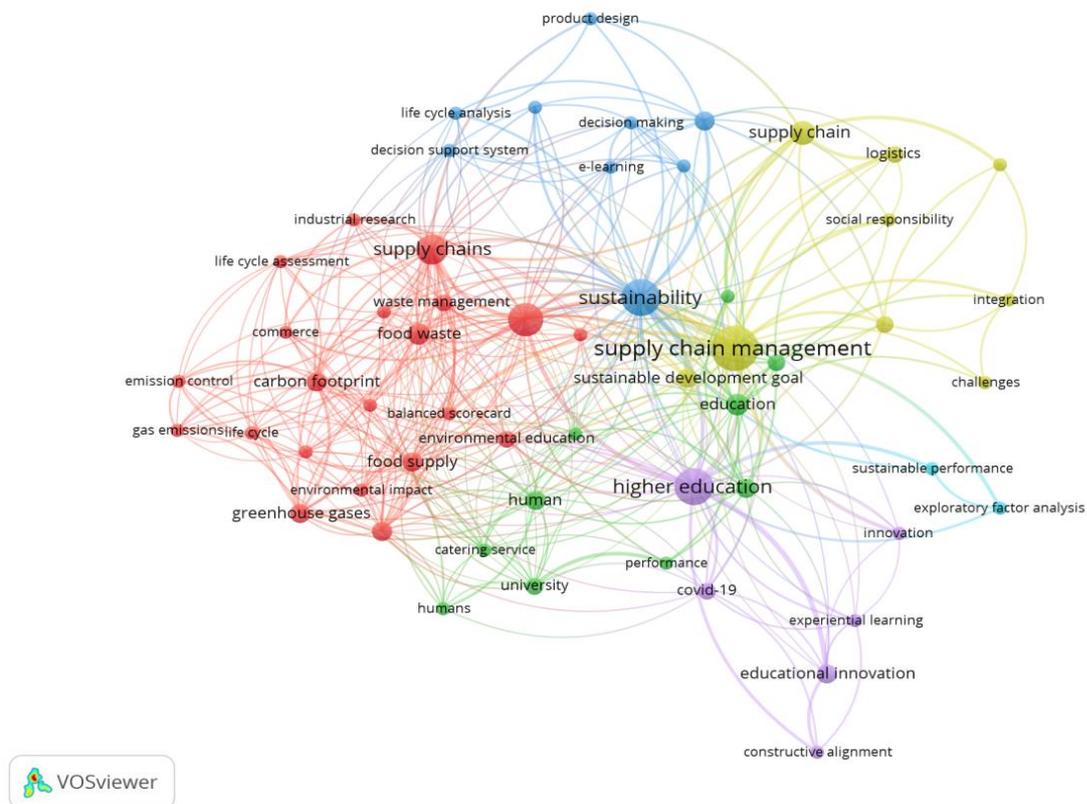
Figure 7: Network visualization by VOS viewer

This visualization not only maps out the key research areas but also vividly demonstrates the multidisciplinary nature of this field, suggesting a dynamic interplay between sustainability, technology, and education reforms. The interconnected nodes provide insights into emerging research trajectories, particularly in harmonizing sustainable practices with technological advancements in educational settings.

Table 1: Cluster 1

id	label	x	y	cluster	weight \<Links\>	weight \<Total link strength\>	weight
3	balanced scorecard	0.1725	0.6163	1	9	2	2
4	carbon footprint	0.0439	0.4178	1	19	4.0003	4
7	commerce	0.1776	0.5713	1	9	1.9999	2
15	emission control	0.0526	0.6029	1	11	2.0001	2
16	engineering	0.1118	0.5055	1	11	2	2
18	environmental education	0.1089	0.7625	1	22	3.0005	3
19	environmental impact	0.1923	0.5238	1	19	2.0005	2
20	environmental management	0.0497	0.6504	1	9	2.0001	2
23	food supply	0.0943	0.3825	1	27	4.0003	4
24	food waste	0.1762	0.6918	1	27	5.0002	5
25	gas emissions	0.0241	0.4543	1	11	2.0001	2
26	greenhouse gases	0.0344	0.5384	1	17	4	4
33	industrial research	0.1447	0.4093	1	9	1.9999	2
37	life cycle	0.0936	0.6845	1	16	1.9999	2
39	life cycle assessment	0.182	0.43	1	15	2.0002	2
44	recycling	0.1411	0.4629	1	19	2.0005	2
49	supply chains	0.1849	0.3605	1	35	9.0004	9

51	sustainable development	0.1345	0.3228	1	35	12.0001	12
54	universities	0.0585	0.7223	1	27	4.0005	4
56	university canteen	0.0468	0.4823	1	21	2.0004	2
57	waste management	0.223	0.4531	1	22	3.0005	3

The Vosviewer analysis of Cluster 1 elucidates a concentrated framework within higher education sustainable supply chain management, focusing on environmental sustainability. This cluster notably integrates key themes such as 'sustainable development,' prominently linked to 'supply chains,' highlighting the essential role of integrating sustainable practices within academic institutions. Central nodes like 'environmental education' and 'environmental impact' emphasize the educational sector's focus on imparting knowledge about sustainability, whereas 'carbon footprint,' 'greenhouse gases,' and 'emission control' suggest a strong research interest in measuring and mitigating the ecological impacts of university operations. Practical applications such as 'food waste' and 'recycling' point towards the adoption of circular economy concepts, crucial for enhancing sustainability in campus operations. This cohesive array of interconnected themes not only underscores the current scholarly focus but also opens avenues for future exploration in optimizing supply chain processes to support sustainable development goals, ultimately guiding institutions in merging operational efficiency with environmental stewardship.

Table 2: Cluster 2

ID	label	x	y	cluster	weight <Links>	weight <Total link strength>	weight
1	article	0.2683	0.7978	2	18	2.0005	2
2	artificial intelligence	0.3363	0.8076	2	5	2	2
5	catering service	0.1959	0.8794	2	18	2.0004	2
13	education	0.3757	0.8636	2	20	5.0001	5
30	human	0.3026	0.8587	2	22	4.0003	4
32	humans	0.2697	0.9135	2	9	2.0002	2
36	learning	0.3209	0.7747	2	15	4.0002	4
41	performance	0.356	0.9172	2	4	1.9999	2
46	student	0.3545	0.8234	2	11	2.9999	3
55	university	0.2105	0.8307	2	19	3.0004	3

Cluster 2 of the Vosviewer output delves into the human aspects of sustainability within higher education, highlighting a focused exploration on how academic institutions integrate sustainability into their core practices. Central themes such as 'education,' 'learning,' and 'university' underscore the pivotal role of these institutions in cultivating sustainability competencies, with 'university' serving as a key node linking various educational elements. The inclusion of 'artificial intelligence' and 'performance' reflects the integration of advanced technologies and evaluative metrics, enhancing educational outcomes and operational efficiencies in alignment with sustainability goals. Moreover, terms like 'human' and 'humans' emphasize the social dimensions of sustainability, recognizing the critical role of human resources in implementing sustainable practices. This cluster vividly illustrates how

universities are adapting their strategies to effectively meet educational and sustainable imperatives, focusing on both technological advancements and a human-centric approach to fostering an inclusive and sustainable academic environment.

Table 3
Cluster 3

id	label	x	y	cluster	weight \<Links>	weight \<Total link strength>	weight
10	decision making	0.4554	0.1547	3	9	2	2
11	decision support system	0.4576	0.2229	3	12	2.0003	2
12	e-learning	0.4583	0.2728	3	9	2	2
17	engineering education	0.3728	0.134	3	14	3.9999	4
31	human resource management	0.4854	0.1754	3	9	2	2
38	life cycle analysis	0.356	0.2046	3	9	2.0002	2
42	product design	0.3772	0.3167	3	5	1.9999	2
43	purchasing	0.4576	0.1011	3	6	1.9999	2
50	sustainability	0.356	0.257	3	38	14.0006	14

Cluster 3 in Vosviewer analysis identifies key factors critical to operational viability in a university environment, with a focus on approaches through which universities enable practice incorporation in both educational and operational processes. Central to this cluster, 'sustainability' with its widespread connectivity, reflects its widespread impact in adjacent subjects such as 'engineering education' and 'e-learning.' That connectivity reflects the key role played by cutting-edge educational technology in developing environmentally friendly practice in curriculums for both educational efficiency and operational effectiveness. In addition, 'human resource management' and 'life cycle analysis' refer to careful stewardship of sustainable human assets and environmentally friendly evaluation of operational processes, respectively, critical to minimizing ecologic footprints and optimizing asset use. 'Product design' and 'purchasing' refer to pragmatic factors in terms of incorporation of sustainability in purchasing processes and design protocols and therefore represent key factors in choosing inputs and output factors that contribute to university operations' sustainability profile. Together, these subjects not only illustrate the nuance in university value chain integration of sustainability but also reveal avenues for improvement in such processes, and in so doing, contribute to larger educational and ecologic ends.

Table 4
Cluster 4

id	label	x	y	cluster	weight <Links>	weight <Total link strength>	weight
6	challenges	0.6535	0.5822	4	3	0.9999	2
28	higher education institution	0.7032	0.3983	4	4	1.9999	2
29	higher education institutions	0.6981	0.5384	4	8	2.9998	3
35	integration	0.7368	0.5713	4	5	1.9999	2
40	logistics	0.7346	0.4957	4	7	3	3
45	social responsibility	0.6681	0.4507	4	6	2	2
47	supply chain	0.6082	0.5457	4	11	5.9999	6
48	supply chain management	0.6338	0.3654	4	41	18.0005	21
52	sustainable development goal	0.5797	0.5006	4	15	4.0002	4

Cluster 4, determined via Vosviewer analysis, prioritizes the role of sustainable logistics in tertiary education, with 'supply chain management' at its focal point and high link strength, and in doing so, underlines its critical role in balancing logistics operations with sustainability targets. 'Supply chain' and 'logistics' both have strong links with the focal point, supporting an integral model for inscribing sustainable processes in tertiary educational institution operational frameworks at several scales. In addition, strong connectivity between 'higher education institutions' and 'social responsibility' reflects a commitment to ethics and sustainability. 'Integration' is a key word, representing a harmonious integration of both educational and operational frameworks with sustainability. It is a strong reflection of universities working towards improving logistics operations in consonance with worldwide standards for sustainability, and in the long run, strengthening their stewardship of the environment and contributing positively towards overall sustainability objectives.

Table 5
Cluster 5

id	label	x	y	cluster	weight <Links>	weight <Total link strength>	weight
8	constructive alignment	0.5197	0.8563	5	4	2	2
9	covid-19	0.4817	0.7917	5	13	3.0002	3
14	educational innovation	0.557	0.7966	5	9	4.0003	4
21	experiential learning	0.5746	0.8234	5	9	2.0003	2
27	higher education	0.4766	0.732	5	30	13.0001	14
34	innovation	0.5461	0.7613	5	7	2.0003	2

Cluster 5 from the Vosviewer map significantly highlights the integration of innovative educational strategies with sustainable supply chain management in higher education, emphasizing nodes like 'educational innovation,' 'experiential learning,' 'higher education,' and 'innovation.' These themes collectively underscore a shift toward interactive, technology-enhanced learning environments where sustainability principles are not only taught but embedded deeply into both curricular and extracurricular activities. The focus on 'experiential learning' underscores the importance of hands-on experiences, facilitated by digital technologies, allowing students to apply theoretical knowledge in practical settings, thus

bridging the gap between theory and real-world application. This approach highlights the sector's role in using digital tools to foster a robust commitment to sustainability, making higher education institutions not just centers of learning but also leaders in advancing sustainable practices within global supply chains. The integration of digital education ensures that these institutions are equipped to handle the complexities of sustainable supply chain challenges, preparing students to innovate and manage effectively in this critical field.

Table 6
Cluster 6

id	label	x	y	cluster	weight <Links>	weight <Total link strength>	weight
22	exploratory factor analysis	0.6608	0.7247	6	3	2	2
53	sustainable performance	0.6667	0.687	6	3	2	2

Cluster 6 from the Vosviewer output, focusing on 'exploratory factor analysis' and 'sustainable performance,' underscores the vital interplay between methodological rigor and performance outcomes in the sustainability discourse within higher education. Exploratory factor analysis is highlighted as a crucial statistical method for uncovering the underlying factors that influence sustainable performance, providing a clear empirical foundation to guide strategic decisions. This approach is integral for disentangling the complex interactions that define sustainability, ensuring that sustainability initiatives are both effective and measurable. The theme of sustainable performance emphasizes the importance of continuous assessment to ensure these efforts meet their intended goals, reinforcing the need for higher education institutions to not only adopt but also effectively implement and track the success of their sustainability strategies. This synthesis of methodology and application highlights the dynamic nature of sustainability practices, urging a rigorous assessment to achieve tangible improvements in sustainability outcomes.

Findings

Environmental Focus in Higher Education Sustainable Supply Chain Management
When comparing the techniques of supply chain management (SCM) within the Eastern countries of China and Indonesia to the Western policies of Spain and Italy, a stark difference in their approach to environmental considerations is evident. Eastern countries such as China and Indonesia focus on specific metrics such as operational efficiency as shown by, Le et al. (2023) conducted a detailed carbon footprint analysis of food waste in university canteens, while Gök et al. (2024) emphasized the enhancement of service performance through SCM strategies. In contrast, Western countries (such as Spain and Italy) tend to adopt more holistic sustainable development frameworks and emphasize multi-stakeholder engagement. Terrón-López et al. (2020) integrated UN Sustainable Development Goals into supply chain logistics education, while Martínez-Acosta et al. (2023) explored models of higher education institutions collaborating with communities to promote sustainable development.

Human-Centric Approaches in Higher Education Sustainable Supply Chain Management
Human-centric considerations are developing sustainable supply chain management in higher education. This has led to separation in Eastern and Western institutions. Eastern institutions (like Oman and Vietnam) have placed greater weight on the development of professional competencies and alignment with industry. For instance, Al Harrasi et al. (2024) examined

how graduate-skills transformations correspond to industry requirements, while Kiet et al. (2024) looked into synergies between professional development and social performance. Western institutions appear to be overarching in their considerations concerning experiential learning and societal engagement. This is equally substantiated by studies conducted in Germany Martínez-Acosta et al. (2023) on universities as social laboratories, and Italy Berra and Cavaletto (2020) on gender inclusivity in STEM education and supply chains. The nexus perceived here is about developing inclusive socially responsible learning environments.

Technological Integration in Higher Education Sustainable Supply Chain Management
The technological infrastructure and digital transformation in higher education sustainable supply chain management reveal contrasting responses to the digital transformation imperatives among the eastern and western institutions. Eastern institutions emphasize the development of comprehensive technical frameworks and systematic implementation strategies, exemplified by research in China on the metaverse integration evaluation systems (Wang et al., 2024). Western institutions focus on technology governance and infrastructure sustainability, exemplified by Spanish research on EdTech investment decisions (Von Berlepsch et al., 2024). Key differences in technological integration strategies are evident in their core practices: Eastern approaches prioritize technical system optimization and standardization for resource optimization, while Western institutions emphasize technology governance frameworks and sustainable infrastructure development through stakeholder engagement mechanisms. This contrast is particularly visible in the systematic evaluation methods used in Chinese institutions versus the stakeholder-centric decision models employed in Western universities.

Institutional Challenges in Higher Education Sustainable Supply Chain Management
In higher education sustainable supply chain management (HESSCM), institutions face distinct challenges in responding to regional regulatory contexts and stakeholder demands. Eastern institutions, particularly in China and Indonesia, encounter challenges related to procurement systems, resource allocation, and regulatory compliance (Jin et al., 2024; Salinas-Navarro et al., 2024). These challenges primarily stem from their regulatory and policy context. Western institutions predominantly face challenges in stakeholder engagement, sustainable purchasing implementation, and balancing economic with environmental priorities (Durán-Sandoval et al., 2024; Pullman & Wikoff, 2017), reflecting their emphasis on stakeholder demands.

A significant contrast exists in how institutions address these challenges: Eastern institutions tend to focus on systematic solutions through structural reforms and policy adjustments within their core HESSCM practices, while Western institutions emphasize stakeholder-driven approaches and sustainable innovation mechanisms. This difference is particularly evident in recent studies examining sustainable procurement in Chinese higher education versus European approaches to institutional environmental initiatives.

Educational Innovation and Performance Measurement in Higher Education Sustainable Supply Chain Management
Educational innovation and performance measurement in higher education sustainable supply chain management demonstrate distinct characteristics between Eastern and Western approaches in their assessment of educational quality and social-cultural performance:

Eastern institutions emphasize quantitative assessment and systematic optimization. Malaysian researchers Hosseinnia Shavaki and Ebrahimi Ghahnavieh (2023) developed a five-dimension evaluation tool encompassing supplier partnership, customer partnership, information sharing, technology, and innovation capabilities. Huang et al. (2022) analyzed the input-process-output framework in technical vocational education, focusing on resource allocation efficiency. Chinese research Liestiandre et al. (2024) assessed higher education credentials' sustainable development performance from a labor market transition perspective, emphasizing practical value measurement.

Western institutions prioritize innovative teaching models and qualitative evaluation. In Latin America, Salinas-Navarro et al. (2024) proposed a conceptual framework transforming SCM&L operations into educational opportunities, emphasizing community engagement. German scholars Rosi and Obrecht (2023) explored the innovative application of the Supply Chain Operations Reference (SCOR) model in university education. Brazilian researchers de Andrade et al. (2018) developed a balanced scorecard strategy map incorporating sustainable development, environmental education, and process management dimensions, reflecting a holistic assessment approach.

Discussion and Conclusion

This study makes several significant theoretical and practical contributions to the understanding of HESSCM implementation in global higher education contexts. Through a systematic review and bibliometric analysis, we develop an integrated theoretical framework that captures the complex interactions between external and internal drivers, core practices, and performance dimensions in HESSCM. Our findings reveal that cultural and institutional contexts fundamentally influence HESSCM implementation patterns. Eastern institutions demonstrate technology-driven approaches, prioritizing AI and IoT integration for operational efficiency, while Western institutions emphasize stakeholder engagement and comprehensive sustainability assessments. These distinctions extend beyond mere operational differences, reflecting deeper cultural and institutional factors that shape how sustainability initiatives are conceptualized and implemented.

Theoretically, this study advances HESSCM literature in three ways. First, it establishes a comprehensive framework that integrates previously disparate elements of sustainable supply chain management in higher education. Second, it demonstrates how cultural contexts mediate the relationship between institutional drivers and sustainability outcomes. Third, it identifies specific mechanisms through which regional adaptation influences the development of context-specific practices. From a practical perspective, our findings suggest that successful HESSCM implementation requires careful alignment between technological innovation, stakeholder needs, and cultural contexts. Higher education institutions must develop balanced approaches that accommodate both global sustainability standards and local cultural considerations. This involves thoughtful integration of digital technologies while ensuring stakeholder engagement and maintaining educational quality.

Despite these contributions, our study has limitations that suggest directions for future research. The geographical scope of current literature remains concentrated in certain regions, indicating the need for expanded research coverage, particularly in Africa and the Middle East. Additionally, longitudinal studies are needed to examine how HESSCM practices

evolve over time. Future research should also focus on developing standardized performance metrics that can effectively measure outcomes across different cultural contexts while maintaining sensitivity to local conditions. Ultimately, this research underscores that HESSCM represents a complex interplay between global sustainability imperatives and local institutional realities. As higher education institutions continue to pursue sustainability objectives, understanding these dynamics becomes increasingly critical for successful implementation.

Theoretical Implications

This study refines the conceptualization of Higher Education Sustainable Supply Chain Management (HESSCM) through a systematic integration of supply chain management principles with sustainability and educational management under a human-centered sustainability framework. The research makes several significant theoretical contributions:
First, this study extends traditional supply chain theory by incorporating both tangible resources and intangible elements unique to educational settings (Basu et al., 2016; Bathla et al., 2023). Empirical evidence demonstrates how traditional SCM strategies can systematically integrate sustainability objectives within higher education contexts, as evidenced by carbon footprint assessments (Aboelmaged et al., 2024; Cammarano et al., 2022) and community engagement initiatives (Lang et al., 2024).

Second, the research identifies three key theoretical dimensions that distinguish HESSCM from commercial supply chains. For external and internal drivers, findings reveal how cultural context and regional adaptation significantly shape HESSCM strategies, with Eastern institutions emphasizing technological efficiency and compliance Idrees et al. (2023), while Western institutions prioritize participatory approaches (Khaw et al., 2024). Regarding core HESSCM practices, the study demonstrates that sustainable supply chain practices must adapt to differing cultural norms through context-specific educational innovation and stakeholder engagement mechanisms. In terms of performance dimensions, the research establishes a multi-dimensional framework integrating educational quality and social-cultural performance alongside traditional environmental and economic metrics (Lang et al., 2024).

Third, this study contributes to the theoretical understanding of how regional contexts influence HESSCM implementation. The findings underscore that sustainable supply chain practices must adapt to differing cultural norms, regulatory frameworks, and institutional priorities. This advances our understanding of how cultural factors influence successful HESSCM implementation in higher education settings.

Practical and Social Implications

The findings yield significant practical implications for institutions implementing HESSCM frameworks, which can be organized along three key dimensions: Regarding external and internal drivers, institutions should adopt a phased, context-sensitive approach to HESSCM integration. Evidence from Chinese higher education institutions demonstrates that successful implementation requires careful consideration of local regulatory requirements, institutional capabilities, and stakeholder dynamics (Jin et al., 2024). Organizations must develop customized implementation strategies aligned with their cultural context and institutional structure through systematic stakeholder mapping and engagement processes (Lang et al., 2024).

For core HESSCM practices, institutions should focus on two primary areas. First, strategic investment in technological infrastructure is crucial for supporting sustainability objectives. Recent research demonstrates how targeted investments in AI and IoT technologies can significantly enhance operational efficiency while advancing sustainability goals (Khai Loon Lee et al., 2023). Second, organizations need to establish clear, measurable metrics for assessing sustainability performance across their supply chain operations, building on frameworks such as the comprehensive carbon footprint assessment model developed by (Oestreich et al., 2024; Rojas-Sánchez et al., 2023).

In terms of performance dimensions management, institutions must develop robust mechanisms for stakeholder engagement that balance local cultural norms with active participation in sustainability initiatives (Aboelmaged et al., 2024). Policy makers and educational administrators should prioritize developing flexible regulatory frameworks that accommodate both global sustainability standards and local needs. This is exemplified by recent research on food waste management in university settings Durán-Sandoval et al. (2024), which demonstrates how institutional policies can effectively bridge global sustainability objectives with local operational realities.

The implications extend to policy development, suggesting that policy makers should establish platforms for knowledge sharing and best practice exchange between institutions. Evidence from successful collaborative initiatives indicates that well-designed policy frameworks can effectively drive technological adoption and sustainability improvements, particularly when they account for regional variations in implementation capacity and cultural context.

Comparative analysis reveals fundamental differences in how Eastern and Western institutions operationalize HESSCM within the theoretical framework dimensions. Eastern and Western approaches demonstrate distinct patterns in their response to external drivers, implementation of core practices, and performance measurement strategies. Eastern higher education institutions demonstrate a technology-centric approach driven by operational efficiency imperatives. Empirical evidence shows Chinese universities' systematic integration of AI and IoT systems for resource optimization, resulting in quantifiable improvements in scheduling efficiency (Barton et al., 2025). Similarly, Bangladesh institutions have implemented digital supply chain practices structured around performance metrics and trust-based frameworks (Mohamed et al., 2023). This technology-focused approach aligns with Eastern institutions' emphasis on systematic implementation and standardization.

In contrast, Western institutions exhibit a more experimental approach to technological integration, prioritizing stakeholder engagement and innovation. Recent research documents Western universities' adoption of immersive technologies and hybrid learning models Salinas-Navarro et al. (2024), reflecting a focus on enhancing educational experience rather than immediate operational efficiency. This approach manifests in their procurement strategies, where Western universities incorporate comprehensive life cycle evaluations and environmental impact assessments (Pudjiarti et al., 2024). Stakeholder engagement mechanisms further differentiate these approaches. Eastern institutions typically employ hierarchical, top-down implementation methods Kiet et al. (2024), while Western institutions favor collaborative models emphasizing community partnerships and knowledge co-

production (Lang et al., 2024). These distinctions reflect fundamental differences in institutional priorities and cultural approaches to sustainability implementation.

Limitations and Suggestions for Future Research

This study presents several methodological limitations that inform future research directions in HESSCM implementation and assessment. Current research exhibits significant geographical bias, with disproportionate representation from East Asia, Europe, and North America. This limitation, as documented by Rosi and Obrecht (2023), potentially affects the generalizability of findings to underrepresented regions. Methodological constraints emerge from the inherent limitations of bibliometric analysis and potential publication bias toward positive outcomes. Additionally, language barriers and database selection criteria systematically exclude relevant research from non-English speaking regions (Jin et al., 2024). Based on these restrictions, numerous intriguing avenues for future research arise. Priority, the identified limitations point toward critical areas for future research development in HESSCM. Expanding geographical coverage to encompass underrepresented regions, particularly developing nations, emerges as a primary research imperative. This expansion necessitates mixed-method approaches integrating quantitative analysis with qualitative case studies, as demonstrated in recent research on university-community relationships (Lang et al., 2024).

Longitudinal research offers significant potential for examining the temporal dynamics of HESSCM implementation. Such studies would provide insights into the evolution and sustainability of these practices across different institutional contexts. This includes investigating the role of institution culture in HESSCM implementation success, as suggested by recent findings (Kiet et al., 2024). Methodological advancement through the development of standardized assessment metrics suitable for diverse institutional contexts represents another crucial research direction. Al Harrasi et al. (2023) work on carbon footprint assessment provides a model for developing such standardized frameworks while maintaining sensitivity to local conditions.

Primary research employing surveys and interviews would enhance understanding of implementation barriers and success factors. This approach would complement existing bibliometric analyses and provide deeper insights into the cultural and institutional factors affecting HESSCM adoption. Such research directions would not only address current methodological limitations but also contribute to the development of more effective, culturally sensitive HESSCM practices in global higher education, particularly focusing on frameworks that balance universal sustainability standards with local implementation requirements.

Acknowledgement

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