

Review Article

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Sustainability in Malaysian Higher Education: A Comprehensive Analysis with Suggestions for Malaysian Universities' Future

Sharmini Kumaran , Izian Idris

Abstract

Background/purpose. Adapting sustainability practices has become imperative in all fields of life, including the education sector. Therefore, various strategies have been developed and promoted to encourage different institutions to incorporate sustainability policies, enabling them to transform effectively. This approach is considered effective in ensuring the economic stability of various developing countries, such as Malaysia. Malaysian universities face unique opportunities and barriers in this context as developing nation institutions strive for global sustainability standards.

Materials/methods. This review aims to systematically appraise and synthesize literature on sustainability in Malaysian higher education within the period 2013-2023. The scoping methodology filters 31 articles analysing themes including campus greening practices, sustainability measurement frameworks, institutional governance, stakeholder perspectives, education programs, and financial motivators and barriers. The effects of COVID-19 on sustainable practices, the dynamics between public and private universities, and the difficulties in adopting and implementing sustainability are some of the other important topics covered.

Results. Findings identify multifaceted problems and publication platform fragmentation. While higher education institutions actively embrace sustainability for branding in the face of commercialization constraints, public universities display nationally aligned waste and energy programmes. During COVID-19, the digital gap was made worse by the inclusion of resilience planning in the curriculum.

Conclusion. To advance sustainability across Malaysia's diverse higher education landscape, recommendations emphasize a balanced integration of environmental, social, and economic considerations. This approach involves predictive modelling, unified theoretical frameworks, tailored policies, educational enhancements, public-private comparisons, systems perspectives, and participatory communication.

1. Introduction

Sustainability has become a central discussion, leading to transformative actions across different sectors. The higher education sector has also depicted a crucial commitment to this perspective in recent years, positioning universities as key players in advancing and spreading sustainable development (Anthony Jnr, 2021; da Silva, de Aguiar Dutra, & de Andrade Guerra, 2023). Global initiatives like the UN's Agenda 21 (Ghosh & Malhotra, 1992) and the evolving theoretical support concepts like the Triple Bottom Line concept (Arowoshegbe, Emmanuel, & Gina, 2016; Slaper & Hall, 2011; Žak, 2015) interweaving environmental, social, and economic dimensions are core catalysts in this context. The Malaysian higher education landscape is booming in this domain as well and has become a focal point for examination in recent Malaysian sustainability and education research (Ali, Ayodele, & Ibrahim, 2019; Azman & Abdullah, 2021; Mohd Muhiddin et al., 2022; Zakaria & Zurcher, 2023).

There is no questioning the need for sustainability in higher education, which is gaining traction due to the push for an international agreement to address environmental, social, and economic issues. Universities in developing nations see their role as instructors and promoters of sustainable practices. However, as recent research on Malaysian universities has shown, there are some challenges in fully implementing and translating inspiration into action plans (Elmassah et al., 2022; Saleem et al., 2023). Studies reveal that sustainability initiatives are frequently classified, and rather than being handled through a single sustainability framework, education, research, operations, and physical planning are frequently handled independently (Aleixo, Leal, & Azeiteiro, 2018; Ruiz-Mallén & Heras, 2020). In its extreme, this fragmentation prevents integrated systems from fully realising the revolutionary potential of universities. Additionally, sustainable campus development facets, such as eco-friendly buildings, often receive inconsistent emphasis in literature and practice due to numerous challenges, including cost and time management (Saleem et al., 2023; Trevisan et al., 2023). This systematic review aims to present a thorough analysis of Malaysian higher education sustainability literature. It will highlight recent trends and themes in this domain, examine differences in sustainability approaches in private and public universities, and explore differences pre- and post-COVID-19 in sustainability initiatives.

There are important implications for this review's advancement of sustainability understanding in Malaysian higher education. The review's findings, which highlight gaps and suggest integrated techniques, might help universities devise more successful tactics. Such assessments have the potential to have an impact not just on academia but also on policy, governance, and social viewpoints. Given that environmental disasters affect the entire world, this study may help establish Malaysian institutions as models of sustainability for emerging countries. It has the potential to spark a larger movement in the Asian education industry, raising its profile and reducing its global carbon impact.

2. Literature Review

2.1. Triple Bottom Line and Green Agenda 21

Over the years, various theories have been developed and implemented to explore the impact of sustainability on different aspects of life. In this regard, the Triple Bottom Line (TBL) is considered to attain greater value. This theory was formulated in the 1990s. It mainly integrates three important pillars that support the promotion of sustainability. These pillars include "environmental, social and economic" (Elkington, 1998). This theory was developed based on the classic definition of sustainable development, as presented in the 1987 Brundtland Report which stated sustainability as meeting the needs of the present without compromising future generations' needs (Brundtland, 1987). The TBL approach works at developing an interdisciplinary lens that views sustainability through a three-dimensional lens instead of only focusing on environmental factors. In the same context, the 1992

UN Green Agenda 21 roadmap for sustainable development prioritizes environmental concerns by addressing the need for sustainable development in society. This approach is considered crucial for promoting sustainability within society, with a significant impact on the higher education sector. This agenda focuses on the environmental, economic, and social objectives of various sectors, including the education sector and advocates curriculum innovations and campus greening initiatives that can together equip students with sustainability knowledge and skills (Alabaster & Blair, 2014; Huckle & Sterling, 1996; Mawonde & Togo, 2019). However, critics have highlighted that Green Agenda 21's priorities favour industrialized nations and their goals and overlook pressing needs like poverty and human welfare in developing countries (Brown, 2013; Dernbach, 1997; Norton, 2014).

Both the Green Agenda 21 and the TBL model offer guidelines for sustainable campus development. They both recommend integrating waste reduction, resource conservation, social inclusion, building economic viability, and other similar initiatives into university systems to improve overall organisational sustainability (Alshuwaikhat & Abubakar, 2008). Energy efficiency, the use of renewable energy, sustainable buildings, waste reduction, water conservation, green procurement, community partnerships, sustainable reporting, and the integration of pertinent curriculum are some of the specific focus areas (Berchin et al., 2021; Ramos et al., 2015). This concept is considered effective within the context of the current study, as it focuses on integrating sustainability into Malaysian higher education.

2.2. Sustainability Education, Practices, and Initiatives in Universities

Sustainability education and campus programs in Malaysian universities have been more experiential, interdisciplinary, and student-led. In their study, Crosling et al. (2020) discovered that Education for Sustainable Development (ESD) was mostly comprehended and embraced by academic staff working in public HEIs, resulting in diversity and participatory pedagogies and curriculum innovation. The experiences of campuses that have combined environmental protection and sustainable waste management practices reported a noticeable change in behaviour among all stakeholders when students became active in the planning and implementation processes (Chan et al., 2022). Mawardi et al. (2025) took a balancing entrepreneurship and sustainability approach to quantify how the combination of green entrepreneurial intent and institutional support helped Malaysian and Indonesian students start environmentally friendly ventures.

This research offers a look at the significant obstacles encountered by campus green programs. It demands better leadership, governance, and funding, particularly in the form of revolving loan funds and green office installations (Mahdee et al., 2022). Taken together, these articles point to the transition of Malaysian HEIs to active, systematic sustainability education and campus-wide transformation.

2.3. Sustainability in Malaysian Universities

The use of sustainability in Malaysian higher education is still fragmented and limited, despite increased focus (Azman & Abdullah, 2021). Though progress has been sluggish, policies and programmes have attempted to improve sustainability throughout planning and operations at universities. According to Hussin and Kunjuran (2015), some of the main obstacles include a lack of regular methods for assessment, inadequate financing and resources, and a lack of attention from senior leadership. Sustainability research in Malaysian universities focuses on the environmental outcomes of organizational practices, with a few attempts at developing holistic assessments spanning the economic, social, and ecological dimensions (Anthony Jnr, 2021). As Hassim (2011) highlights, inability is more than pro-environmental behaviour. Still, Malaysian studies overwhelmingly focus on green initiatives only. Additionally, there is a lack of comprehensive research on the difference between public and private university approaches to sustainability (Saadatian et al., 2009). Therefore, there is a need to examine Malaysian university literature

regarding sustainability assessment within the institutions. Undoubtedly, the education sector is the key to long-term success in implementing sustainable practices within society and achieving UN Sustainable Development Goals (Purcell, Henriksen, & Spengler, 2019). Thus, a systematic analysis to spotlight the recent trends in the Malaysian search for sustainability in education can help understand the transition better and provide future recommendations for improvement.

3. Methodology

A scoping review methodology was adopted to map findings on sustainability in Malaysian higher education systematically. Scoping reviews follow a similar process to systematic reviews but focus on synthesizing broad research themes rather than assessing study quality or conducting meta-analysis (Munn et al., 2022; Pollock et al., 2021). The methodological framework incorporated in this study includes five important phases (Arksey & O'Malley, 2005; Westphal et al., 2021), which focus on defining the research questions, identifying potentially relevant studies, screening and selecting literature, data extraction and analysis, and result synthesis.

The specific research questions which are taken into account for current study, are devised as follows:

1. What themes are addressed when exploring sustainability in higher education institutions in Malaysia?
2. How has sustainability evolved in Malaysian higher education during the COVID-19 pandemic, and what lessons can be learned from the pre- and post-COVID periods to enhance future adaptability?
3. To what extent do the sustainability practices and challenges differ between public and private universities in Malaysia?

For this systematic research, different online databases were taken into account which include Scopus, ScienceDirect, and Google Scholar. For this research, peer-reviewed articles published between 2013 and 2023, were taken into account. Boolean operators (AND, OR) combined the sustainability-related keywords with terms covering higher education, Malaysia, and COVID-19 (see Table 1). Date filters bounded search results within the 20-year scope. Targeted title/abstract screening filtered down to the full-text review of relevant articles. Reference sections of selected papers underwent secondary screening for additional studies meeting the eligibility criteria.

Table 1. Keywords used in literature search

Focus Area	Keywords
Sustainability	"sustainability," "sustainable development," "sustainable campus," "green university," "triple bottom line", "green campus"
Higher Education Institutions	"university," "Private university," "Public university," "higher education institution," "college," "academia"
Malaysia	"Malaysia", "Malaysian"
COVID-19	"COVID-19", "coronavirus", "pandemic"
Campus Operations	"campus operations," "facilities management," "waste management", "green practices"
Education Programs	"curriculum," "sustainability education," "sustainability literacy"
Policies	"policy," "directive," "initiative," "guideline*"
Perspectives	"Perspective*", "view*", "opinion*", "perception*", "attitude*"

The studies and articles included in this systematic review mainly comprised of English language journal articles, which focus on addressing sustainability issues in Malaysian higher education institutions, spanning campus operations, education programs, policies, practices, challenges, and stakeholder perspectives. Exclusions encompass opinion pieces, conceptual papers, book chapters, non-peer-reviewed work, and non-English papers. Studies narrowly concentrated on environmentalism, devoid of holistic sustainability assessments, were also excluded. Table 2 summarizes the inclusion-exclusion criteria.

The collected papers were then entered into the Excel sheet and were analysed according to the formulated inclusion and exclusion criteria. As a result, the qualitative synthesis systematically extracted relevant textual/tabular data from meeting papers into Excel. Extracted information was descriptively coded using the Braun & Clarke (2014) iterative categorization process. Codes were sequentially refined to determine overarching themes linked to the guiding research questions. Further, VOS VIEWER has been used for variety of analyses such as co-author and keywords maps. Findings were analysed within and across studies using descriptive synthesis to integrate evidence and identify research gaps. Table 3 maps themes and sub-themes in the study.

Table 2. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Type	• Peer-reviewed journal articles • Conference Papers	Opinion pieces, conceptual papers, book chapters
Language	English language	Non-English papers
Geographic Focus	Malaysia	Studies outside the context of Malaysian higher education
Content Focus	Sustainability issues in higher education	Studies narrowly focused on environmentalism
Publication Scope	Journal articles	Non-peer-reviewed work
Time Frame	2013-2023	Studies published before 2013 or after 2023
Study Type	Empirical studies	Non-empirical studies (e.g., conceptual work)
Subject Area	Higher education institutions in Malaysia	Studies not related to sustainability in education
Study Format	Research articles with substantive content	Short opinion pieces without substantial research content

4. Results

4.1. Search Outcomes

For initial analysis, SCOPUS, Web of Science (WoS), and Google Scholar were taken into account, and around 212 documents were selected. After removing duplicate copies, 41 documents remained from Google Scholar, 35 from SCOPUS, and 39 from WoS, making a total of 115 papers. Next, 29 documents were excluded as they were undesired document types, i.e., books, white papers, etc. The next step involved analysis of the titles and topics of these studies, which reduced the sample to

54. Next, the full text of the papers was accessed, and 14 papers were reduced. Overall, 15 papers were retrieved from Google Scholar, 14 from WoS, and 11 from Scopus. After full-text analysis, a final set of 31 papers was selected for the review. The reasons for rejection are shown in Figure 1, mapping the entire process of selection and filtration.

Table 3. Thematic Map of Coding Hierarchy

	Theme	Sub-Theme
Sustainability in Universities	Campus Sustainability Practices	• Resource Conservation • Waste Minimization • Energy Management
	Assessment and Measurement	• Carbon Foot printing • Ecological Footprinting • Sustainability Audits and Rankings
	Institutional Commitment and Governance	• Policies and Planning • Leadership and Administration
	Teaching and Learning	• Sustainability Education • Curriculum Integration • Pedagogical Approaches
	Stakeholder Engagement	• Staff Involvement • Student Participation • Community Outreach
	Financial Sustainability	• Funding Constraints • Financial Planning and Management
	COVID-19 Response	• Health and Safety • Academic Continuity • Post-Pandemic Adaptability
	Challenges and Recommendations	• Obstacles to Implementation in the Public/Private Sector • Proposed Strategies and Frameworks

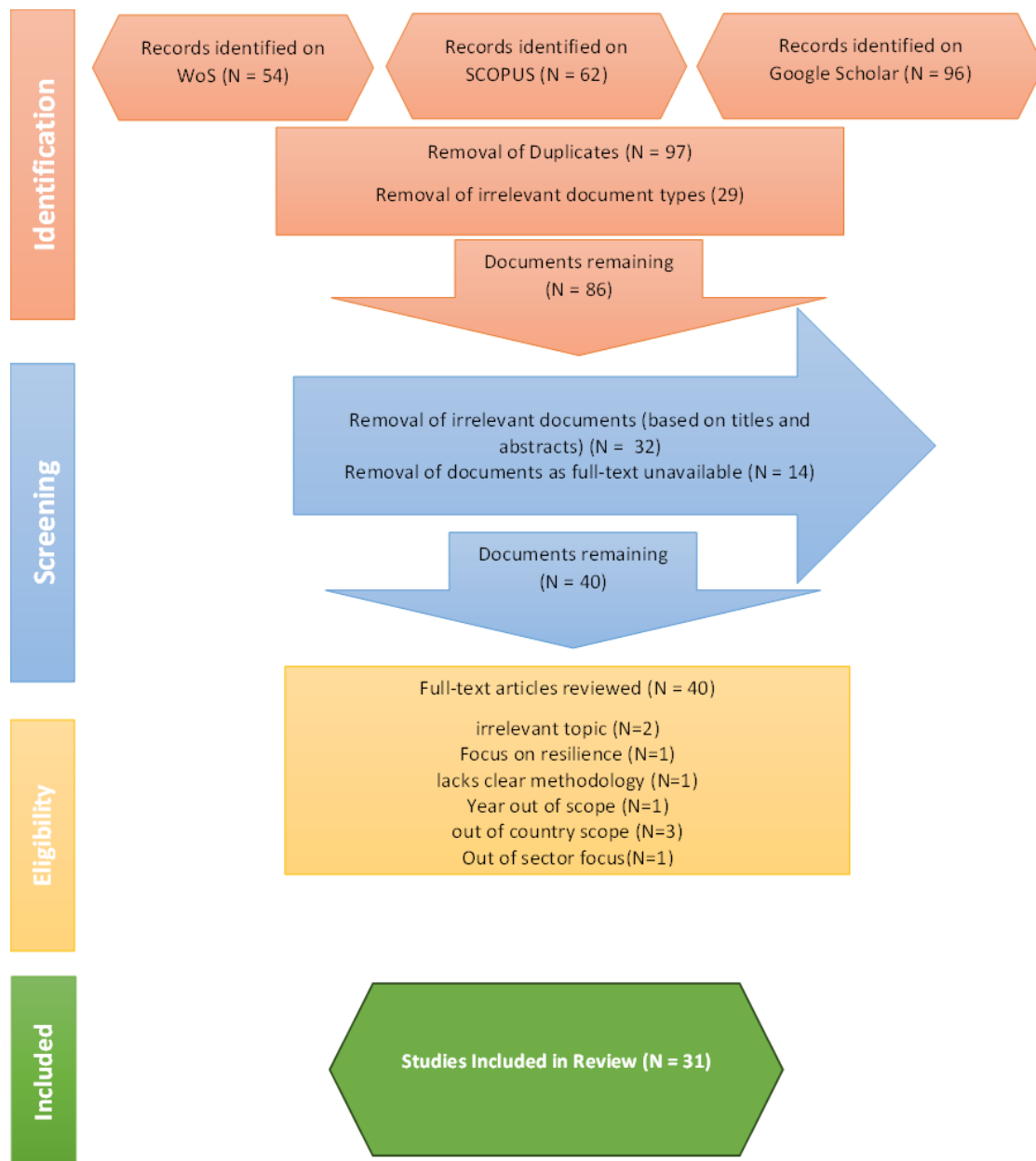


Figure 1. Flowchart of Selection and Filtration

4.2. Characteristics of Papers

For the current review, 31 articles were taken into account which included journal papers, conference proceedings, and book chapters. Figure 2 shows the distribution of publications over the 2013-2023 period. A predominant share of the literature emerged after 2015, indicating growing research attention towards sustainability issues in Malaysian higher education.

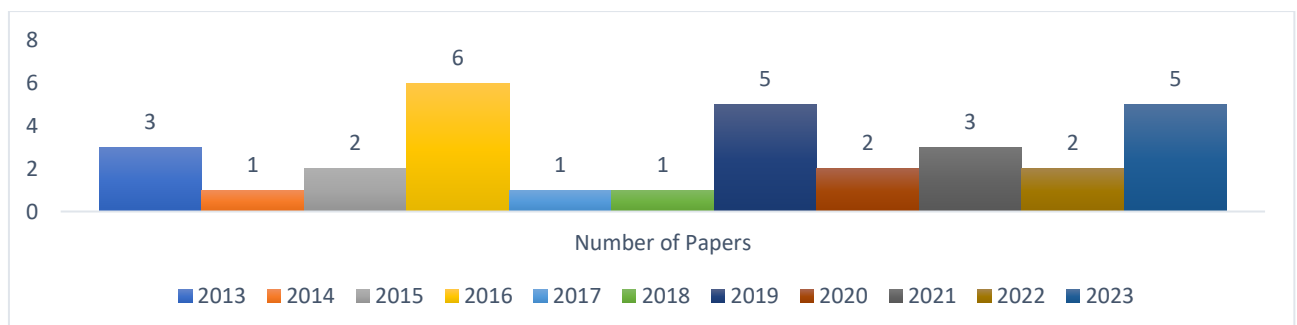


Figure 2. Year-Based Division

Out of the 31 sources, journal articles formed the majority, with 25 papers, followed by six conference papers (Figure 3). This highlights academic journals as the foremost avenues for scholarly dissemination. Tables 4 and 5 show that all studies focused entirely on sustainability aspects within Malaysian higher education institutions, aligning with the country-specific research objectives guiding article selection.

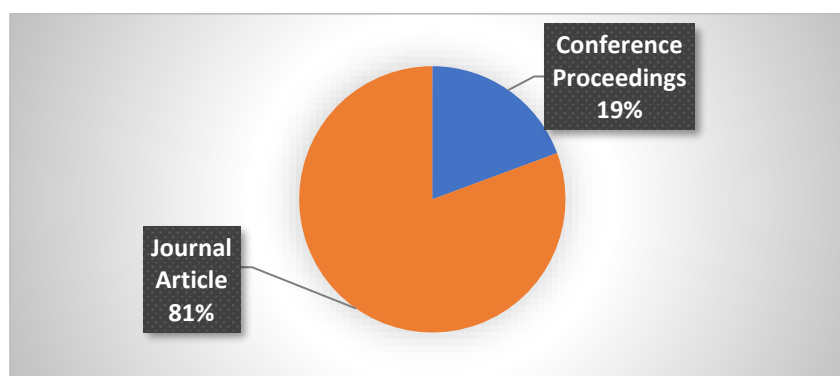


Figure 3. Reference Type Division

Regarding publication outlets, articles were dispersed across 21 journals and five conference proceedings (see Tables 4 and 5). The Journal of Cleaner Production accounted for the highest share with three articles, indicating its favourability as a relevant channel. However, most journals and conferences hosted single papers on the topic. This distribution signifies an absence of dedicated high-impact outlets catering to Malaysian or regional higher education sustainability issues.

Table 4. Conference-Based Division

Name of Conferences	# of papers
E3S Web of Conferences	1
e-Proceeding of 1st International e-Conference on Green and Safe Cities 2022	1
IOP Conference Series: Earth and Environmental Science	1
Proceedings of the 3rd International Conference on Green Environmental Engineering and Technology: IConGEET 2021, Penang, Malaysia	1
MATEC web of conferences	2

Table 5. Journal Based Division

Name of Conferences	# of papers
Applied Mechanics and Materials	1
Asian Academy of Management Journal	1
Environment-Behaviour Proceedings Journal	1
International Journal of Advanced and Applied Sciences	1
International Journal of Business and Society	1
International Journal of Engineering and Advanced Technology	1
International Journal of Higher Education and Sustainability	1
International Journal of Scientific and Technology Research	1
International Journal of Sustainability in Higher Education	1

Journal of Advanced Research in Engineering Knowledge	1
Journal of BIMP-EAGA Regional Development	1
Journal of Science and Technology Policy Management	1
Malaysian Journal of Social Sciences and Humanities (MJSSH)	1
Recycling	1
Sage Open	1
Sustainability	1
World Applied Sciences Journal	1
World Review of Science, Technology and Sustainable Development	1
Geografia Malaysian Journal of Society and Space	2
Journal of Sustainability Science and Management	2
Journal of Cleaner Production	3

Most studies concentrated on public universities and the overall national higher education landscape. Comparatively fewer sources (4 papers) investigated sustainability specifically within private universities, suggesting an imbalance in research attention that warrants bridging given private higher education's increasing prominence in Malaysia. Additionally, only 1 study offered a direct comparative lens between public and private institutions based on the dimensions of social responsibility motivations and practices (Figure 4).

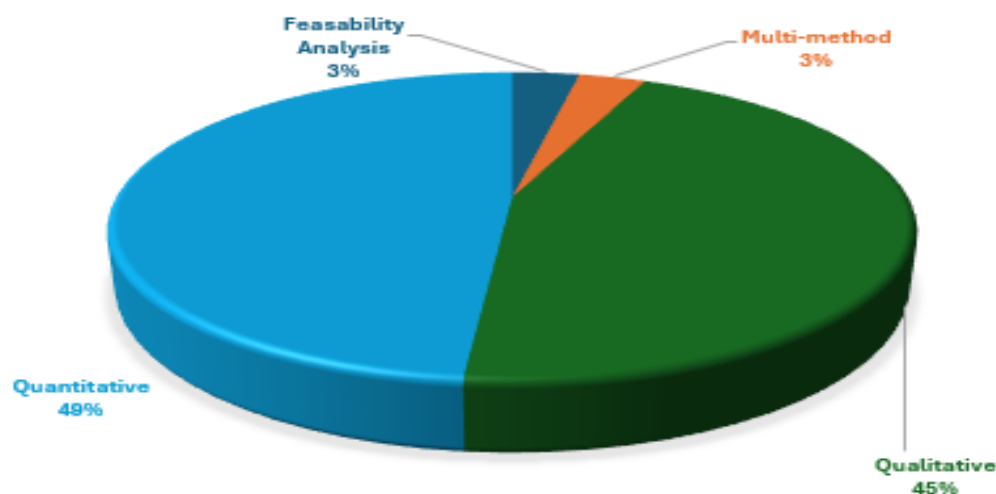


Figure 4. Type-Based Division

Concerning the different types of research, 15 studies (49%) used quantitative methods to analyse statistical sustainability performance data, while 10 studies used closed-ended instruments to poll participants' perspectives, and 5 studies used case study-based analysis. In the meantime, 14 studies used qualitative designs, gathering stakeholder opinions through focus groups and interviews, as well as document analysis, looking for sustainability-related information in policies, reports, and historical records. There is just one publication that combines quantitative and qualitative methods. This suggests a similar distribution of methodological preferences amongst researchers using quantitative and qualitative approaches. The prevalence of descriptive quantitative designs, however, suggests that in order to improve evaluative insights and prediction capacities in subsequent research, more sophisticated analytics and modelling techniques are required (Figure 5).

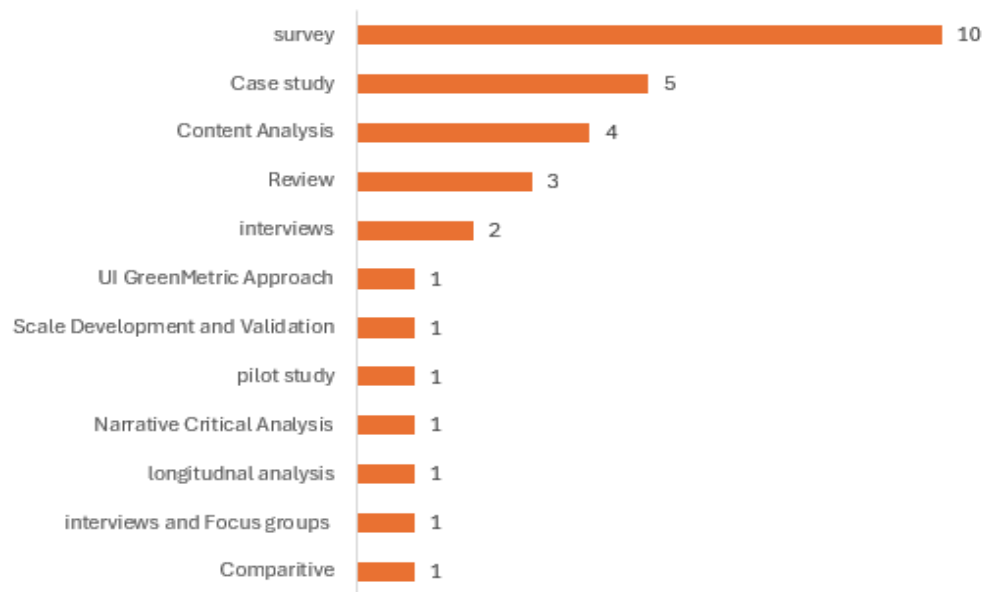


Figure 5. Study Design-Based Division

Analysing citation networks offers further insights concerning impactful studies and patterns of knowledge exchange (see Figure 6). Co-citation mapping of all authors identified the most significant cluster comprising 11 key authors, as shown in Figure 7. Within this group, See, Wai and Zen (2016), Omar et al. (2018) and Baharom et al. (2022) emerge as the most central nodes with the highest co-citation linkages, highlighting their influential works contributing insights on waste management, carbon footprint modelling, and sustainability education, respectively, within Malaysian higher education. Meanwhile, Baharom et al. (2022) are intricately linked, denoting collaborative outputs related to ecological footprint assessments (Table 6).

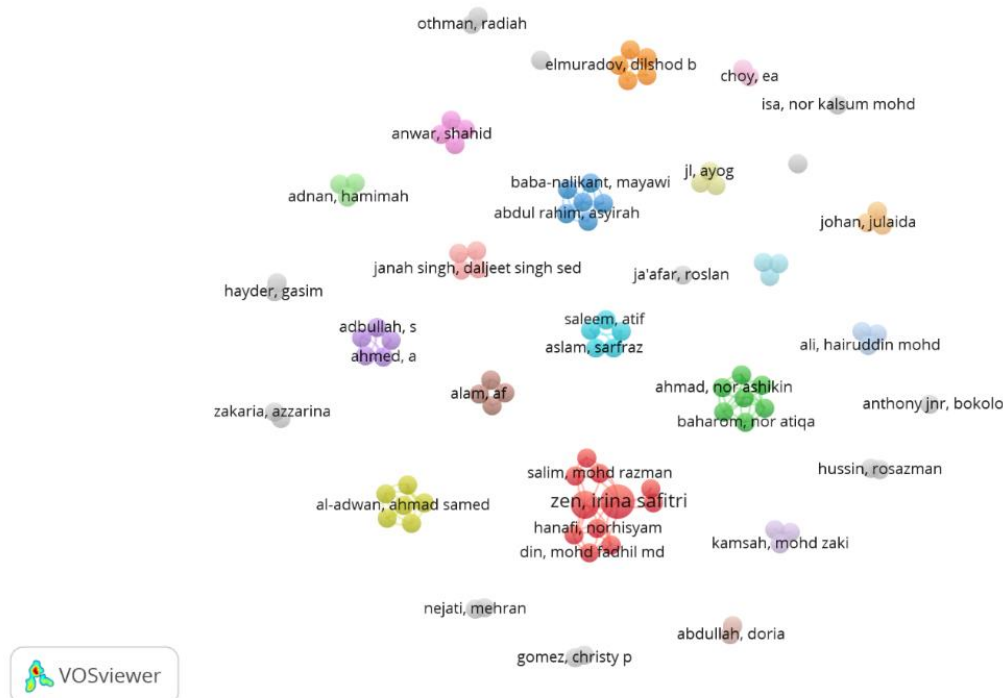


Figure 6. Authors Co-Citation Map (All Authors)

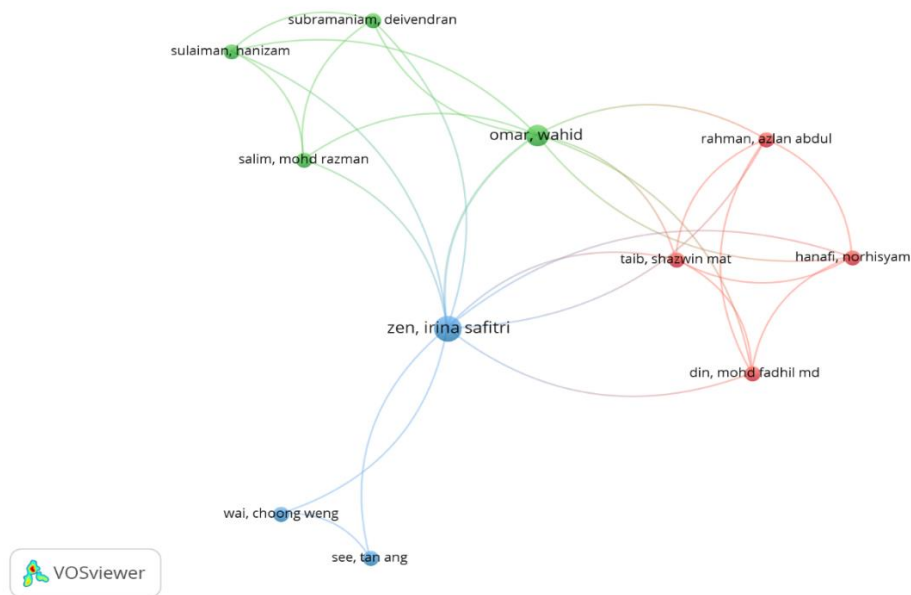


Figure 7. Authors Co-Citation Map (Largest Cluster-11 Authors)

Table 6. Top Ten Authors

Id in Vos Viewer	Author	No. of Documents	Total Link Strength
94	zen, irina safitri	3	11
67	omar, wahid	2	9
6	ahmad, nor ashikin	1	6
23	baharom, nor atiqah	1	6
24	boboc, madalina	1	6
58	mohd noor, norazian	1	6
84	wan ahmad, wan amiza amneera	1	6
89	yusuf, sara yasina	1	6
93	za'aba, siti Khadijah	1	6
1	abdul rahim, asyirah	1	5

Source: Vos Viewer Data

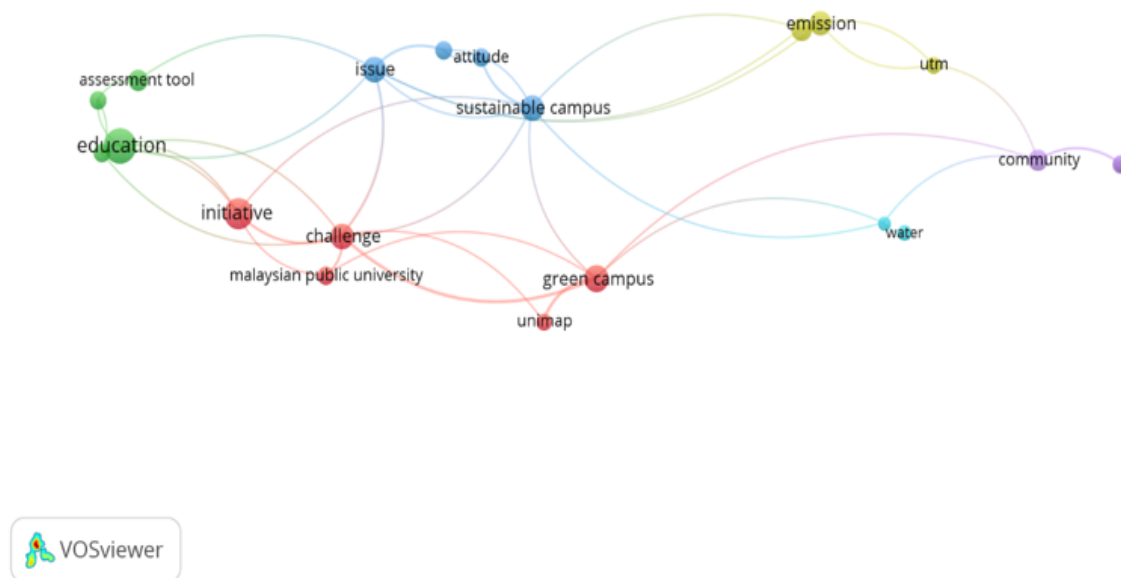


Figure 8. Keyword Co-occurrence (Titles and Abstracts)

The most commonly used words in the collected studies were obtained after analysing text corpora from abstracts, as shown in Table 7. Moreover, figure 8 also indicates the clusters of co-occurring words. Top terms include carbon footprint, community, assessment tools, emissions, Malaysian universities, public universities, and environment. This affirms the prominence of themes around measurable indicators, local higher education contexts, and comparative institution types discussed earlier. The prevalence of these descriptive terms rather than theory-related words also aligns with the observation that studies emphasize practical topics and cases versus conceptual advancements.

Table 7. Top Ten Authors

Term	Occurrences	Relevance Score
Carbon Footprint	13	1.1045
UTM	7	1.1966
Community	11	1.2243
Emission	14	1.286
Assessment Tool	11	1.3044
Malaysian University	8	1.3808
Water	6	2.1007
Public University	7	2.2012
Environment	8	2.2012

Source: Vos Viewer Data

Table 8 summarizes the focused topic and findings against selected studies for this review.

Table 8. Summary of Reviewed Literature

Authors and Year	Topic of focus	Main Findings
(Nejati & Nejati, 2013)	University Students' Perceptions of Sustainable University Factors"	The study identifies four dimensions—community outreach, sustainability commitment and monitoring, waste and energy management, and land use and planning—based on 379 university students' perceptions. It sheds light on key elements crucial for a sustainable university, addressing the lack of awareness among stakeholders.
(Foo, 2013)	Environmental Higher Education Contribution to Sustainable Development in Malaysia	The study traces the historical evolution of environmental higher education in Malaysia, highlighting fragmented policies and the importance of research breakthroughs.
(Yazdani, Talkhestan, & Kamsah, 2013)	Ecological Footprint in University	The study assesses the carbon footprint at the University Technology Malaysia (UTM) main campus in Skudai, focusing on transportation, electricity consumption, and waste generation. Strategies for carbon emission mitigation and energy management systems are identified to reduce CO ₂ emissions, providing insights and recommendations for sustainable practices at UTM.
(Othman & Othman, 2014)	University Social Responsibility in Developing Countries	Public and private universities in developing countries differ in social responsibility approaches, yet both recognize their importance for legitimacy and survival in higher education.
(Hussin & Kunjuraman, 2015)	Exploration of Strategies for Sustainable EcoCampus	UMS explores strategies for achieving its EcoCampus vision, focusing on natural resource conservation and energy-saving projects. A five-year plan (2013-2017) has been implemented to transform UMS into an EcoCampus, showcasing a sustainable development commitment.
(JL, Bolong, & Makinda, 2015)	Rainwater Harvesting in Eco-Campus	This feasibility assesses the potential of rainwater harvesting to provide untreated water for non-consumptive activities and reduce water bills at Universiti Malaysia Sabah.
(Zen et al., 2016)	Campus Waste Minimization for Sustainability Governance	Universiti Teknologi Malaysia successfully institutionalizes waste minimization, achieving significant reductions in paper consumption, economic savings, and carbon emissions through Green Office initiatives. Participatory approaches and effective monitoring are crucial for sustaining these gains.
(Azlin et al., 2016)	Consumer role in increasing campus sustainability	The National University of Malaysia study explores perceptions of a sustainable campus among students, staff, and administrators, focusing on how individuals contribute as consumers to maintain campus sustainability and preserve the environment.
(Johan, Yusof, & Omar, 2016)	Financial Sustainability of Higher Education Institutions	The study addresses budgetary challenges in Malaysian higher education, emphasizing the shift from state-funded education. Public institutions explore philanthropic funds, particularly the 'endowment fund' or waqf, to ensure financial sustainability. Challenges in fundraising, competent management teams, and complexities related to waqf management are identified, highlighting its potential and hurdles in addressing financial challenges.
(Isa, 2016)	Academic Staff Sustainability Awareness and Behaviour	The study assesses UPSI academic staff's awareness of sustainable campus principles, revealing high awareness but weak correlation with positive actions. Despite high awareness, it suggests that positive actions for sustainability at UPSI are not significantly driven by awareness alone.
(Reza, 2016)	Sustainability in Higher Education	The study reviews sustainability programs in Malaysian higher education, revealing efforts towards long-term well-being but facing effectiveness challenges. Pedagogical approaches are assessed, emphasizing the need for improvement in Education

		for Sustainable Development (ESD). Recommendations include enhancing teaching methods for impactful sustainability education.
(See, Wai, & Zen, 2016)	Ecological Footprint in University Students	The pilot study uses the Redefining Progress ecological footprint online calculator to explore the Ecological Footprint (EF) of students at Universiti Teknologi Malaysia (UTM). This study aims to measure in-campus activities and provide valuable data to enhance UTM's overall sustainability efforts by building an understanding of the ecological footprint of the student community.
(Elmuradov et al., 2017)	Measuring Sustainability Performance of Higher Education Institutions	The study examines international sustainability assessment tools for higher education institutions (HEIs), recognizing eleven tools with varied scoring methods and results. It proposes the systematic application of assessment tools and advocates for creating a tailored Sustainability Management System (SMS) designed explicitly for Malaysian HEIs.
(Omar et al., 2018)	Campus Sustainability Transformation	The research showcases UTM's dedication to sustainability, emphasizing its evolution into a living laboratory. UTM has actively engaged in UI GreenMetric audits, enhancing its ranking, and embedding sustainability elements into its strategies. Projects like the Water and Energy Nexus and integrating Sustainable Development Goals (SDG) into Living Labs initiatives underscore UTM's commitment to global sustainability.
(Ali, Ayodele, & Ibrahim, 2019)	Sustainability of Malaysian Higher Education Institutions	A survey of 263 administrators highlights challenges in long-term strategic planning initiatives (LSPI), particularly in communication, decision-making, and organizational climate. The study suggests implementing a balanced scorecard for enhanced effectiveness and efficiency in Malaysian Higher Education Institutions (MHEI), emphasizing the need for further research and investigating leadership perspectives for sustainability.
(Noor, Loong, & Naamandadin, 2019b)	Challenges in Implementing Green Campus	UniMAP aims for a Green Campus beyond green technology, emphasizing sustainable development values. Challenges include a lack of environmental education, managerial inefficiencies, implementation costs, space constraints, and general disinterest. The research provides insights applicable to green campus initiatives and sustainable projects.
(Adbullah et al., 2019)	Green University Campus Maturity Framework	The paper proposes a Green University Campus Maturity (GUCM) Framework to address Malaysian universities' lack of focus on sustainability. Identifies obstacles, including managerial inexperience and funding shortages. The GUCM Assessment Tool offers a country-specific framework for progressive sustainability.
(Gomez & Yin, 2019)	Sustainable Campus Carbon Footprint	Using the UI GreenMetric approach, the study assesses the carbon footprint at Universiti Malaysia Terengganu. Positive sustainability efforts are indicated by a decrease in carbon footprint, attributed to accurate measurement techniques, data verification, and sustainability plans. Attention is needed to enhance water and energy categories.
(Lim & Hayder, 2019)	Sustainable Campus Carbon Footprint	The research analyses and addresses the carbon footprint emission on a university campus, focusing on Malaysia's policies for sustainable development. It explores alternatives for students and staff to decrease emissions, contributing to establishing a sustainable campus. Key aspects include carbon footprint analysis, CO2 emission reduction, transportation impact, and promotion of green initiatives.

(Junior et al., 2020)	Green Campus Governance for Sustainable Development	The study develops a Green campus governance model for Higher Learning Institutions (IHL) in Malaysia, integrating economic, social, and environmental dimensions. It provides insights into influencing factors, declarations, summits, challenges, and the current adoption of Green practices in sixteen Malaysian universities. The derived model factors can serve as an assessment tool for benchmarking sustainable development in universities.
(Nawi & Choy, 2020)	Campus Sustainability	UMS is the first university in Malaysia to launch the Eco-Campus Action Plan and is ranked 44th globally in the IU-Green Metric Campus standings. The study aims to identify the level of knowledge and practices of sustainability among the UMS campus community, including students and staff. Questionnaires were distributed to 65 students and staff members from UMS. For this purpose, random sampling was done. Results indicate a high awareness of sustainable campus concepts among students and staff. However, willingness to adopt sustainable practices is at a moderate level. A lack of campus community activities may lead to a communication gap. Emphasizes the need for a committed and comprehensive partnership among stakeholders to contribute to sustainable campus development.
(Anthony Jnr, 2021)	Green Practices in Malaysian Higher Education	Malaysian higher education institutions actively implement green practices, with sustainability archival documents from sixteen universities indicating a positive trend towards sustainability.
(Azman & Abdullah, 2021)	Malaysian Higher Education Institutions' Response to COVID-19 (Focus on Sustainability of Education)	The qualitative review explores Malaysian Higher Education Institutions' response to COVID-19, emphasizing student and staff welfare, health, and safety. It discusses measures taken, such as emergency aid and administrative actions for academic continuity through online learning. The study highlights the digital divide as a significant challenge to post-COVID-19 recovery.
(Al-Rahmi et al., 2021)	Factors Affecting Mobile Learning for Sustainability in Higher Education	In this study, the Technology Acceptance Model (TAM) was used for exploring Mobile Learning (M-learning) among Malaysian university students. Findings indicate that students' attitudes and intentions positively influence the actual use of M-learning, showcasing its potential long-term sustainability. Satisfaction is expressed with perceived usefulness, ease of use, enjoyment, and task-technology fit.
(Mohd Muhiddin et al., 2022)	Challenges in Implementing Green Campus	Through interviews, the research explores challenges in implementing green campus initiatives in Malaysian public universities. Prominent challenges include limited space, financial constraints, lack of awareness, insufficient support, absence of frameworks, bureaucratic obstacles, and climate uncertainties. Overcoming these requires a collective shift in mindset and increased coordination.
(Baharom et al., 2022)	Ecological Footprint in University	The study investigates Universiti Malaysia Perlis's (UniMAP) carbon footprint during the pre-COVID-19 and COVID-19 periods. A 29.5% reduction in carbon footprint was observed during the pandemic, with recommendations for future reduction strategies focusing on energy savings, energy auditing, and carbon offsetting to enhance sustainability.
(Zakaria & Zurcher, 2023)	Analysis of Sustainability Approaches	Analysing sustainability reports of Malaysian public universities, the study identifies varying emphasis on Sustainable Development Goals (SDGs). Three common sustainability themes emerge: Impart knowledge, Technology breakthrough, and Strategic alliance.

(Ja'afar, 2023)	Green Campus Initiatives	Investigating green campus initiatives at Universiti Kebangsaan Malaysia, the study reveals positive student perceptions. Over 80% hold a favourable view, with 90% feeling that green activities contribute to environmental awareness and promote energy-saving practices. The study offers recommendations for promoting green campus initiatives.
(Saleem et al., 2023)	Education for Sustainable Development	The study explores Education for Sustainable Development (ESD) practices and perceptions in Malaysian university classrooms. Holistic, pluralistic, and action-oriented approaches to ESD positively influence sustainability consciousness. The research highlights the importance of sustainability education, emphasizing the need for further development of action-oriented methods.
(Nadzmy, Adnan, & Yaman, 2023)	Sustainable Campus Development in Public Universities	Through content analysis, the paper assesses Sustainable Campus Development (SCD) criteria among Malaysian public universities. The study highlights the relationship between Sustainable Development Goals (SDGs) and UI-GreenMetric ranking.
(Baba-Nalikant et al., 2023)	Zero-Waste Campus Perspectives	The study investigates the USM campus community's perceptions and practices related to achieving a zero-waste campus. Factors influencing pro-environmental behaviour (PEB) include environmental goals, education, personal experiences, policy awareness, and social media.

5. Discussion

5.1.1. Various Temes in Reviewed Literature

The reviewed literature reveals several key themes related to sustainability in higher education institutions in Malaysia, as discussed below.

5.1.1.1. Campus Sustainability Practices

This analysis also shows that universities are implementing important practical initiatives and projects to promote sustainability. In this regard, waste reduction and management efforts act as a core component of greening campuses. Zen et al. (2016) present a case study of green office initiatives at Universiti Teknologi Malaysia (UTM), highlighting the institutionalization of waste minimization through systemic and integrated efforts resulting in paper savings, carbon emission reduction, energy savings, and positive behavioural changes. Baba-Nalikant et al. (2023) examine perceptions and practices related to achieving zero-waste campuses, emphasizing the vital role of community participation. A few other studies reviewed in the current study also discussed that waste management practices and waste production minimization are prioritized in Malaysian universities under there campus sustainability practices (Nawi & Choy, 2020; Saleem et al., 2023).

Studies also show that Malaysian universities employ renewable energy on campus in addition to waste management to ensure effective energy utilisation and work towards sustainable development goals. In their research, Hussin and Kunjuran (2015) have brought attention to the fact that Malaysian universities are implementing eco-campus development plans that include energy optimisation and the installation of renewable energy sources. Furthermore, by lowering energy use and enhancing overall environmental performance, better monitoring and measuring of energy usage promotes the shift towards a lower carbon footprint (Baharom et al., 2022).

Other facets of campus sustainability practices include integrating technological advancements and infrastructural upgrades that can help realize sustainability goals. In one of the studies, Noor, Loong and Naamandadin (2019b), it is recognized that a lack of green facilities at the campus can act as a potential barrier to eco-friendly innovation that can address various economic, environmental,

and social issues in the education sector of Malaysia. Integrative planning and development of sustainability-centred facilities can generate long-term efficiencies while allowing institutions to lead by example (Adbullah et al., 2019).

5.1.1.2. Assessment and Measurement

Campuses prioritise assessing sustainability initiatives through extensive indicators, metrics, and specialised assessment systems in addition to implementation. Carbon footprint is a measurable sustainability metric that has been measured and analysed in several studies to evaluate environmental consequences and direct improvement initiatives. Yazdani et al. (2013) employ source data from the transportation, energy consumption, and waste generation categories to estimate the total carbon emissions of a public institution. In addition, comparative and trend analyses enable the monitoring of performance over time, the identification of trouble spots, and the assessment of the results of interventions (Adbullah et al., 2019; Lim & Hayder, 2019).

Standardized measurement systems like UI GreenMetric provide recognized benchmarks, allowing universities to rank their sustainability levels (Elmuradov et al., 2017), while identifying areas needing attention. Nadzmy, Adnan and Yaman (2023) utilize GreenMetric indicators for content analysis of public university websites to determine variations and compare adoption levels of sustainability practices aligned with global metrics. Such frameworks offer reference standards for continuing progress. In addition to benchmarking models, studies also critique evaluation instruments used to appraise sustainability in higher education institutions systematically (Elmuradov et al., 2017), which signals the need for new, holistic frameworks tailored to the evolving Malaysian context for consistent appraisals.

5.1.1.3. Institutional Commitment and Governance

The evidence obtained from the review also revealed the role of leadership priorities, policies, and structural reorientation in enabling sustainability pursuits in higher education. Junior et al. (2020) formulated an integrative Green Campus Governance Model for balanced, sustainable development that offers decision-making, planning, and systematically advancing multifaceted campus sustainability. Meanwhile, studies similarly highlight the adoption of holistic governance mechanisms through centralized specialized offices overseeing and coordinating various initiatives (Omar et al., 2018).

Several articles discuss the existence of sustainability declarations (Ali, Ayodele, & Ibrahim, 2019), action plans (Nawi & Choy, 2020), and integration into vision or development blueprints (Omar et al., 2018) as indicative of institutional commitment. Nevertheless, bureaucratic hurdles are identified as obstacles in turning high-level policy provisions into actionable implementation (Mohd Muhiddin et al., 2022). This demonstrates complications that can arise between espoused mission statements and on-ground realization.

Researchers also emphasise how top management's resource allocation and priority-setting impact sustainability project implementation. Adbullah et al. (2019) demonstrate enhanced environmental advantages through better decision-making and data verification by top administration. On the other hand, Mohd Muhiddin et al. (2022) identify the absence of financial support for leadership as a significant obstacle, indicating hindrances to change.

5.1.1.4. Teaching and Learning

The literature further highlights sustainability education as a vital channel for raising awareness and developing capable human capital to drive progress in the sector. Studies examine efforts to incorporate sustainability knowledge and develop specialized skills among students to shape attitudes and behavioural tendencies. Reza (2016) reviews integration across current academic

programs, concluding the need to adopt more impactful teaching techniques. Meanwhile, Saleem et al. (2023) survey the predominant use of holistic, pluralistic, and action-oriented content delivery, showing associations with sustainability consciousness. However, students indicate lower exposures to transformative action-focused methods, signalling gaps. Several authors correspondingly push for curriculum improvements to meet Sustainable Development Goal (SDG) requirements through use of problem-based learning (Nadzmy, Adnan, & Yaman, 2023; Omar et al., 2018; Saleem et al., 2023). The analyses indicate growing attention, but further enhancements are needed in the quality of sustainability education to achieve significant student outcomes.

In addition, document the perspectives of campus community members on the significance and function of sustainability education. Azlin et al. (2016) emphasises raising awareness among university staff and the general public on the importance of universities serving as information hubs and agents of attitudinal change. In the meanwhile, students believe that sustainability skills will be essential for jobs in the future (Reza, 2016). These findings support the notion that higher education should take the lead in developing capability.

5.1.1.5. Teaching Stakeholder Engagement

In addition to physical operations and development, stakeholder perspectives and engagement emerge as a pivotal component that cuts across other aspects of campus sustainability.

A few studies investigate the outlook and consciousness of students and staff concerning sustainability concepts to diagnose gaps in understanding that may undermine practical efforts. Reza (2016) indicates fragmented thinking and the need for pedagogical improvements concerning environmental literacy and responsible behaviour among students. Similarly, Isa (2016) reveals high cognitive awareness but poor behavioural translation among academics at a Malaysian university, underscoring the need for participatory learning. In contrast, Saleem et al. (2023) discover relatively positive student and teacher perceptions regarding the prevalent use of pluralistic teaching methods incorporating environmental, social, and economic dimensions. Meanwhile, Ja'afar (2023) finds over 80 percent of student respondents hold favourable views of existing green initiatives on campus. Such studies offer insights into stakeholder attitudes that impact successful implementation.

Studies also examine how students actively participate in campus group sustainability initiatives across institutions. Azlin et al. (2016) conducted a poll to gather opinions on how the general public, employees, and students may make a difference by becoming environmentally conscious consumers. Noor et al. (2019) identify a modest level of desire despite high knowledge, partially attributing it to a deficiency in chances for engagement and a sense of belonging for both staff and students. The analysis reiterates the challenges in integrating diverse groups to collaborate towards sustainability.

5.1.1.6. Financial Sustainability

Ali, Ayodele and Ibrahim (2019) discuss reduced public funding in Malaysian institutions, with universities increasingly seeking alternative, innovative financing channels. Specifically, Johan, Yusof and Omar (2016) consider Islamic endowment funds (waqf) to sustain operations while navigating complex regulations. The finance-environment nexus underscores capital requirements for high-cost sustainable investments alongside tighter budgets. Meanwhile, other analyses document promising returns from sustainability projects, indicating potential alleviation of budget pressures. Zen et al. (2016) showcase substantial savings from minimized paper usage over eco-friendly gains from Green Office initiatives. Similarly, water conservation systems project considerable cost and resource savings in residences (JL, Bolong, & Makinda, 2015). The evidence suggests financial motivations for adopting sustainability, despite initial barriers.

5.1.2. COVID-19 Response

The COVID-19 pandemic caused significant disruptions across Malaysian higher education, requiring urgent responses to safeguard health and ensure academic continuity (Azman & Abdullah, 2021). Studies revealed how institutions prioritized student and staff welfare by providing emergency aid and developing safety protocols aligned with government advisories (Al-Rahmi et al., 2021; Mohd Muhiddin et al., 2022). To sustain teaching and learning, universities swiftly transitioned to online delivery modes, facing varying readiness levels.

However, the abrupt shift exposed Malaysia's "digital divide" as a critical barrier, exacerbated by disparities in digital infrastructure, resources, and capabilities between institutions and across student groups (Al-Rahmi et al., 2021). Rural access barriers, economic constraints inhibiting technology ownership, and uneven IT literacy challenged the effective adoption of remote learning platforms for equitable participation (Al-Rahmi et al., 2021). This threatened to learn sustainability amidst aspirations for flexibility and evidence-based responses emphasizing academic quality and support services (Azman & Abdullah, 2021).

As campuses reopened partially, epidemiological shifts and evolving government advisories warranted calibrated responses balancing health safeguards, student priorities and policy pressures in a climate of uncertainty (Mohd Muhiddin et al., 2022). Institutions incorporated pandemic impacts in strategy adjustments – from sustainable campus planning to curriculum innovations in healthcare education responding to societal needs (Abdullah et al., 2019; Mohd Muhiddin et al., 2022).

Interestingly, several studies analysed the environmental dimensions. Reduced on-campus activities and travel restrictions lowered carbon emissions, providing insights into leveraging such involuntary shocks for sustainability (Baharom et al., 2022; Hussin & Kunjuraman, 2015; Noor, Loong, & Naamandadin, 2019a). However, Mohd Muhiddin et al. (2022) cautioned against deriving simplistic linkages between emission cuts and lasting behavioural changes without support structures. Recommendations emphasized reskilling administrators on evidence-informed leadership to negotiate complex trade-offs around health, equity, and environmental pressures in a disruptive context (Azman & Abdullah, 2021).

5.1.3. Comparative Analysis of Public and Private University Sustainability

While studies reveal increasing sustainability efforts across Malaysian higher education, noticeable variations between public and private institutions appear regarding prevalent practices, motivations, and implementation barriers (Azlin et al., 2016; Gomez & Yin, 2019; Zen et al., 2016).

5.1.3.1. Sustainability Practices

Evidence indicates differences in program priorities and strategic approaches to campus sustainability across public and private spheres.

Reviews of large public universities highlight waste and energy programs (Zen et al., 2016), infrastructure upgrades, and carbon footprint monitoring (Abdullah et al., 2019) as predominant projects. Practices align with national policy directives like the EcoCampus initiative (Nawi & Choy, 2020). Gaining sustainability rankings and achieving external benchmarks motivate adoption (Mansor et al., 2019). Additionally, studies report public universities prioritizing internal community dimensions protecting institutional identities by serving existing students and employees (Othman & Othman, 2014). This manifests in educational programs that impart knowledge (Reza, 2016) and create environmental awareness, targeting campus members as primary beneficiaries (Azlin et al., 2016).

In the meantime, private universities place greater emphasis on the outside world, deliberately utilising sustainability to respond to external needs and attract new students. According to Othman and Othman (2014), private colleges in Malaysia are still developing their reputations by positioning

their brands on social responsibility platforms like environmentalism. Consequently, community collaborations (Junior et al., 2021), green marketing (Gomez & Yin, 2019), and prominent certifications signify priorities. Moreover, Ali et al. (2019) discusses aggressive income diversification among private institutions reflectively of competitive funding dynamics and commercial orientations. These contrast with public universities contending with tightening state budgets, but are more financially stable currently. The evidence suggests market-centred motives shaping private university sustainability.

5.1.3.1. Implementation Challenges

Despite common obstacles like space constraints and climate uncertainties, public and private institutions grapple with specific barriers influencing sustainability. Analyses indicate bureaucratic impediments and hierarchical decision structures in public universities, slowing development approvals for sustainability initiatives (Mohd Muhiddin et al., 2022). Government project budgeting requirements and standardized designs limit flexibility for innovations. Leadership prioritization issues arise from managerial gaps between senior policymakers and implementing officers (Ali et al., 2019). Such institutional rigidities frustrate progress.

In contrast, private campuses encounter fewer bureaucratic controls but face capital and expertise deficiencies without assured state funding. High upfront investments (Noor et al., 2019) and specialist skills requirements for technologies (Gomez & Yin, 2019) intensify demands on limited private university budgets. Managerial inexperience in integrating sustainability amidst commercialization also challenges smooth adoption (Gomez & Yin, 2019).

6. Conclusion

The purpose of this systematic scoping review was to investigate the state of sustainability practices and frameworks and challenges in Malaysian higher education institutions (HEIs). Set in the context of the broader sustainable development agenda and informed by an emerging need for institutional change, the research aimed to describe major patterns and gaps in Malaysian universities' approach to sustainability. The study employed a scoping review methodology and analysed 36 peer-reviewed articles and conference proceedings. Inclusion criteria were focused on the empirical studies regarding the college activity connected with sustainability education, institutional governance, stakeholder engagement, financial and policy aspects, and the consequences of the COVID-19 pandemic. Key questions regarding sustainability research and adoption patterns in Malaysian higher education institutions were covered by this systematic scoping review. These questions included practices, measurement, institutional commitment, education programmes, stakeholder perspectives, COVID-19 response, public-private dynamics, challenges, and recommendations. 31 publications published between 2013 and 2023 were analysed to create a summarised story that may be used to assess the field's status, drive policy decisions, and suggest productive avenues for future study. The insights derived are summarized in Table 9 below across the dimensions of focus mapped to the guiding research questions.

Table 9. Summary of Key Findings

Research Questions	Key Findings
RQ1: What themes are addressed when exploring sustainability in higher education institutions in Malaysia?	• - Campus greening practices around waste, water, energy management (prominent focus) • Sustainability measurement is achieved through footprint audits and UI GreenMetric benchmarking. • Institutional governance via policies, leadership priorities, restructuring • Sustainability education and curriculum integration • Stakeholder perspectives of admin, staff, students • Financial costs, funding constraints, and savings opportunities
RQ2: How has sustainability evolved in Malaysian higher education during the COVID-19 pandemic, and what lessons can be learned from pre- and post-COVID periods?	• Health, safety, and academic continuity prioritized amidst campus closures. • The rapid shift to online learning exposed the digital divide across student groups. • Environmental gains from reduced activities require support structures for sustained behavioural change. • Pandemic incorporated into strategy adjustments spanning planning, curriculum innovations
RQ3: To what extent do the sustainability practices and challenges differ between public and private universities in Malaysia?	• Public sustainability practices: Waste/energy programs aligning with national policies, inward focus on-campus community education • Private sustainability practices: Outward-facing adoption for branding and legitimacy, collaborations, green marketing • Public challenges: Bureaucratic hurdles, hierarchical decision structures, leadership coordination issues • Private challenges: Capital and expertise deficiencies without assured state funding, commercialization challenges

The analysis identifies multi-level gaps, providing a foundation for proposing recommendations to enhance scholarship and practice on sustainability in Malaysian higher education.

7. Implications and Recommendations

This study offers various recommendations for practitioners. For instance, it is suggested that mainstream predictive modelling and mixed methods can be used for robust, multi-lens evaluations that explain adoption variability between institutions and forecast effectiveness. Cultivate dedicated scholar networks publishing in specialized sustainability-focused journals to consolidate knowledge and enable regional, national, and international collaborations. Develop unified theoretical frameworks contextualized for Malaysian higher education to provide consolidated platforms for analysis and progress measurement.

It is also suggested that there should be some coherent nationwide policies, financial incentives, and governance mechanisms tailored for public and private institutions based on their constraints. Also, there is need to enhance pedagogical approaches and learning activities to build student sustainability capabilities, focusing on transformative and action-oriented education. From a research aspect, there is a need to increase research attention on private institutions and public-private comparative aspects to diagnose convergence and divergence. Incorporate resilience planning and health system strengthening in education and campus operations as part of COVID-19 adaptations. Refine mechanisms to evaluate sustainability integration and actual adoption levels systematically, institution-wide, beyond high-level audits. Finally, there is need to foster participatory initiatives and communication to sustain campus community and stakeholder engagement for shared sustainability goals.

7.1. Limitations and Future Research Scope

It is important to recognise the limits of the scoping review. First off, prospective insights from grey literature or non-English sources are not included in the sample since it only includes academic works that are peer-reviewed in the English language. Second, the study is limited in its ability to assess real-world application since it is based only on published research. Thirdly, the synthesis does not employ quantitative meta-analysis; instead, it uses only descriptive approaches. However, the study provides a wide base upon which further research addressing the identified gaps might be built. Predictive simulations, policy analysis, qualitative implementation evaluations, and updated metric audits can all be included in integrated mixed-methods investigations. Internal validity and causality determination can be strengthened by longitudinal designs that monitor institutions over time. Moreover, translational research synthesizing literature insights with fresh situational data through stakeholder engagement workshops can catalyse scalable solutions. Focusing on high-impact journals with robust peer review and global dissemination avenues can enhance scholarly contributions. Concerted efforts bridging academia, policymakers, and practitioners across public and private spheres are vital to transitioning Malaysian higher education onto a sustainability trajectory that balances environmental integrity, social equity, and economic viability through systems thinking.

Declarations

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