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Sustainability in Polytechnic Institutions: A Roadmap to A Greener Future

Full Paper

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Abstract

Sustainability is an essential concept that has gained momentum in recent years as a response to the growing concern about global environmental issues. A sustainable approach seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. Polytechnic institutions, as centers of education and innovation, have a crucial role to play in fostering sustainability by integrating its principles into academic curricula, research, campus management, and community outreach. This paper will discuss the significance of sustainability in polytechnic institutions and provide recommendations on how to achieve it effectively. This research paper uses quantitative methods on previous studies related to sustainability and was published on Scopus from 2000 to 2023. The results of the study found that sustainability in polytechnic institutions can be improved in terms of collaborative relationships between institutions and encourage all students, not just freshmen, to think sustainably. The results of this study are expected to help TVET institutions, stakeholders, and the government to develop a green curriculum especially in the implementation of green elements as well as increase the marketability and competitiveness of TVET graduates.

Keywords: - Sustainability, polytechnic, TVET

1. Introduction

Polytechnic institutions are specialized, career-focused educational establishments that provide students with technical and vocational training in various fields such as engineering, technology, applied sciences, and business management according to Technical and Vocational Education and Training – Education for sustainable Development (TVET-ESD) (UNESCO, 2014). These institutions emphasize hands-on, practical learning experiences and often collaborate with industry partners to align their curricula with the needs of the job market. Polytechnic institutions serve as vital contributors to the development of skilled professionals, who play a significant role in driving economic growth, innovation, and social progress (Giesecke, 2013). As centers of education and innovation, polytechnic institutions bear the responsibility of promoting sustainability in their academic and operational practices to ensure a better future for the planet and its inhabitants.

Polytechnic institutions, with their focus on applied learning and industry-driven curricula, have a unique opportunity to contribute to sustainability by preparing students for careers that address environmental, social, and economic challenges (Sterling, 2004). The relationship between polytechnics and sustainability lies in their ability to influence future professionals who will implement sustainable practices in various sectors, such as engineering, technology, and business management.

The issue at hand is the urgent need for integrating sustainability into polytechnic institutions. As centers of education and innovation, these institutions have a crucial role to play in fostering a sustainable future by addressing environmental, social, and economic challenges. The issue concerns the development and implementation of sustainable practices across various aspects of polytechnic institutions, including academic curricula, research initiatives, campus management, and community outreach. By failing to prioritize and incorporate sustainability, polytechnic institutions may inadvertently contribute to environmental degradation, resource depletion, and social inequalities, which can have long-lasting negative consequences for future generations.

Alshuwaikhat & Abubakar (2008) and Fadeeva & Mochizuki (2010) state that there is an immediate need to integrate sustainability into polytechnic institutions. As educational and innovative hubs, these institutions play an essential role in fostering a sustainable future by addressing environmental, social, and economic challenges (Lozano et al., 2013; Tilbury, 2011). By incorporating sustainability principles and practises into their curricula, research, and campus operations, polytechnic institutions can assist in equipping the next generation of leaders with the skills and knowledge necessary to create a more sustainable world (UNESCO, 2017; Wiek, Withycombe, & Redman, 2011).

Integrating sustainability into polytechnic education involves incorporating sustainable principles and practices across all aspects of the institution, including academic curricula, research initiatives, campus operations, and community engagement (Mochizuki & Fadeeva, 2008). By doing so, polytechnic institutions can produce graduates with the knowledge, skills, and values necessary to develop innovative solutions to complex sustainability challenges, thus fostering a greener and more equitable future.

1.1 Objective

This research will discuss the significance of sustainability in polytechnic institutions and provide recommendations on how to achieve it effectively. This study will make it easier for other educational institutions to use the same strategy or improve it in the future. To achieve this goal, the objectives are developed based on the following points:

1. To survey the intellectual core and landscape of the general body of knowledge in sustainability in polytechnic.
2. To access the quality of the current body of knowledge sustainability in polytechnic.

1.2 Scope

The scope of this study is focused on the 23 years of publication and research in Scopus from 2000 to 2023.

2. Literature Review

Sustainability has become a critical issue in higher education institutions, including polytechnics. Polytechnic institutions are expected to play a significant role in promoting sustainability and creating a greener future. However, studies have shown that sustainability is not adequately integrated into the curriculum of polytechnic institutions (Nazif, Mustapha, & Ocheme, 2020).

The implementation of sustainability practices in higher education institutions has been analyzed in several studies which analyzed the current state of implementation of sustainability development in Portuguese higher education institutions (Aleixo, Azeiteiro, & Leal, 2018). The study found that there is a need for a more comprehensive approach to sustainability in higher education institutions. Storey, Killian & O'Regan (2017) mapped the field of responsible management education in the context of the Sustainable Development Goals (SDGs). The study highlighted the importance of integrating sustainability into the curriculum of higher education institutions.

Several studies have focused on the role of polytechnic institutions in promoting sustainability. Lee-Yaw et al. (2016) analyzed the possible ways that educational institutions can implement green ICT to ensure that their environment is economically sustainable. The study used Accra Polytechnic in Ghana as a case study (Pardal, Romeira, & Durão, 2020) that studied the challenges and opportunities of creating an eco-green campus at the Polytechnic Institute of Beja. The study highlighted the important role of higher education institutions in promoting sustainability.

Polytechnic institutions have also been studied in terms of their economic impact. Alves et al. (2015) estimated the economic impact of a group of polytechnic institutes located in regions with diverse socioeconomic realities. The study found that polytechnic institutions have a significant impact on the local economy.

In conclusion, sustainability is a critical issue in polytechnic institutions. Studies have shown that sustainability is not adequately integrated into the curriculum of polytechnic institutions. However, there is a growing awareness of the importance of sustainability in higher education institutions, and several studies have focused on the role of polytechnic institutions in promoting sustainability. Polytechnic institutions have also been studied in terms of their economic impact.

3. Methodology

In this study, qualitative methods were used in this research. Using the keywords “sustainability” and “polytechnic”, 168 papers have been identified for the analysis using a science mapping tool. Science mapping was conducted in two stages. The first stage involved constructing networks through keywords and institutions co-occurrence analysis as explained in the next section and the second stage involved generating maps for mining useful information from network measures, and to display conceptual, intellectual, or social evolution of the research field, discovering patterns, trends, seasonality, and outliers (Chen, 2017).

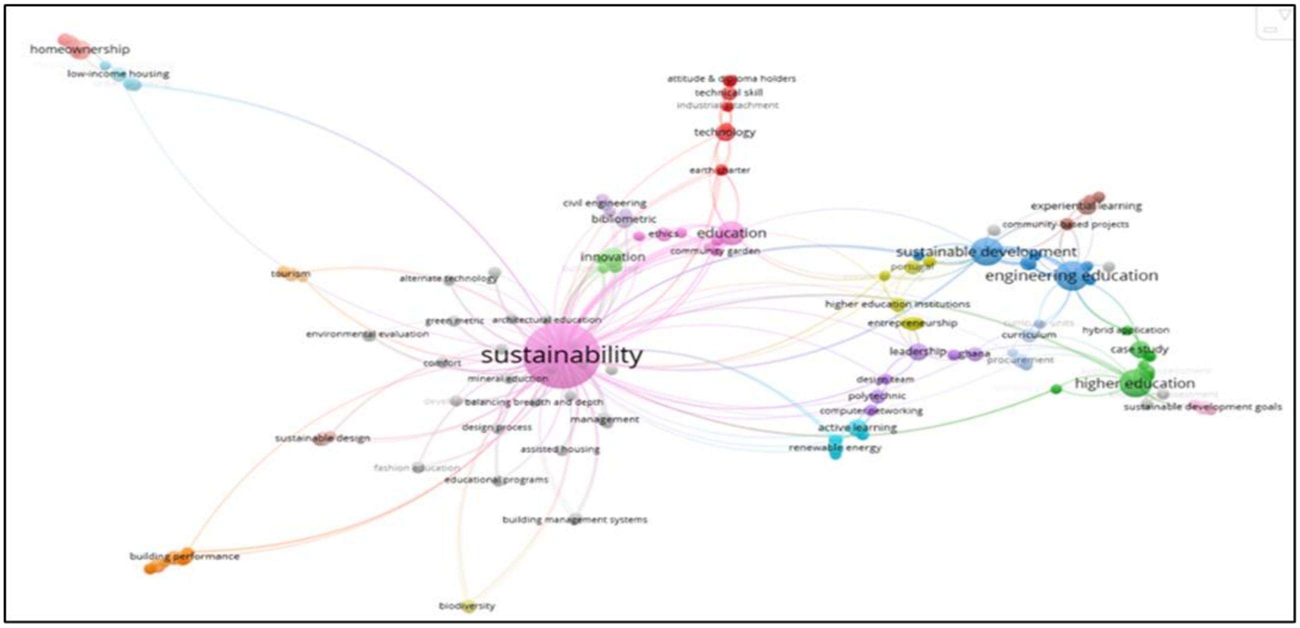

Fig. 1. Main research interests on sustainability in polytechnics (co-occurrence network keywords)

4. Result and Discussion

The study of sustainability in polytechnics were discussed in terms of: (a) keyword of occurrence and (b) country collaboration.

4.1 Objective

VOS viewer is used to establish a system of collaborative writing between numerous institutions. In a typical keyword co-occurrence network, the nodes represent the keywords themselves, and the edges represent the relationships between them (representing relations among sets of keywords). Connections between organizations are shown as lines between circles. The greater the concentration of institutions, the more often they occur simultaneously. Each cluster of keywords is represented by a different colour, and these colours correspond to research hubs. The closeness or cooperation between two nodes is represented by the thickness of the link's silhouette. These descriptions can later be applied to other networks by substituting keywords with countries and institutions. Table 1 and Fig. 2 shows the result of co-occurrence keywords.

Table 1. Top 50 keywords

Degree	Centrality	Label	Relative Influence
117	520	sustainable development	1
85	310	sustainability	2
73	280	engineering education	3
57	110	students	4
46	100	architectural design	5
45	60	education	6
40	90	Higher education	7
38	90	leadership	8
35	40	design	9
32	40	curricula	10
28	80	budget control	11
28	70	energy utilization	12
25	20	Beijing	13
25	20	investment	14
24	80	climate change	15
23	40	China	16
22	10	construction	17
22	60	buildings	18
22	10	building technology	19
21	20	energy conservation	20
21	20	building systems	21
20	10	construction industry	22
20	20	decision making	23
19	60	international cooperation	24
19	20	ecology	25
18	20	environmental engineering	26
18	10	architecture	27
17	20	energy efficiency	33
17	10	education computing	35
16	10	curriculum	37
15	10	teaching	38
15	10	energy saving	39
14	10	management	40
14	10	automation	42
14	10	3d model	43
14	20	civil engineering	44
14	60	building performance	45
14	10	4d model	46
14	20	urban planning	47
13	10	environmental management	48
13	10	emission control	49
13	10	carbon footprint	50

Using weighted degree values, the most influential keywords in the network were identified. Nodes were recoloured and resized according to their weighted degree values, with larger nodes and thicker linkages denoting greater weighted degree values (Van Eck & Waltman, 2011). Several key findings have been found from the analysis:

i. Some research interests have received special attention, while others have remained under research. Given that this review paper initially focused on these terms, sustainability development and sustainability are the most frequently occurring keywords. Engineering education, students, architectural design, education, higher education, and leadership have received considerable attention in sustainability in polytechnic research (Table 1). They are all interconnected terms related to the larger theme of sustainable energy and climate change mitigation. The results indicate that these have been the top themes in literature.

ii. Sustainable development and sustainability mostly focus on engineering education and students. For instance, in Malaysia, green curriculum has been embedded in the engineering department of polytechnics Malaysia (Jabatan Pendidikan Politeknik, 2018) whereas for the non-engineering course, green elements are difficult to integrate into the existing program/syllabus structure. They must create syllabus based on the green compliance that suitable with Malaysian environment. Lozano et al. (2015) emphasize the importance of integrating sustainability into the academic curriculum of higher education institutions, including polytechnics. The authors highlight the need for interdisciplinary courses that cover sustainability principles and focus on practical applications across various fields. They also stress the importance of fostering problem-solving, critical thinking, and collaboration skills among students to enable them to develop innovative solutions to real-world challenges related to sustainability.

iii. The result further suggests that limited attention has been directed toward knowledge in carbon footprint, emission control, management, environmental, urban planning and 4d model. This must draw the higher education administrator's attention, given that knowledge in carbon footprint, how to control emission, good management and applying new technology such 4D model can assist sustainability issue especially in knowing the impact of the programme. Briens et al. (2023) reported that as the importance of sustainability teaching and learning increases, a growing number of higher education institutions (HEIs) are evaluating the efficacy of their approach to sustainability education. However, most assessments fall short of determining how curriculum plans influence learning outcomes.

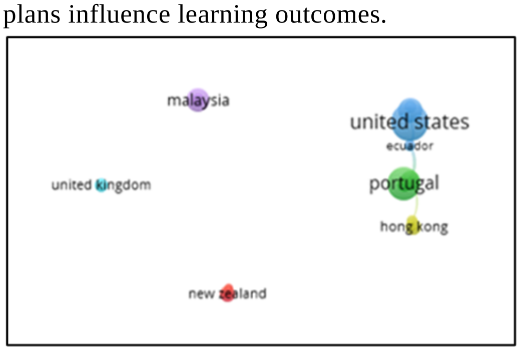

Fig. 2. Collaboration network of countries in the literature on sustainability in polytechnics

4.2 Collaboration Between Countries

It is helpful for research partnership and policymaking to learn about the network of institutions with a high investment and interest in research on retrofitting. Fig. 2 shows that out of the 50 countries studied, only 18 of them publish three or more documents. Concerning the strength of relations, the strongest relations were among these countries the United States, Equatorial Guinea, and Hong Kong have intergovernmental cooperation among these 18 nations. However, the link silhouette suggests that the networking is weak. Even though Malaysia, the United Kingdom, and New Zealand have produced more than three documents on the subject, there has been no international cooperation on sustainability in polytechnics for these nations.

5. Limitation and Suggestion

There is a lack of expertise in sustainability, particularly in third-world countries, is to highlight the disparities in resources, education, and infrastructure that contribute to this knowledge gap. These countries often face numerous social, economic, and political challenges that hinder the development of expertise in sustainability.

Moreover, the prioritization of immediate needs, such as addressing poverty, hunger, and basic infrastructure, may lead governments and institutions in third-world countries to allocate fewer resources to the development of sustainable expertise. Furthermore, the lack of collaboration and knowledge-sharing between developed and developing nations may also contribute to the gap in sustainability expertise.

To address this issue, it is essential to foster international partnerships and knowledge-sharing initiatives, as well as invest in capacity-building programs that can help develop local expertise in sustainability. By providing resources, training, and support to third-world countries, the global community can work together to close the sustainability expertise gap and promote sustainable development in all regions of the world.

Polytechnic institutions should foster research projects related to sustainability, encouraging collaboration among students, faculty, and industry partners. Research initiatives can range from exploring new materials and processes for energy-efficient construction to investigating the potential of renewable energy sources or developing innovative waste management solutions. By fostering a culture of sustainability-focused research, polytechnic institutions can contribute to the development of ground-breaking technologies and strategies that address environmental and societal challenges.

6. Conclusion

In conclusion, the integration of sustainability in polytechnic institutions is of paramount importance in shaping a greener and more equitable future. As centres of technical and vocational education, polytechnics have the potential to drive positive change by equipping students with the knowledge, skills, and values necessary to address complex environmental, social, and economic challenges. To achieve this, polytechnic institutions must commit to incorporating sustainability principles across all aspects of their operations, including academic curricula, research initiatives, campus management, and community engagement. By establishing dedicated sustainability committees, developing comprehensive policies and action plans, and fostering a culture of sustainability, polytechnic institutions can serve as exemplary models for other educational institutions and contribute significantly to global sustainability efforts. As we collectively strive for a more sustainable world, it is vital for polytechnic institutions to embrace their pivotal role in nurturing the next generation of sustainability-conscious professionals and innovators, ultimately driving the transition towards a greener future.

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