

Minds and Megawatts: University Students' Engagement with Energy Efficiency and Sustainability Practices

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Abstract

Universities play a significant role in fostering energy efficiency and sustainability habits among the younger generation. As centres of knowledge and innovation, they are uniquely positioned to influence the attitudes and behaviours of future leaders. Studies measuring the effectiveness of sustainability-based educational interventions at higher-level institutions, whether they are curriculum-oriented Chen et al (2024); Zin et al (2023); Mohamed et al (2024) or campus-focused initiatives (Dagiliute et al., 2018; Jehtae et al., 2021; Ribeiro et al., (2021), have largely indicated that university undergraduates' level of sustainability knowledge is at low to moderate levels, with limited adoption of the practice. This paper presents a pilot study conducted to measure university students' knowledge, behaviours, and self-efficacy towards energy efficiency and sustainability practices. The sample involved 79 students from one of the faculties at the Universiti Teknologi MARA Puncak Alam Campus. The findings reveal that students' knowledge of energy efficiency and sustainability was at a foundational level. Although the students demonstrated safety consciousness and valued sustainability practice, they were unwilling to sacrifice convenience for energy-saving behaviours, with minimal involvement in collective sustainability efforts. Students were generally confident in their ability to integrate sustainable practices into their lives; however, their consistency might waver under time constraints and competing priorities. The findings also suggest that students recognized the importance of advocacy for energy efficiency and

sustainability initiatives. They, however, may lack the confidence to champion these causes against potential social barriers. The study emphasizes the need for integrating sustainability-focused curricula, fostering peer-led initiatives, and providing support structures and networks within the campus. These endeavours will assist in developing a community of practice that encourages continuous engagement and support towards energy efficiency and sustainability practices.

Keywords: Sustainability, SDG, Energy Efficiency, Environmental Advocacy, Higher Education, Green Campus Initiative

Introduction

Energy efficiency and sustainability have become significant topics in the discourse around climate change, environmental conservation, and resource management. There is a pressing need to foster a culture of sustainability among the younger generation Dagiliute et al (2018); Jehtae et al (2021), particularly as the world faces the threat of resource depletion (Abhayawansa et al., 2021; Al-Nuaimi & Al-Ghamdi, 2022; Ribeiro et al., 2021). Education is viewed as an effective means of cultivating sustainability-oriented thinking and disposition, and universities play a critical role in this endeavor (Alsaati et al., 2020; Mohamed et al., 2024; Radwan & Khalil, 2021). Various initiatives have been implemented at higher education institutions, including the introduction of sustainability-focused academic programs and courses Chen et al (2024); Zin et al (2023), Green Campus Initiatives (GCI) Dagiliute et al (2018); Ribeiro et al (2021), and short-term and long-term education and community programs targeting the adoption of sustainability practices (Alsaati et al., 2020; Mohamed et al., 2024). Despite the growing interest, significant gaps remain in students' awareness and adoption of sustainable practices (Mafongso et al., 2018; Ribeiro et al., 2021).

Existing literature highlights a mixed picture of university students' engagement with sustainability. Some studies indicate a reasonable level of awareness and positive attitudes towards sustainability Abdul Halim et al (2021); Alsaati et al (2020); Jehtae et al (2021); Radhwan & Khalil (2021), however, others reveal persistent gaps in knowledge and limited practical engagement (Chen et al., 2023; Mohamed et al., 2024). Furthermore, many students recognize the importance of sustainable behaviours yet struggle to integrate these practices consistently into their daily lives, often prioritizing convenience over sustainability (Jehtae et al., 2021; Radwan & Khalil, 2021). This disconnect signals the need for more rigorous and concerted efforts in fostering practical application and long-term sustainability-related behavioural change (Ribeiro et al., 2021).

The discussions in this paper are based on a pilot study carried out to measure the effectiveness of pre and post instruments developed for an energy-efficiency and sustainability-focused educational intervention program. The intervention, in a form of an interactive seminar, involves Universiti Teknologi MARA (UiTM) students from five campuses. The pilot study was administered involving the students of a faculty from Universiti Teknologi MARA (UiTM) Puncak Alam Campus, one of the participating campuses. The data is based on post-survey responses, and the discussion omits the element of targeted change as the piloted respondents were not exposed to the intended intervention. The discussions in this paper, are guided by the following research questions:

1. What is the level of students' knowledge about energy efficiency and sustainable practices?

2. How do students incorporate energy-efficient and sustainable practices into their daily routines?
3. How confident are students in their ability to adopt and advocate for energy efficiency and sustainable practices?

The findings of this study bridge a gap in the literature as they offer meaningful insights into the current state of students' engagement with sustainability. This study supports the broader institutional and national efforts to promote sustainability, such as the Green Campus Initiative and the National Energy Efficiency Action Plan (NEEAP) 2016-2025. By understanding the current landscape of student engagement with sustainability, educational institutions can better design and implement programs that not only educate but also empower students to become proactive contributors to environmental sustainability.

Literature Review

The review of literature examines the varying levels of sustainability knowledge and practice among university students, the influence of curricular content, and the broader implications for fostering a culture of sustainability within higher education institutions.

Studies measuring university students' environmentally sustainable knowledge and practice have largely reported them to be inadequate. University students did not find sustainability concept as foreign Jehtae et al (2021); Radwan & Khalil (2021), this included to 'having heard of the term' such as in Alsaati et al.'s (2020) study, to having acquired advanced level of basic sustainability knowledge as demonstrated by the findings in Radwan and Khalil's (2021) study. There were also studies which reported the extremes, having found students lacked the sustainable knowledge Chen et al (2023); Michael et al (2020); Mohamed et al (2024); Ribeiro et al (2021); Abedin et al (2023) or highly knowledgeable in matters pertaining to conservation and sustainability (Abdul-Halim et al., 2021; Al-Nuaimi & Al-Ghamdi, 2022; Syed Azhar et al., 2022). Nevertheless, their involvement in sustainability-related initiatives was limited (Alsaati et al., 2020; Jehtae et al., 2021). University students were also found to be unwilling to sacrifice convenience over a greener lifestyle (Jehtae et al., 2021; Radwan & Khalil, 2021). In Radwan and Khalil's study (2021), the students surveyed admitted to view sustainability-related behaviours positively (such as using environmentally friendly products and conserving water), however disagreed with the move to limit the number of cars in the campus. The authors associated the disapproval with the entrenched culture among the young Emiratis who believed driving as a crucial aspect to their daily lives. Similarly, Jehtae et al (2021) found that students in their study implemented energy and water saving measures however neglected other aspects of sustainability practice due to the lack of time.

Curricular content was deemed critical in embedding and strengthening sustainability knowledge and practices among university students (Chen et al., 2024; Zin et al., 2023; Mohamed et al., 2024). The most common research focus involves examining the effectiveness of sustainability-related courses in bringing about the intended shifts in knowledge, attitudes, and behaviours. A study by Alsharif and Ofori-Darko (2024), for instance, explored the influence of specific university programs and disciplines on their students' attitudes and engagement towards sustainability. Data were gathered quantitatively from 943 students at a Saudi Arabian university representing various programs and years of study. The findings indicated that students in environmentally-themed programs

and courses demonstrated a higher level of commitment to sustainability than students in other programs (Alsharif & Ofori-Darko, 2024). Abdul-Halim et al (2021) revealed that sustainability knowledge and practice grew stronger over time, with findings indicating a positive correlation between knowledge, attitude, practice, and the year of study. Final year students and alumni of the Sustainable Science program at a Malaysian university showed higher knowledge, attitudes, and practices in comparison to students of other year of studies. Michael et al (2022) produced similar findings, with their final year students demonstrated the highest level of sustainability awareness.

Knowledge and awareness related to sustainability were deemed fundamental in the adoption of sustainable practices. Zin et al (2023), who surveyed 385 students from a number of Malaysian universities, concluded the salient role of sustainability-related knowledge in influencing accountable behaviour towards sustainable development. Many other studies have also revealed positive correlation between knowledge on sustainability and the adoption of its practice (Abhayawansa et al., 2021; Kalsoom, 2018; Kim et al., 2019). Studies on sources of sustainability knowledge points towards the importance of providing information and access to information in promoting sustainability (Al-Nuaimi & Al-Ghamdi, 2022; Mohamed et al, 2024). For instance, Mohamed et al (2024) who investigated nursing students of three Egyptian universities conveyed the low sustainability awareness with the students' due to the lack of access to sustainability-related information. The only means of obtaining information about sustainability was via social media. Mohamed and his colleagues stressed that sustainability-focused nursing programs would have facilitated greater commitment towards sustainability among the future nurses. A study by Al-Nuaimi and Al-Ghamdi (2022), however, produced contradicting findings. The sustainability-related knowledge and attitudes of a majority of the students in their study were predominantly informed by external sources (such as news, social media, relatives and friends) even when they are attending university programs with sustainability-integrated elements. University courses came second, followed by learning community within campus and information disseminated from campus facilities (Al-Nuaimi & Al-Ghamdi, 2022).

Studies on university students' sustainability practices were also motivated towards measuring the effectiveness of campus-initiated sustainability efforts and activities (Alsaati et al., 2020; Dagiliute et al. 2018; Jehtae et al., 2021; Radwan & Khalil, 2021). Dagiliute et al (2018) compared sustainability-related knowledge and practices among students from a green university and a non-green university. Students from the green university were reported to have higher access to environmental information with higher level of engagements in sustainability activities. Ribeiro et al (2021) examined the viability of Green Campus Initiatives at four Brazilian universities in impacting students' knowledge and proactivity concerning sustainable development. The authors unveiled that only 30% of the university students in their study were positively impacted by sustainability-focused knowledge dissemination strategies. Of this, only 18% partook proactive engagement in sustainability initiatives. These findings are consistent with that of Fahrianto et al (2018), Mafongso et al (2018), and Perrault and Clark (2017) who asserted that having sustainability knowledge did not necessarily lead towards action. Nevertheless, Ribeiro et al (2021) and Perrault and Clark (2017) emphasized the central role of sustainability knowledge as a prerequisite for the adoption of environmentally sustainable habits and initiatives.

The review of literature reveals significant gaps in sustainable knowledge and practice among university students. The impact and effectiveness of sustainability-themed programs have been reported to vary widely, highlighting the need for more structured and comprehensive approaches. Ensuring equitable access to sustainability knowledge and fostering a culture of proactive engagement in sustainability practices are crucial steps towards achieving the desired educational outcomes.

Method

The pilot study is carried out to inform the refinement of pre and post instruments developed in evaluating energy efficiency and sustainability practices among UiTM undergraduates. The discussion in this research paper, however, focuses on post-survey data and findings are reported to answer three research questions related to energy efficiency and sustainability practices. Through the reliance on quantitative research design, the study adopts surveys as the primary data collection method. Survey provides a robust foundation for large-scale studies given its standardized and structured approach to data collection involving diverse group of participants. This, in turn, ensures consistency and uniformity in the data gathered (Creswell & Creswell, 2018).

Context

The respondents of the pilot study were part of a larger study population aiming to measure the effectiveness of an intervention targeting shifts in respondents' knowledge and awareness, behavior, and self-efficacy related to energy efficiency and sustainability practices. The intervention consisted of a 4-hour interactive seminar where students participated in three modules on energy efficiency and sustainability practices.

The seminar involved 400 students from five UiTM campuses, totalling 2,000 participants. It was part of the Green Campus Initiative by UiTM Selangor Branch (UCS), in collaboration with Tenaga Nasional Berhad (TNB), whose organizational ethos includes leading the region in energy transition to a high-value green economy by 2050 and achieving net zero commitments (Tenaga Nasional Berhad, 2024). The seminar aimed to achieve the following objectives: 1) Cultivating best practices and daily routines that support efficient and prudent use of electricity among students; 2) Raising awareness and promoting the adoption of desirable behaviors concerning energy efficiency and sustainability among students; and 3) Enhancing knowledge and skills regarding the latest technology in energy efficiency practices among students.

Instrument

The instrument developed consists of 33 items based on three main constructs: knowledge and awareness, behaviour and self-efficacy. The construct of self-efficacy comprised two sub-constructs: participants' perceived self-efficacy on attempting the intended change, and their perceived self-efficacy in overcoming barriers pertaining to change. Table 1 presents the construct-item mapping, number of items and the type of scales employed.

Table 1

Construct-item mapping

Constructs	Total Items	Operational Definitions	Scales
Participants' Demography	5	Represents background characteristics of each respondent, used to categorize participants into various groups based on factors such as age, gender, educational level, and other socio-economic indicators. It assists in interpreting variations in responses due to different personal and social contexts.	-
Knowledge and Awareness	10	Gauges the extent of students' understanding and consciousness regarding energy conservation issues. It reflects the level of information the students have about energy-saving methods, the importance of energy conservation, and the impacts of energy use on the environment and economy.	Dichotomous scale (true and false)
Behaviour	10	Represents the observable actions and practices adopted by students to conserve energy. It encompasses specific, measurable activities such as using energy-efficient appliances, reducing electricity usage, and participating in sustainability initiatives. Behaviour is directly influenced by students' attitudes towards energy conservation and is an indicator of the practical application of their knowledge and awareness of energy conservation issues.	5-point action scale (not a priority, considering, will do it, not consistent, routine)
Self-efficacy	8	Measures the belief in one's own ability to execute behaviours necessary to produce specific performance attainments. In the context of energy conservation, self-efficacy reflects students' confidence in their capability to perform energy-saving actions effectively, despite potential obstacles.	5-point confidence scale (not confident, slightly confident, confident, very confident, will adopt as routine)

The five-point action scale for items representing attitudes and behaviour is a direct adoption of the five stages of change in the Transtheoretical Model (TTM) (Prochaska and DiClemente, 1982). Additionally, the five-point confidence scale for self-efficacy items is an adaptation of the stages in TTM, paraphrased to reflect the degree to which participants are confident in their ability to adopt the suggested changes.

Participants

The participants consisted of 79 undergraduate students from a faculty at the Puncak Alam Campus. The sample was selected randomly from students across seven different undergraduate programs within the faculty, and the instrument was administered using an online survey platform. Random sampling was deemed appropriate as everyone in the population had an equal probability of being selected, enabling the collection of all sampling units (Cresswell, 2014). This sampling technique allows for unbiased and representative estimates of the parameters Noor et al (2022); Xie (2023) that fully define the population and sample selection relevant to the well-defined research questions (Cresswell, 2014; Xie, 2023).

Validity and Reliability Measures

While the pilot study itself is a measure of reliability, several steps were undertaken to ensure high instrument quality prior to the piloting process. These steps included an expert review, during which the instrument was revised by academic staff with expertise in sustainability, green energy, and energy efficiency practices. The selection of appropriate models and initiatives as the theoretical framework for the study was also an effort to ensure content validity.

Findings

Instrument Reliability

A Cronbach's alpha of 0.932 was obtained for the overall scale, indicating a high level of reliability among the items.

Demographic Information of Respondents

The pilot study was responded to by 79 undergraduate students from one of the faculties at UiTM Puncak Alam Campus. Of these, 61 (77%) were female, while the remaining 18 (23%) were male students. The majority (n=72, 91%) were bachelor's degree students, and 9% (n=7) were pursuing master's degrees. Most respondents were in the age range of 23-25 years old (n=59, 75%), followed by 16 students who were 22 years old or younger (20%); 3 (4%) students were between 26 and 28 years old; and only 1 (1%) respondent was between 29 and 30 years old.

Knowledge of Energy Efficiency and Sustainability

The first research question aimed to investigate the respondents' knowledge of energy efficiency and environmentally sustainable practices. The findings were measured using ten dichotomous items (True and False) based on the content that the actual participants were exposed to during the intended intervention. Table 2 presents the frequency analysis of the items.

Table 2

Frequency analysis of respondents' knowledge of energy efficiency and sustainable practices

No	Items	n	%
1	Electrical injuries do not cause internal damage to body muscles.	53	67
2	The three steps for treating burn wounds are known as cool, cover, cure (3C).	12	15
3	Victims who suffer third-degree burns are not able to feel pain.	51	65
4	Victims need to be rescued immediately if the incident occurs in a high-voltage area.	58	74
5	There are concerning side effects related to the safety and quality of green buildings in promoting energy efficiency.	17	21.5
6	There are no energy sustainability issues in Malaysia because the electricity supply in Malaysia is sufficient to meet the needs.	58	74
7	Cardiopulmonary Resuscitation (CPR) can be performed to save the victims of all types of electrical injuries.	65	82.5
8	The National Energy Efficiency Action Plan (2016-2025) has a specific focus on electricity usage compared to other aspects in the energy sector.	15	19
9	Minimum Energy Performance Standards (MEPS) have been incorporated into the amendments of the 1994 Electricity Regulations.	8	10
10	The Energy Efficiency and Conservation Act (EECA) will be enforced in Malaysia to replace the National Energy Efficiency Action Plan starting in 2026.	17	21.5

The analysis of responses from 79 undergraduate students indicates a varied level of knowledge. The respondents showed a moderate to high level of knowledge regarding electrical safety and electrical-related accidents. For instance, 67% correctly identified that electrical injuries do cause internal damage to body muscles, and 65% were aware that victims of third-degree burns are unable to feel pain. However, only 15% knew the correct steps for treating burn wounds (cool, cover, cure – 3C). This discrepancy suggests that while students are aware of the basic effects of electrical injuries, they lack detailed knowledge of first aid procedures related to burns and accident-related injuries, indicating an area where targeted intervention could significantly improve their practical skills and response readiness. Additionally, high percentages are reflected by items that measure respondents' knowledge on CPR (n=65, 82.5%); awareness of immediate response actions involving accidents in high voltage areas (n=58, 74%); and the fact that energy sustainability is an issue in Malaysia (n=58, 74%).

The findings highlight a significant gap in the respondents' awareness of important policy measures and regulatory standards that govern energy efficiency and conservation efforts in Malaysia. Knowledge about specific national policies and regulatory frameworks was notably low among respondents. Only 19% were aware of the National Energy Efficiency Action Plan's focus on electricity usage, and even fewer (10%) knew about the incorporation of Minimum Energy Performance Standards (MEPS) into the 1994 Electricity Regulations. Additionally, only 21.5% were aware of the upcoming Energy Efficiency and Conservation Act (EECA) set to replace the current plan in 2026.

The findings to the first research question highlight a discrepancy between basic safety knowledge and the understanding of more complex procedural skills, indicating that while students are adequately informed about immediate safety measures, they lack detailed knowledge of specific first aid procedures. This suggests an educational gap in practical training and preparedness. The findings also reveal a significant lack of awareness regarding national energy policies and regulatory frameworks. This gap suggests a misalignment between policy initiatives and public understanding, highlighting the need for targeted educational programs to bridge this divide.

Adoption of Energy Efficiency and Sustainable Practices

The second research question sought to examine the extent to which undergraduate students integrate energy-efficient and sustainable strategies into their daily activities. The findings were generated from responses to ten items on a five-point action scale (not a priority, considering, will do it, not consistent, routine). Table 3 presents the descriptive statistics (mean values and standard deviations) for these items.

Table 3

Descriptive statistics for the adoption of energy efficiency and sustainable practices

No	Items	mean	SD
1	Leave the switches of certain electrical equipment in standby mode/on for convenience of later use.	4.49	.752
2	Leave devices (e.g., mobile phones, laptops) charging while sleeping/for extended periods.	4.33	.892
3	Increase self-awareness/knowledge about climate change and environmental sustainability (e.g. YouTube videos, documentary series, reading);	3.69	.857
4	Take precautions and follow safety guidelines when using electrical/electronic equipment.	4.23	.852
5	Check the star rating and purchase electrical/electronic products that prioritize environmental sustainability.	3.76	1.034
6	Consider the safety of yourself and others around you when using electrical equipment.	4.26	.813
7	Encourage housemates, friends, and family members to adopt energy saving practice.	3.95	.866
8	Consider the impact of using electrical/electronic equipment in daily activities on the environment.	3.78	.907
9	Participate in energy efficiency and environmental sustainability initiatives and activities (e.g., Earth Hour, recycling projects).	3.49	.908
10	Engage in volunteer activities with a specific focus on conservation and environmental sustainability.	3.28	.979

The analysis indicates a strong inclination towards convenience over energy-saving behaviours, as seen in the high mean values for leaving electrical equipment on standby (mean = 4.49, SD = 0.752) and charging devices overnight (mean = 4.33, SD = 0.892). These high means suggest that a majority of students habitually engaged in these energy-inefficient practices. The relatively low standard deviations (SD) indicate a consistent pattern of

behaviour across the sample, suggesting that these habits were widespread and deeply ingrained.

Conversely, there are positive signs of safety consciousness and awareness in other areas. For example, students showed a strong commitment to taking precautions with electrical equipment (mean = 4.23, SD = 0.852) and increasing their knowledge about climate change and sustainability (mean = 3.69, SD = 0.857). The means here are moderately high, indicating that many students recognized the importance of these practices. However, the SDs suggest some variability, indicating that while a substantial number of students were proactive, there was still a significant number that did not consistently engage in these behaviours.

When examining behaviours related to environmental impact and sustainability, the data paints a mixed picture. For instance, checking the star rating for sustainable products (mean = 3.76, SD = 1.034) and considering the environmental impact of using electrical equipment (mean = 3.78, SD = 0.907) showed moderate engagement. The higher SDs for these items reflected a significant range of responses, indicating that while some students are diligent in these practices, many others are less consistent. This inconsistency points to an opportunity for educational programs to emphasize the practical benefits and ease of integrating these habits into daily life.

Participation in broader sustainability initiatives, such as Earth Hour and recycling projects (mean = 3.49, SD = 0.908), and engagement in volunteer activities focused on conservation (mean = 3.28, SD = 0.979), were among the lowest in terms of mean values. These low means indicated minimal involvement in collective sustainability efforts. The high SDs further suggested a wide differences in engagement levels, from highly active participants to those who were largely disengaged.

Self-efficacy in the Integration of Energy Efficiency and Sustainable Activities

The third research question focused on respondents' self-efficacy in adopting and overcoming barriers related to energy efficiency activities and sustainable practices. The findings were derived from eight items based on a 5-point confidence scale (not confident, slightly confident, confident, very confident, will adopt as routine). Respondents' self-efficacy was measured in carrying out tasks related to injury prevention and response in electrical-related accidents (corresponding directly to the seminar content), engaging in energy-efficient and sustainability-related behaviours, and overcoming barriers to adopting sustainability practices. The results, gathered through descriptive statistics for these items, are presented in Table 4.

Table 4

Descriptive statistics for self-efficacy in the integration of energy efficiency and sustainable practices

No	Items	mean	SD
1	Use electrical equipment safely to avoid the risk of injury.	3.86	.936
2	Rescue victims involved in electrical-related accidents.	2.31	1.108
3	Provide early assistance during emergencies involving victims of electrical injuries.	2.50	1.114
4	Influence others to adopt energy conservation and sustainable practice as part of their way of life.	3.64	1.044
5	Make energy-efficient practices and environmental sustainability a priority in life.	3.82	1.041
6	Engage in energy-efficient and environmentally sustainable activities even when busy.	3.71	1.070
7	Reorganize daily routines and habits to accommodate energy efficiency and sustainable practice (e.g., recycling practices, buying local products, reducing electricity usage).	3.74	1.037
8	Promote the importance of sustainable practices among university members, even if the initiatives are not popular.	3.45	1.040

The analysis discloses a foundational level of self-efficacy among students in adopting energy-efficient and sustainable practices, with significant differences across different areas. Most students were confident in their practical safety skills, reflected by higher mean values and SD in using electrical equipment safely to avoid injury (mean = 3.86, SD = 0.936). However, this confidence did not extend to emergency response behaviours as lower mean values and high SD are noted in the respondents' perceived ability in providing emergency response, such as rescuing victims of electrical-related accidents (mean = 2.31, SD = 1.108) and providing early assistance during electrical emergencies (mean = 2.50, SD = 1.114). This lack of confidence is understandable given the significant skills required in carrying out the tasks.

In terms of influencing others and making sustainable practices a priority, the findings show moderate to high confidence levels. Respondents exhibited a fairly strong belief in their ability to influence others to adopt sustainable practices (mean = 3.64, SD = 1.044) and to prioritize energy efficiency and environmental sustainability in their own lives (mean = 3.82, SD = 1.041). The SDs indicate some variability, reflecting differences in how consistently students applied these practices. This suggests that while many students were committed to sustainability, there was still a notable segment that may struggle to influence others or to consistently prioritize sustainability due to various barriers or lack of sustained motivation.

Engagement in energy-efficient and environmentally sustainable activities, even when busy, showed a mean of 3.71 with an SD of 1.070, and reorganizing daily routines to accommodate these practices (mean = 3.74, SD = 1.037) indicated moderate confidence with some variation. These results imply that students were generally confident in their ability to integrate sustainable practices into their lives, however their consistency might waver under time constraints or competing priorities.

Promoting sustainable practices among university members, even if the initiatives are not popular, has a lower mean value (mean = 3.45, SD = 1.040), indicating that while students

recognized the importance of advocacy, they may lack the confidence to champion these causes against potential social resistance. The higher SD reflected variability in willingness to engage in unpopular sustainability initiatives, suggesting that peer influence and social acceptance were significant factors in students' advocacy efforts.

Despite the low mean values and high SD recorded for items involving emergency response behaviours, the remaining of the items yielded mean values above the mid-point of the scale suggesting that students were between 'confident' and 'very confident' in their ability in carrying out the measured practices.

Discussion

The pilot study examined the knowledge and awareness, behaviour, and self-efficacy of university students towards energy efficiency and environmentally sustainable initiatives. The study was conducted as a validation and improvement measure of the pre- and post-surveys developed to assess the effectiveness of an educational intervention. The discussions in this paper, however, are informed only by the post-survey data and guided by three research questions focusing on the respondents' relative energy efficiency and sustainability knowledge, behaviour, and self-efficacy.

The findings indicate that university students possessed a basic understanding of energy efficiency and sustainability. There was a notable difference between basic safety knowledge and the understanding of more complex procedural skills. The findings also disclose a gap between policy initiatives and public understanding. This significant lack of awareness may suggest that students' level of interests towards sustainability-driven initiatives was not adequately in-depth to covering matters pertaining to national policies. The findings of this pilot study align with Radwan and Khalil (2021), who confirmed that the students in their study demonstrated an advanced level of basic knowledge about sustainability. While the students in this study acquired more complex sustainability-related knowledge compared to those in Alsaati et al (2020), whose respondents' sustainability knowledge was limited to familiarity with the term, the students in this study still exhibited a moderate level of awareness and understanding of sustainability-related issues.

The findings reveal a contradiction when it comes to integrating energy-efficient and sustainable practices into their daily routines. On one hand, students demonstrated behaviours driven by convenience, such as leaving electrical equipment on standby and charging devices overnight. These habits, which were counterproductive to energy-saving efforts, were prevalent and consistent among the majority of respondents. On the other hand, there were areas where students showed positive engagement, such as taking precautions with electrical equipment and seeking information about climate change. This mixed pattern indicates the recognition on the importance of sustainable practices, however they struggled with the consistent application of these behaviours in their everyday lives. The preference for convenience over sustainability was also evident in the findings of (Jehtae et al., 2021; Radwan and Khalil, 2021). The students in Jehtae et al.'s study declared their commitment to engaging in environmental issues more efficiently and were advocates for promoting energy-efficient and waste recycling practices. However, the authors found inconsistencies in their behaviours, with students reverting to environmentally unsustainable actions when pressed for time (Jehtae et al., 2021). Similarly, the university students in

Radwan and Khalil's (2021) study engaged in water conservation and prioritized environmentally friendly products, but they were unwilling to give up the use of cars for a greener environment. The authors attributed this disapproval to the entrenched culture among young Emiratis, who viewed driving as a crucial aspect of their daily lives. This pattern highlights a significant challenge in shifting behaviours towards more sustainable practices, which require deliberate effort and consistency.

There are, nevertheless, positive signs of engagement in areas related to safety and environmental awareness. Students showed a strong commitment to taking precautions with electrical equipment and increasing their knowledge about climate change. These behaviours indicate a recognition of the importance of safety and sustainability, although the application of this knowledge was inconsistent. Even though energy efficient and sustainable practices were yet to be integrated as daily routines, the employment of the measured practice was largely inconsistent. This positive engagement provides a foundation upon which more comprehensive and consistent sustainable practices can be built to strengthen and foster more frequent adoption of the initiatives.

The students' self-efficacy, or their confidence in adopting and advocating for energy-efficient and sustainable practices, presents a complex picture. Students felt relatively confident in their ability to perform individual sustainable actions, such as using electrical equipment safely and making sustainability a priority in their lives. Their confidence, however, diminished significantly in relation to emergency responses and broader advocacy efforts. The moderate to low confidence in influencing others and promoting unpopular sustainability initiatives indicates that students might face social barriers and lacked the advocacy skills necessary to champion sustainability causes effectively. This variability suggests that social acceptance and peer influence played significant roles in students' willingness to advocate for sustainability (Mingolla et al., 2020; Saracevic & Schlegelmilch, 2021). Addressing this variability through targeted educational programs that build advocacy skills and create supportive peer networks is crucial for fostering a more proactive and confident student body (Brouwer et al., 2022; Hansmann & Binder, 2023).

The findings of this study resonate with those of Fahrianto et al (2018)| Mafongso et al (2018); Perrault and Clark (2017); Ribeiro et al (2021), who asserted that knowledge and awareness in sustainability may not necessarily translate into environmentally sustainable behaviours. Nevertheless, an increasing body of research has attested to the significance of sustainability knowledge as a precursor to the adoption of sustainable initiatives (Chen et al., 2024; Zin et al., 2023; Mohamed et al., 2024). Campus initiatives and increasing students' access to information on energy efficiency and sustainability would promote more widespread awareness of these initiatives, enhancing the potential for higher adoption rates of energy-efficient and environmentally sustainable practices (Al-Nuaimi & Al-Ghamdi, 2022; Mohamed et al., 2024; Ribeiro et al., 2021).

Limitations

The pilot study is bounded by several limitations. The primary limitation arises from the small number of respondents, which does not allow for the generalization of the findings to the larger population. The reliance on survey as the sole methodology of data collection is another limitation. Mixed-method research, for instance, would enable a more robust

understanding. Incorporating qualitative data could either reinforce or challenge the quantitative findings, providing a more holistic view of the respondents' knowledge, behaviour, and self-efficacy toward energy efficiency and sustainability practices. Additionally, the use of surveys for recording respondents' responses may lead to biases, such as social desirability bias, due to its self-reporting format.

Implications, Contributions and Future Research

The findings of this study present critical implications for educational institutions, policymakers, and sustainability advocates. It is timely and imperative for educational institutions to integrate comprehensive sustainability education into their curricula, ensuring that courses cover both theoretical knowledge and practical skills related to energy efficiency and sustainability. Developing peer-led initiatives within universities can significantly influence students' behaviours and attitudes towards sustainability. Programs that empower students to advocate for energy-efficient practices within their social circles can utilize peer influence to promote broader engagement. Additionally, creating support structures and networks within the campus, such as sustainability clubs or groups, can foster a community of practice that encourages continuous engagement and support.

For policymakers, collaborating with educational institutions to develop programs that inform students about these policies and their importance is a step in the right direction. Providing incentives for students to adopt sustainable practices, such as scholarships, grants, or recognition programs for sustainability efforts, can motivate behaviour change and encourage more students to participate actively.

Sustainability advocates should focus on public campaigns that highlight the importance of sustainability and the role of young adults in achieving environmental goals. Utilizing social media and other platforms popular among university students can help reach a wider audience. Collaborations with universities to organize events, workshops, and seminars that promote energy efficiency and sustainable practices can provide students with exposure to real-world applications and success stories.

Future studies should incorporate longitudinal design that track changes in students' knowledge, attitudes, and behaviours over time, providing deeper insights into the long-term effectiveness of educational interventions. Integrating qualitative methods alongside quantitative surveys can offer a more comprehensive understanding of students' perspectives on sustainability. Expanding the sample size to include students from multiple faculties and campuses can enhance the generalizability of the findings.

Conclusion

The pilot study provides valuable insights into university students' knowledge, behaviour, and self-efficacy regarding energy efficiency and sustainability practices. The findings reveal that students' knowledge of energy efficiency and sustainability was at a foundational level. They were also unwilling to sacrifice convenience for energy-saving behaviours, with limited engagement in collective sustainability efforts. Involvement in sustainability initiatives was largely inconsistent and they were likely to resort to energy inefficient and environmentally unsustainable practices under time constraints and other competing priorities. Additionally, the study highlights a discrepancy between policy initiatives and public understanding,

indicating the need for targeted educational programs. The findings emphasize the importance of integrating comprehensive sustainability education into university curricula, fostering peer-led initiatives, and enhancing hands-on training to build practical skills. Addressing these areas can empower students to become proactive advocates for sustainability, bridging the gap between knowledge and consistent sustainable behaviour. This study highlights the critical role of educational institutions, policymakers, and sustainability advocates in promoting and supporting sustainable practices among the younger generation, ultimately contributing to broader environmental conservation and resource management efforts.

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