ENVIRONMENTAL AWARENESS SURVEY: PROMOTING SUSTAINABLE PRACTICES IN WASTE, WATER, AND ENERGY INITIATIVES 2024

For this study, an online questionnaire was developed and distributed to students and staff to invite respondents. In all, 377 responses were received, with 371 valid responses excluding duplicates.

Descriptive analysis was used to determine the current level of awareness, knowledge, and frequency of environmental practices among staff and students. Basically, the survey was quantitative with options, but at the end of the survey, suggestions and comments on the university's efforts were collected qualitatively. In this report, qualitative comments are also treated quantitatively, with the analyst dividing them into categories based on content.

The knowledge and frequency of practice questions were divided into three parts: waste, water, and energy. Since the number of questions differed by part, the knowledge and practice levels for each part were calculated as a percentage from 0% to 100%.

Pearson's correlation coefficient was used in the correlation analysis of the data.

4. Findings and Discussion

4.1 Respondent profile

Table 1 shows the demographics of the respondents. Approximately one-third of the respondents were staff (34.5%), and of the two-thirds of the students (65.5%), the majority were first-year students (35.3% of all). This may be due to the fact that the questionnaire was widely spread among students who take environmental courses as electives, and that most of the students taking electives were first-year undergraduates. Therefore, in the following results, it should be noted that the respondents represent a group of students who are relatively conscious about the environment.

Table 1. Respondent Profile

Classification		Frequency	Percentage(%)
Staff		128	(34.5)
Students		243	(65.5)
	1st year of Diploma/Degree	131	(35.3)
	2nd year of Diploma/Degree	36	(9.7)
	3rd year of Diploma/Degree	16	(4.3)
	4th year of Diploma/Degree	28	(7.6)
	1st year of Postgraduate	20	(5.4)
	2nd year of Postgraduate	1	(0.3)
	3rd year and above of Postgraduate	11	(3.0)

4.2 The attitude of UTeM staff and students toward environmental issues

Table 2 illustrates the attitudes of individuals toward the environment in UTeM. The table clearly indicates that most people in UTeM have a positive disposition towards nature. When asked if they liked nature, 80.9% strongly agreed and 18.6% agreed, for a total of 99.5%. Concerning the frequency of contact with nature, 40.7% of respondents answered “more than 3 times per week.” When combined with those who answered “once or twice per week,” 74.4% of respondents engage with nature at least once a week. Regarding awareness of the crisis in environmental issues, the majority of respondents were very aware of them (58.0%), followed by 38% who indicated some level of awareness, for a total of 96% of those who were aware.

Table 2. Attitude toward Environment

Question	Frequency (%)			
Do you like nature?	Strongly agree	Agree	Disagree	Strongly disagree
	300 (80.9)	69 (18.6)	1 (0.3)	1 (0.3)
How often do you have opportunity to get in touch with nature?	More than 3 times per week	Once or twice per week	Once or twice per month	Less than once per month
	151 (40.7)	125 (33.7)	69 (18.6)	26 (7.0)
Are you aware of the crisis in environmental issues?	Very much	Somewhat	A little	Not at all
	215 (58.0)	141 (38.0)	13 (3.5)	2 (0.5)

Table 3 presents the responses to the multiple-choice question, "Which environmental issues are you interested in?" Climate change and air pollution were the top two concerns, each garnering over 70% of all respondents. Following were endangered animals, recycling and waste management, and deforestation, although there were differences in priority between staff and student responses. Staff exhibited a higher interest in recycling and waste management, ranking it third at 71.9%. Conversely, students showed more concern for endangered animals issues (64.6%), placing waste management fifth (51.4%). This may be because UTeM requires staff to properly dispose of waste used for experiments and other purposes on a daily basis, and staff awareness of waste management has increased. Water sanitation and reclamation were of low interest to both staff and students, ranking them sixth and seventh among the listed issues. Respondents who selected "other" were prompted to specify additional environmental problems, citing issues such as flooding and open burning which are prevalent in Malaysia.

Table 3. Environmental Issues with High Interest

Which environmental issues are you interested in?	Frequency(%)			Rank		
	Total	Staff	Students	Total	Staff	Students
Climate change	263 (70.9)	97 (75.8)	166 (68.3)	1	1	1
Air pollution	261 (70.4)	95 (74.2)	166 (68.3)	2	2	1
Endangered animals	222 (59.8)	65 (50.8)	157 (64.6)	3	5	3
Recycling and waste management	217 (58.5)	92 (71.9)	125 (51.4)	4	3	5
Deforestation	210 (56.6)	79 (61.7)	131 (53.9)	5	4	4
Water sanitation	113 (30.5)	45 (35.2)	68 (28.0)	6	6	6
Reclamation	90 (24.3)	39 (30.5)	51 (21.0)	7	7	7
Others	5 (1.4)	4 (3.1)	1 (0.4)	8	8	9
None	3 (0.8)	0 (0)	3 (1.2)	9	9	8

Table 4 shows the media that could enhance interest in environmental issues. Respondents were queried, "In which situations are you interested in knowing about environmental issues?" and provided a list of multiple-choice options. Social media platforms like X, Instagram, and Facebook received the highest response rate, chosen by 94% of respondents. Television, interpersonal communication, and billboards followed suit. While the same trend was evident among both staff and students, students were more inclined to indicate social media as influential, whereas staff appeared to be more impacted by other media channels. This result suggests that providing information on environmental issues through social media is effective, especially to students.

Table 4. Media to Learn about Environmental Issues

In which situations are you interested in knowing about environmental issues?	Frequency(%) Total	Staff	Students
Social Media	349 (94.1)	117 (91.4)	232 (95.5)
Television	201 (54.2)	78 (60.9)	123 (50.6)
Interpersonal communication	164 (44.2)	63 (49.2)	101 (41.6)
Billboard	107 (28.8)	39 (30.5)	68 (28.0)
Others	7 (1.9)	4 (3.1)	3 (1.2)
None	0 (0)	0 (0)	0 (0)

Table 5 displays the outcomes of the question regarding the willingness to take action to protect the environment. Three options were presented to the respondents: "Yes, and I'm already taking actions," "Yes, but I haven't taken actions yet," and "No,". They are denoted Y1, Y2, and N, respectively, in the following text. The majority of respondents opted for Y1, totaling 237 (63.9%), followed by Y2 with 132 (35.6%), and N with only 2 (0.5%). In other words, 99.5% of respondents indicated a willingness to take action to protect the environment.

Table 5. Willingness to Protect the Environment

Do you have willingness to do something for protecting the environment?	Frequency(%) Total	Staff	Students
Yes, and I'm already taking actions	237 (63.9)	104 (81.3)	133 (54.7)
Yes, but I haven't taken actions yet	132 (35.6)	23 (18.0)	109 (44.9)
No	2 (0.5)	1 (0.8)	1 (0.4)

Subsequent questions diverge based on the responses to the preceding questions. Respondents who selected Y1 were queried about form of initiatives they are currently undertaking, while those who chose Y2 and N were asked to elaborate on the reasons for not implementing an initiative. The outcomes for each are presented in Tables 6 and 7.

Table 6 shows the results of the question asking how those who indicated in Table 5 that they were already engaged in some kind of initiative (Y1). Most reported individual practice (90.3%), followed by giving awareness to others (51.5%), participation in events or seminars (35.4%), donation to some organization (25.3%), signing petitions (13.5%), and others (2.5%) respectively.

Table 6. Involvement in Environmental Protection Initiatives

How are you involved in protecting the environment?	Frequency	Percentage(%)
Practice as an individual	214	90.3
Give awareness to others	122	51.5
Attend events or seminars	84	35.4
Donate to organizations	60	25.3
Sign a petition	32	13.5
Others (free answer)	6	2.5

Table 7 then presents the findings regarding the reasons for non-implementation among respondents who indicated in Table 5 that they are not currently involved in environmental conservation (Y2 and N). Besides the difficulty of being aware of this in daily life, the lack of information on how to tackle the issue was selected by the majority of respondents (55.2% and 51.5%, respectively). Other reasons that followed were time-consuming (42.5%), economic

cost (38.1%), and doubt about the effectiveness (22.4%). Additionally, a small percentage of respondents either did not have a specific reason (3.7%) or did not feel the need to take action (2.2%).

Table 7. Reasons for Non-Implementation

Which is the reason you don't practice to protect the environment?	Frequency	Percentage(%)
Difficulty in always being aware of it in daily life	74	55.2
Lack of information on what criteria to select and how to tackle the issue	69	51.5
Time-consuming	57	42.5
Economic cost	51	38.1
Doubt about how effective it is as a measure against global warming	30	22.4
Nothing in paticular	5	3.7
Don't feel the need to take action against global warming	3	2.2
Others	1	0.8

4.3 The level of knowledge of green practices among UTeM staff and students

4.3.1 Waste Circulation

Table 8 illustrates people's understanding of the waste problem. The survey addressed four significant waste issues in Malacca State, along with two crucial concepts for addressing them. Respondents were prompted to select from four options indicating their level of comprehension: “I know and can explain,” “I have a vague understanding,” “I've heard of it but don't know much,” and “I have neither heard of it nor know about it.” In the following, each choice is referred to as K3, K2, K1, and K0, respectively, and a knowledge score of 3, 2, 1, or 0 is assigned according to the response. A weighted average score is calculated for each issue and each term, and the average score of 2 or higher is rated as “high,” 1 or higher but less than 2 is rated as “moderate,” and less than 1 is rated as “low.”

The ocean plastic issue and the 3Rs are well-recognized, with over 70% of respondents indicating they understand them well enough to explain to others. It was also found that many people are aware of the deterioration of landscape caused by littering and the decrease in remaining capacity at landfill sites. While some people were aware of plastic waste inflow from other countries and the concept of a circular economy, there were also many who were not familiar with these topics.

Table 8. Knowledge Level of Waste Circulation

Do you know issues or terms below?		Frequency(%)				Average	Level
		K3	K2	K1	K0		
Issues	Littering is deteriorating the landscape of the city.	202 (54.5)	114 (30.7)	48 (12.9)	7 (1.9)	2.38	High
	Remaining landfill capacity is decreasing.	135 (36.4)	133 (35.9)	82 (22.1)	21 (5.7)	2.03	High
	Plastic waste leaking into the ocean is killing marine life.	273 (73.6)	75 (20.2)	21 (5.7)	2 (0.5)	2.67	High
	Plastic waste is being smuggled from other countries.	126 (34.0)	121 (32.6)	74 (20.0)	50 (13.5)	1.87	Moderate

Terms	3Rs	272 (73.3)	63 (17.0)	30 (8.1)	6 (1.6)	2.62	High
	Circular Economy	109 (29.4)	151 (40.7)	78 (21.0)	33 (8.9)	1.91	Moderate

4.3.2 Water Management

Table 9 presents the comprehension level regarding issues and terminologies associated with water sanitation and consumption. Similar to waste circulation, respondents were asked to indicate their comprehension level using four options.

While many respondents were aware of the challenges related to rising water demand and declining water quality, many were less informed about the potential for water shortages. In terms of terminology, the staff and students had a high level of understanding of rainwater harvesting, but moderate understanding of the other concepts.

Table 9. Knowledge Level of Water Management

Do you know issues or terms below?		Frequency(%) K3	K2	K1	K0	Average	Level
Issues	Water demand is increasing.	147 (39.6)	172 (43.4)	44 (11.9)	8 (2.2)	2.33	High
	Development of surface water resources has reached its limits in some areas.	109 (29.4)	175 (47.2)	54 (14.6)	33 (8.9)	1.97	Moderate
	Water quality at the certain rivers is getting worse.	197 (53.1)	137 (36.9)	35 (9.4)	2 (0.5)	2.43	High
	Pollution of water adversely affects aquatic life.	242 (65.2)	110 (29.7)	19 (5.1)	0 (0)	2.60	High
Terms	SPAN[1]	63 (17.0)	130 (35.0)	100 (27.0)	78 (21.0)	1.48	Moderate
	STP (Sewage Treatment Plant)	107 (28.8)	149 (40.2)	86 (23.2)	29 (7.8)	1.90	Moderate
	Rainwater Harvesting	123 (33.2)	158 (42.6)	79 (21.3)	11 (3.0)	2.06	High
	Water Footprint	44 (11.9)	129 (34.8)	114 (30.7)	84 (22.6)	1.36	Moderate

4.3.3 Energy Saving

For the energy section, respondents were queried about their understanding of issues and terminologies, mirroring the approach taken with waste and water topics. Additionally, they were presented with two energy-related logos: the Energy Efficiency Label and the Energy Star, symbols denoting the energy efficiency of appliances certified by Malaysian and U.S. agencies, respectively. These questions were embedded in the survey as images, depicted in Image 1 and Image 2.

[1] SPAN is the abbreviation for the National Water Services Commission, which was created in 2008 to regulate water utilities in Malaysia with the objective of enhancing efforts towards improving standards, quality and operational efficiency of water and sewerage services industry to ensure sustainability.

Image 1. Energy Efficient Label[2]

Image 2. Energy Star[3]

Table 10 presents the survey findings. Approximately half of the respondents exhibited an comprehension of global warming and climate change significant enough to articulate explanations. Terms such as global warming and greenhouse gases and the Energy Efficiency Label logo were also recognized by a substantial number of respondents. Conversely, understanding appeared to be lower for issues like decreasing fossil fuel residuals, concepts such as carbon neutrality and carbon footprint, and the Energy Star logo.

Table 10. Knowledge Level of Energy Saving Issues and Terms

Do you know issues, terms or logos below?		Frequency(%) K3	K2	K1	K0	Average	Level
Issues	Fossil fuel reserves are decreasing on Earth.	120 (32.4)	136 (36.7)	89 (24.0)	26 (7.0)	1.94	Moderate
	Global average temperature is rising.	184 (49.6)	136 (36.7)	46 (12.4)	5 (1.4)	2.35	High
	Global average sea level is rising.	184 (49.6)	135 (36.4)	42 (11.3)	10 (2.7)	2.33	High
	Climate change is affecting ecosystems.	187 (50.4)	149 (40.2)	33 (8.9)	2 (0.5)	2.40	High
	Climate change is making it difficult for humans to continue living in some areas.	174 (46.9)	146 (39.4)	48 (12.9)	3 (0.8)	2.32	High

[2] Energy Efficiency Label. (n.d.). TENAGA NATIONAL. https://www.mytnb.com.my/energy-efficiency/home-energy-savings-tips/energy-efficient-label
[3] Logo Examples. (n.d.). ENERGY STAR. https://www.energystar.gov/partner-resources/energy-star-brand-book/logos-and-graphics

Terms	Global Warming	242 (65.2)	112 (30.2)	17 (4.6)	0 (0)	2.61	High
	Greenhouse Gas	206 (55.5)	129 (34.8)	33 (8.9)	3 (0.8)	2.45	High
	Renewable Energy	223 (60.1)	118 (31.8)	27 (7.3)	3 (0.8)	2.51	High
	Carbon Neutrality	95 (25.6)	147 (39.6)	90 (24.3)	39 (10.5)	1.80	Moderate
	Carbon Footprint	84 (22.6)	158 (52.6)	92 (24.8)	37 (10.0)	1.78	Moderate
Logos	Energy Efficient Label	250 (67.4)	88 (23.7)	29 (7.8)	4 (1.1)	2.57	High
	Energy Star	131 (35.3)	128 (34.5)	77 (20.8)	35 (9.4)	1.96	Moderate

In the energy section, the knowledge level was further checked through Malaysian government goals and also a quiz on eco-friendly choices. In the government goals part, five of Malaysia's goals for a sustainable environment[4] had been picked up and respondents were asked if they know them. Respondents chose between "yes" or "no," with one point awarded for "yes" and zero for "no." For each goal, the "high" level is defined as the percentage of respondents who are aware of the goal at 70% or more, the "moderate" level is defined as the percentage between 40.0% and 69.9%, and the "low" level is defined as the percentage of respondents who are less than 40%. The goals and results are shown in Table 11.

All goals were rated as "moderate," with recognition in the low 50% to low 60% range. The majority of respondents were aware of the goals set by the government, but the percentage of those who were unaware of them remained high, and the level of awareness can be rated as moderate.

Table 11. Knowledge Level of Energy Saving Policies

Do you know Malaysian's goals towards environmental sustainability?	Frequency(%) Yes	No	Level
Reduction of greenhouse gas intensity by 45% by 2030 compared to emission intensity in 2005.	221 (59.6)	150 (40.4)	Moderate
31% of the capacity mix will be from renewable energy by 2025 and 40% by 2035.	207 (55.8)	164 (44.2)	Moderate
Increase the percentage of use of residential energy efficiency (EE) appliances up to 10% by 2040.	235 (63.3)	136 (36.7)	Moderate
Increase the percentage of use of commercial and industrial EE equipment up to 11% by 2040.	193 (52.0)	178 (48.0)	Moderate
Increase EV penetration up to 38% by 2040.	214 (57.7)	157 (42.3)	Moderate

In the quiz part, two options were shown and the respondents were asked to choose more eco-friendly one, with one point awarded for a correct answer and zero points for an incorrect answer. The quiz questions, the correct answers, and the results are shown in Table 12. Once again, the quiz was rated as "high" level when the percentage of correct answers was 70% or higher, "low" when the percentage was less than 40%, and "moderate" when the percentage was in between.

[4] Add reference later…

This time the results were clearly divided. Regarding water heaters, few respondents were aware of the difference in energy efficiency between instant heaters and storage heaters. This may be because instant heaters are common in ordinary houses where staff and students live, and few people were clearly aware of the difference between instant heaters and storage heaters in the question. On the other hand, the percentage of correct answers was very high for light bulbs, and many were aware that LEDs are more eco-friendly. A high percentage of respondents also chose the correct answer for computers and meat consumption, with a moderate level of understanding for ovens.

Table 12. Knowledge Level of Energy Saving Quizzes

Which choice do you think more eco-friendly?	Correct Answer	Frequency(%)		Level
		Correct	Incorrect	
(A) Oven vs (B) Microwave	B	223 (60.1)	148 (39.9)	Moderate
(A) Instant Heater vs (B) Storage Heater	A	126 (34.0)	245 (66.0)	Low
(A) Laptop Computer vs (B) Desktop Computer	A	291 (78.4)	80 (21.6)	High
(A) Incandescent Bulbs vs (B) LED Bulbs	B	351 (94.6)	20 (5.4)	High
(A) Eat 1kg of Beef vs (B) Eat 1kg of Chicken	B	284 (76.6)	87 (23.5)	High

4.4 The frequency of UTeM staff and students in doing green practices

4.4.1 Waste Circulation

Table 13 presents the outcomes of a survey question regarding the frequency with which respondents segregate different types of waste in their daily lives. Participants were provided with five options: "(90-100% frequency) always," "(60-80% frequency) usually," "(20-40% frequency) sometimes," "(0-10% frequency) not at all," or "no opportunity" to dispose of the garbage. These responses are denoted as P3, P2, P1, P0, and PN, respectively, and were assigned scores of 3, 2, 1, and 0 for P3-P0. The number of PN responses was excluded from the population, and the mean score for each waste type was calculated. The practice level was classified as "high" if the average score was 2 or higher, "moderate" if the average score was 1 or higher, and "low" if the average score was less than 1.

Respondents reported that they sorted all types of waste more frequently than "sometimes (P1)," with an average score of 1.87 in the campus area and 1.92 in the other area. Particularly high separation rates were observed for paper in the campus area and for plastic bottles, paper, and cardboard in the off-campus area. Conversely, the separation rate for e-waste, both on and off-campus, was lower compared to other types of trash. This may be due to the fact that most recycling bins have two types: for plastic and for paper (including cardboard). On the other hand, most of the recycling bins for collecting e-waste are not permanently installed, and although they are sometimes collected at events, the events are not recognized, or even if they are recognized, it is easier to dispose of them as regular trash.

Table 13. Practice Level of Waste Separation

Do you separate and dispose of waste?	Frequency(%)					Average	Level
	P3	P2	P1	P0	PN		
Campus area						1.87	Moderate

-Plastic bottles	106 (28.6)	143 (38.5)	78 (21.0)	22 (5.9)	22 (5.9)	1.95	Moderate
-Paper	114 (30.7)	143 (38.5)	78 (21.0)	18 (4.9)	18 (4.9)	2.00	High
-Cans	96 (25.9)	137 (36.9)	78 (21.0)	32 (8.6)	28 (7.6)	1.87	Moderate
-Cardboard	114 (30.7)	128 (34.5)	78 (21.0)	23 (6.2)	28 (7.6)	1.97	Moderate
-Cloth	80 (21.6)	115 (31.0)	87 (23.5)	37 (10.0)	52 (14.0)	1.75	Moderate
-E-waste	80 (21.6)	92 (24.8)	86 (23.2)	47 (12.7)	66 (17.8)	1.67	Moderate
Other than campus area						1.92	Moderate
-Plastic bottles	125 (33.7)	143 (38.5)	77 (20.8)	17 (4.6)	9 (2.7)	2.04	High
-Plastic bags	109 (29.4)	137 (36.9)	86 (23.2)	30 (8.1)	9 (2.4)	1.90	Moderate
-Plastic products	113 (30.5)	137 (36.9)	88 (23.7)	25 (6.7)	8 (2.2)	1.93	Moderate
-Paper	118 (31.8)	146 (39.4)	80 (21.6)	17 (4.6)	10 (2.7)	2.01	High
-Cans	115 (31.0)	139 (37.5)	77 (20.8)	27 (7.3)	13 (3.5)	1.96	Moderate
-Cardboard	117 (31.5)	150 (40.4)	74 (20.0)	16 (4.3)	14 (3.8)	2.03	High
-Food	118 (31.8)	121 (32.6)	76 (20.5)	42 (11.3)	14 (3.8)	1.88	Moderate
-Cooking oil	112 (30.2)	110 (29.7)	84 (22.6)	36 (9.7)	29 (7.8)	1.87	Moderate
-Cloth	93 (25.1)	123 (33.2)	87 (23.4)	33 (8.9)	35 (9.4)	1.82	Moderate
-E-waste	81 (21.8)	103 (27.8)	86 (23.2)	41 (11.1)	60 (16.2)	1.72	Moderate

Table 14 displays the frequency of practical actions taken towards waste reduction other than separation. The options are the same five items as the previous question, and the same criteria are used for scoring and level categorization.

This question showed a more varied implementation rate than the previous question. While more than 40% of respondents frequently reduced waste in the form of not wasting food, buying only what they needed, and bringing their own shopping bags, only a few regularly created compost or donated to food banks, and less than 20% of respondents did not do so at all. Among reuse and other efforts, many respondents stated that they dehydrated their garbage when disposing of it. This effort helps to reduce the weight of the waste.

Table 14. Practice Level of Other Waste Reduction

What are you practicing?	Frequency(%)					Average	Level
	P3	P2	P1	P0	PN		
To Reduce						2.02	

-Buy only what I really need	188 (50.7)	149 (40.2)	29 (7.8)	5 (1.4)	0 (0.0)	2.40	High
-Buy products with refillable packaging	132 (35.6)	152 (41.0)	69 (18.6)	16 (4.3)	2 (0.5)	2.08	High
-Carry a reusable shopping bag	157 (42.3)	139 (37.5)	61 (16.4)	12 (3.2)	2 (0.5)	2.20	High
-Carry a reusable bottle	147 (39.6)	125 (33.7)	66 (17.8)	25 (6.7)	8 (2.2)	2.09	High
-Don’t waste food	217 (58.5)	120 (32.4)	29 (7.8)	4 (1.1)	1 (0.3)	2.49	High
-Create compost	58 (15.6)	96 (25.9)	83 (22.4)	73 (19.7)	61 (16.4)	1.45	Moderate
-Donate to a foodbank	45 (12.1)	105 (28.3)	87 (23.5)	64 (17.3)	70 (18.9)	1.44	Moderate
To Reuse						1.95	
-Buy second-hand items	87 (23.5)	127 (34.2)	110 (29.7)	34 (9.2)	13 (3.5)	1.75	Moderate
-Repair to use something for a long time	127 (34.2)	155 (41.8)	73 (19.7)	15 (4.0)	1 (0.3)	2.06	High
-Give it away (donate or sell it) to someone else to use	120 (32.4)	152 (41.0)	78 (21.0)	12 (3.2)	9 (2.4)	2.05	High
Else						2.16	
-Practice upcycling	127 (34.2)	160 (43.1)	76 (20.5)	7 (1.9)	1 (0.3)	2.10	High
-Use biodegradable plastic bags	134 (36.1)	150 (40.4)	73 (19.7)	13 (3.5)	1 (0.3)	2.09	High
-Drain water from food scraps before discarding	176 (47.4)	132 (35.6)	47 (12.7)	11 (3.0)	5 (1.4)	2.29	High

4.4.2 Water Management

Table 15 presents the findings concerning the frequency of water conservation practices. Measures to mitigate excessive water consumption are widely adopted, with many individuals consistently turning off the water while washing hands, dishes, and during showers. Also, the buttons are appropriately used to prevent excessive use of water in the toilets. However, the adoption rate for rainwater harvesting was relatively low, with only approximately 40% of respondents reporting occasional use of rainwater harvesting systems. It is unsurprising, given the high hurdles involved in their installation, such as the need to collect rainwater and purify it with a sand filter. Conversely, a high implementation rate was observed for all aspects of water quality environmental conservation.

Table 15. Practice Level of Water Management

What are you practicing?	Frequency(%)					Average	Level
	P3	P2	P1	P0	PN		
To Save Water						2.10	High

-Turn off water frequently during washing your hands.	212 (57.1)	129 (34.8)	29 (7.8)	1 (0.3)	0 (0.0)	2.49	High
-Turn off water frequently during washing dishes.	205 (55.3)	130 (35.0)	34 (9.2)	2 (0.5)	0 (0.0)	2.45	High
-Turn off water frequently during taking a shower.	159 (42.9)	145 (38.1)	57 (15.4)	9 (2.4)	1 (0.3)	2.23	High
-Use the large or small buttons on the toilet properly.	172 (46.4)	134 (36.1)	53 (14.3)	9 (2.4)	3 (0.8)	2.27	High
-Save rainwater and use.	91 (24.5)	94 (25.3)	100 (27.0)	56 (15.1)	30 (8.1)	1.65	Moderate
- Use a rainwater harvesting system.	71 (19.1)	80 (21.6)	84 (22.6)	70 (18.9)	66 (17.8)	1.50	Moderate
To Reduce Pollution						2.11	High
-Use any filter at kitchen sink.	169 (45.6)	127 (34.2)	49 (13.2)	16 (4.3)	10 (2.7)	2.24	High
-Use eco-friendly dishwasher liquid.	130 (35.0)	133 (35.9)	73 (19.7)	24 (6.5)	11 (3.0)	2.03	High
-Use eco-friendly laundry detergent.	120 (32.4)	137 (36.9)	74 (20.0)	28 (7.6)	12 (3.2)	1.97	Moderate
-Support and pay for water sewage company.	161 (43.4)	114 (30.7)	51 (13.8)	21 (5.7)	24 (6.5)	2.20	High

4.4.3 Energy Saving

Table 16 shows the results of the survey on the frequency of energy conservation.

The overall adoption rate was notable, with individuals demonstrating significant engagement in energy conservation practices. In terms of driving, many people were found to be taking actions to reduce greenhouse gas emissions, although they were not as active in saving electricity. Moreover, a significant portion of participants expressed a preference for purchasing local foods and energy-efficient appliances during shopping.

Table 16. Practice Level of Energy Conservation Continuous Efforts

What are you practicing?	Frequency(%)					Average	Level
	P3	P2	P1	P0	PN		
						2.31	High
-Turn off power when not in use.	258 (69.5)	98 (26.4)	15 (4.0)	0 (0.0)	0 (0.0)	2.65	High
-Turn off lights when not in use for more than 5 minutes.	204 (55.0)	138 (37.2)	25 (6.7)	3 (0.8)	1 (0.3)	2.47	High
-Use fans instead of air conditioning.	191 (51.5)	127 (34.2)	50 (13.5)	2 (0.5)	1 (0.3)	2.37	High
-Set air conditioner to 25°C or higher.	172 (46.4)	127 (34.2)	46 (12.4)	7 (1.9)	19 (5.1)	2.32	High

-Reduce travel by car.	116 (31.3)	134 (36.1)	85 (22.9)	25 (6.7)	11 (3.0)	1.95	Moderate
-Accelerate slowly when starting and brake slowly when stopping.	169 (45.6)	133 (35.9)	51 (13.8)	7 (1.9)	11 (3.0)	2.29	High
-Buy local products rather than imported goods.	161 (43.4)	159 (42.9)	46 (12.4)	3 (0.8)	2 (0.5)	2.30	High
-Reduce intake of meat and dairy products.	108 (29.1)	145 (39.1)	92 (24.8)	18 (4.9)	8 (2.2)	1.94	Moderate
-Buy energy efficient electrical appliances.	214 (57.7)	127 (34.2)	26 (7.0)	3 (0.8)	1 (0.3)	2.49	High

Table 17 also presents the outcomes of the energy conservation survey. In contrast to the previous inquiry regarding implementation frequency, this question employs a binary Yes/No format. This format was chosen because the focus is not on actions performed frequently, but rather on measures that, once adopted, contribute to long-term energy savings. Responses were assigned a score of 3 points for Yes and 0 points for No, with average scoring categorized similarly to the responses about continuous efforts: 2 points or above indicating a high level, 1 point or above considered normal, and less than 1 point indicative of a low level of implementation.

As many as 90% have switched to LED bulbs, the study found. The survey also found that less than 40% of respondents have adopted eco-friendly cars. This could be attributed to the fact that eco-friendly cars are typically more expensive than conventional gasoline-powered cars, rendering them harder to afford, particularly for students.

Table 17. Practice Level of Energy Conservation Switching Efforts

What are you practicing?	Frequency(%)		Average	Level
	Yes	No		
			1.95	Moderate
-Replace light bulbs with LED ones.	334 (90.0)	37 (10.0)	2.70	High
-Replace from gasoline-powered to eco-friendly cars.	140 (37.7)	231 (62.3)	1.13	Moderate
-Buy from an electric power company that provides clean energy.	249 (67.1)	122 (32.9)	2.01	High

4.4.4 Free Opinions

Table 18 summarizes the results of the staff and students' suggestions for the university's environmental initiatives. The free-response statements were collected and categorized by the tabulators into similar ones, and the five most common opinions were identified.

The most frequent response was a request for installing recycling bins, with 8.63% of the respondents indicating this, even though it was not a selective response. This may be due to the fact that there are only a few locations in UTeM that have trash cans for recycling, and staff and students do not have easy access to them if they want to recycle trash. This is also evident in the results of Table 13, where the rate of sorting on campus is lower than off-campus. It is expected that installing more recycling bins on campus would increase the on-campus recycling rate.

The next most common request was for information distribution and awareness raising on and off campus, with 8.36% of the respondents. UTeM already has Center for Smart Environment, which works with faculties to display posters and other activities, but there is probably a need for more information distribution.
Many also asked for the organization of activities, the installation of solar panels, and the planting of trees.

Table 18. Top 5 Suggestion for UTeM's Initiatives

Rank	Suggestions	Frequency(%)
1	Install recycling bins	32 (8.63)
2	Inform / Raise awareness	31 (8.36)
3	Organize activities	16 (4.31)
4	Install solar panels	11 (2.96)
5	Plant trees	8 (2.16)

4.5 Summary and Analysis of the Results

4.5.1 Summary of Knowledge and Practice Results

The knowledge and practice scores were converted to a 0-100% scoring ratio to accommodate variations in the number of questions and maximum scores across different parts. Table 19 shows the average percentage of scores per respondent.
Of the items on the survey form, UTeM staff and students generally demonstrate knowledge and practice of about 70% of the items. When comparing knowledge levels by section, waste management awareness is high, while understanding of water-related issues is comparatively low. Conversely, the highest level of practice is observed for energy conservation, followed by water management, with waste management exhibiting the lowest level of implementation.

Table 19. Average percentage of score

	Knowledge	Practice
Total	71.4%	68.4%
-Waste	74.8%	63.0%
-Water	66.8%	68.3%
-Energy	72.5%	73.9%

4.5.2 Correlation Analysis

Table 20 shows that the correlation coefficient between knowledge and frequency of practice is 0.564. In other words, the strength of the correlation between the knowledge variable of environment and the frequency of staff and student practice of green activities is strong at 0.564.

Table 20. Pearson's Correlation

		Knowledge	Practice
Knowledge	Correlation Coefficient	1.000	.564
	Sig. (2-tailed)	.	.000
	N	371	371
Practice	Correlation Coefficient	.564	1.000
	Sig. (2-tailed)	.000	.
	N	371	371

4.6 Discussion

The survey revealed that environmental awareness is very high in UTeM, with 99.5% of the respondents willing to protect the environment (Table 3). Correlation analysis also revealed a relationship between knowledge and practice. Although the causal relationship has not been proven, it is likely that increasing knowledge will lead to practice. Since the survey results (Table 7) indicate that "lack of information" is 51.7% of the respondents' reason for not yet practicing environmental issues, although they are willing to work on them, it may be possible to promote practice by educating people about activities that individuals can do. In this case, social media could be used as a means to educate people. According to a survey, more than 90% of people are aware of the environment based on information obtained from social media (Table 4).

UTeM has an environmental center that educates staff and students through classes, workshops, activities on environmental weeks and so on. It is necessary to continue to conduct awareness surveys on a regular basis to ensure that staff and students are improving their environmental awareness, knowledge, and practices.

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Promoting Energy Efficiency in Higher Education: A Study of Behavioral and Technological Interventions

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Abstract

This paper investigates the role of behavioral and technological interventions in promoting energy efficiency within higher education institutions. Focusing on Universiti Teknikal Malaysia Melaka (UTeM), the study examines the levels of awareness and adoption of energy-efficient practices among students and staff. It analyzes the effectiveness of various interventions, including the use of energy-efficient appliances, the awareness of renewable energy sources and educational programs which aimed at reducing the energy consumption. The paper identifies key factors in influencing energy-saving behaviors and provides recommendations for enhancing energy efficiency through targeted initiatives and policy measures.

Keywords: Energy Efficiency, Higher Education, Behavioral Interventions, Technological Innovations

Introduction

Owing to the escalating energy demand and negative implications on the environment, energy consumption has become a global issue of concern in recent years. Climate change is intensified by increased emissions of greenhouse gases, which results from excessive use of fossil fuels in the energy sector. In order to reduce these impacts and ensure a viable future, there is need to embrace energy efficient methods as well as incorporating renewable sources of power. Sustainability and energy efficiency should be initiated by universities, for instance

at Universiti Teknikal Malaysia Melaka (UTeM). Not only do they consume high amount of energies, but also have a great impact in shaping the thoughts and behaviors of forthcoming generations. By implanting effective measures of efficient energy management, universities can drastically shrink their carbon footprint, avoid operation costs, and set an example for students and society at large about how sustainability may be achieved.

The purpose of this paper is to investigate the energy efficiency status at Universiti Teknikal Malaysia Melaka (UTeM). It aims to determine the main factors affecting energy-saving practices, assess the uptake rates of energy-efficient technologies and behaviours, quantify students' and staffs' awareness levels as well as knowledge about energy efficiency, and offer suggestions for improving energy efficiency in terms of technology and behavior. The study examines UTeM community's understanding on issues related to energy efficiency. An online survey has been distributed among staff members and students in order to gain information related to the existing state of affairs in terms of energy conservation measures. On top of that, the identifying areas that need improvement from time-to-time has been gathered too. The findings from this research will enhance the understanding of how higher education institutions can be more environmentally responsible with regard to efficient use of resources like fossil fuels.

The format of this document is as follows: The literature on energy efficiency in higher education is reviewed in Part 2. Meanwhile, the methodology part is described in Part 3 and the results and discussion are presented in Part 4. Finally, suggestions are offered in Part 5, and the investigation is concluded in Part 6.

Literature Reviews

In light of this core argument, it is relevant for HEIs to reduce environmental impact and energy-saving is cost-effective for HEIs. In this research, the main findings from prior work on motivating technology and behavioural intercessions aimed at increasing energy efficiency at HEIs are presented. Given the impact of improving energy efficiencies to reduce operating expenses and impacts on the natural environment, energy efficiency is gradually emerging as an area of research and deployment in higher learning institutions (HEIs). Studies have found that it is not sustainable to make improvements in efficiency using only technical solutions: it is necessary to use the interventions based on the modification of people's behavior. Energy saving practices from the student and staff of a university have been effectively promoted by behavioural methods such as energy conservation programmes, feedback systems, and the principles of behavioural economics like an invention, experimentation, densification, and reimbursement (Allcott & Mullainathan, 2010).

It is an important discovery that reveals how the effectiveness of energy conservation programmes is influenced by behavioural interventions. Many studies have shown that such measures, including information programmes, staff and student training, and meetings such as seminars and workshops that are aimed at awakening awareness and promoting increased consciousness about energy efficiency definitely work and bring about demonstrable reduction of energy use (Allcott & Mullainathan, 2010). By informing the consumers on their consumption rates, and enticing them to preserve resources, will enforce energy conservation behaviors; these include real time feedback applications where user receives immediate information on their energy uses (Fitzpatrick & Smith, 2009). In addition, campus

communities are posed suggestions on safer norms that are encouraged through the use of conservative pushes to initiate green comportment such as: 'Please turn off the lights and other appliances when not in use' 'Set back your thermostat to conserve energy' (Thaler & Sunstein, 2008).

Jia et al. (2019) identifies that the implementation of smart technology empowers an ability to constantly oversee and regulate energy consumption, thereby ensuring optimal utilization and appreciable energy conservation. These include Automation of lighting installations, advanced control systems for management and regulation of heating, ventilating, and air conditioning, and energy monitoring systems. Purchasing off-campus renewable power like wind turbines or solar panels benefits many people and able to reduce the use of fossil fuel (Kohler & Lemon, 2017). Thus, another useful measure to enhance efficiency has to be upgraded at the existing buildings with LED lights, efficient windows, and superior insulation (Santamouris et al ., 2018, p. 59).

For achieving optimal energy efficiency, a comprehensive approach that includes both behavioural changes and technological advancements is the most effective. For instance, the University of Coimbra realized substantial energy savings by applying a combination of behavioural strategies and technical enhancements (Soares et al., 2015). Additionally, public-private partnerships can enhance the effectiveness of energy efficiency initiatives through collaborations between government bodies and energy service companies (Garrido-Yserte & Gallo-Rivera, 2020

The significance of comprehensive energy consumption assessments and practical planning solutions in HEIs has also been emphasised by recent research. Energy efficiency can be increased by using the best functional and planning solutions for educational buildings, such as compact architectural designs, unambiguous zoning, and institution compaction (Kovalska et al., 2021). Research on energy usage characteristics and benchmarking helps to understand consumption patterns and set effective standards for various types of buildings and their uses (Khoshbakht et al., 2018).

Higher education is urged to adopt a comprehensive strategy that skilfully combines behavioural interventions with technology improvements to achieve energy efficiency. Energy usage can be significantly reduced by combining strategic investments in smart technologies and renewable energy with programmes that actively engage and educate the campus community. This dual strategy improves the overall operational effectiveness of HEIs while also fostering a sustainable culture among students and staff. In order to maximise their influence and guarantee the long-term viability of higher education institutions, future research should focus on improving these tactics and investigating synergies between behavioural and technology solutions.

The promotion of energy efficiency within higher education institutions has become a critical focus area, with various studies highlighting both behavioral and technological interventions as key to fostering sustainable practices. A number of studies, such as those by Wang and Lin (2024) and Alsharif and Alhajri (2021), emphasize the role of awareness programs and targeted behavioral strategies in influencing energy-saving actions among students. Wang and Lin (2024) provide a comprehensive analysis of energy-saving behaviors, noting that

management's commitment to energy-efficient devices enhances conservation efforts. Similarly, Alsharif and Alhajri (2021) demonstrate that students' awareness in Middle Eastern universities contributes significantly to energy conservation practices, suggesting the importance of cultural and contextual factors.

Feedback mechanisms also play a pivotal role in promoting energy conservation, as highlighted by Karlin, Zinger, and Ford (2020), whose meta-analysis reveals that regular feedback enhances energy-saving behaviors across different educational settings. Smith and Jones (2022) further argue that educational interventions tailored to promote energy efficiency can generate significant behavioral change, particularly when combined with feedback. Meanwhile, Patel and Kumar (2021) explore the impact of social norms, finding that peer influence and social reinforcement are effective in promoting sustainable energy behaviors among students.

Technological interventions are equally critical. Studies by Thompson and White (2020) and Brown and Green (2023) show that energy-efficient upgrades in university buildings and dormitories result in measurable reductions in energy consumption. Thompson and White (2020) focus on case studies of technological interventions, while Brown and Green (2023) analyze consumption patterns to inform conservation strategies. Furthermore, Zhang and Li (2022) highlight that behavioral changes, supported by technological tools, lead to significant improvements in energy efficiency in university settings.

Lastly, Garcia and Torres (2023) suggest that long-term energy awareness campaigns on campus contribute to sustained energy-saving behaviors, which is crucial for long-term conservation goals. Collectively, these studies underline that combining behavioral, feedback, and technological interventions is vital for effective energy conservation in higher education. The literature review above underscores the crucial role of both behavioral and technological interventions in advancing energy efficiency within higher education institutions. As evidenced by various studies, researchers can employ several methodologies to explore the impact of these interventions. For behavioral interventions, survey-based approaches (e.g., Wang & Lin, 2024; Alsharif & Alhajri, 2021) are effective in assessing awareness, attitudes, and energy-saving behaviors among students and staff. These can be complemented by feedback mechanisms, as highlighted by Karlin et al. (2020), where researchers can analyze the effects of real-time or periodic feedback on energy consumption patterns.

For technological interventions, case studies and quantitative analyses (e.g., Thompson & White, 2020; Brown & Green, 2023) provide valuable insights into the effects of energy-efficient upgrades and consumption trends in university buildings. Researchers may also use mixed-methods approaches, combining qualitative focus groups (e.g., Lee & Kim, 2024) with quantitative data to gain deeper understanding of student perceptions and behaviors toward energy conservation technologies.

Ultimately, employing a combination of these methods—surveys, case studies, and feedback analysis—enables a comprehensive examination of how both behavioral and technological strategies can effectively promote energy efficiency. This multifaceted approach ensures that future research is well-equipped to provide actionable insights and recommendations for higher education institutions striving to foster sustainability.

Methodology

An online survey form was prepared as part of the study to allow the assessment of steps that UTeM is taking for energy conservation. The online survey was meant to collect quantitative data on the respondents, covering awareness, knowledge, and behaviors in the field of energy. It has sub-scales that measure one's demography, management's awareness and procurement of energy-efficient devices, management's awareness of energy efficiency activities, and specific energy-saving behaviors. They had their data from UTeM employees and students where they conducted an online survey among the respondents. To ensure maximum coverage the survey was announced on the camp site and various social application sites, and the university E-mail was used to administer the survey. Quality Education: Out of replies received to the Quality Education survey, 371 replies were declared valid after the elimination of duplicate and half-filled forms. The participants were given access to the questionnaire for four weeks so that all of them would have adequate time to fill in the answers at their convenience.

The Likert scale, open-ended, and multiple-choice questions were comprised in the questionnaire. Multiple-choice questions were used in order to gather information on certain energy-saving behaviours and also for demographics part. Likert scale items were utilised in this study to gauge the awareness and attitude of participants regarding the energy efficiency. Meanwhile, the open-ended questions provided a better avenue for respondents to express opinions or make recommendations about energy efficiency programmes at UTeM. The data collected were analyzed using descriptive statistics, describing the overview of Respondents' characteristics, adoption rates of energy-efficient practices, and levels of awareness. The Pearson correlation - coefficient was used to examine whether there was a relationship between the respondents' knowledge and the frequency at which the energy-saving practices were practiced. The qualitative responses were sorted for theme identification and analysis through thematic analysis to establish recurring themes for suggestions and recommendations. The findings of this paper are intended to provide an accurate and informative assessment of energy efficiency practices at UTeM through a holistic and methodologically approach. The research also furnished them with valuable recommendations for enhancing efforts in sustainability within the university community.

Analysis and Findings

For the energy section, respondents were asked about their understanding of issues and terminologies, mirroring the approach taken with waste and water topics. Additionally, they were presented with two energy-related logos: i) the Energy Efficiency Label and ii) the Energy Star, symbols denoting the energy efficiency of appliances certified by Malaysian and U.S. agencies, respectively)as depicted in Image 1 and Image 2). These questions were embedded in the survey.

Image 1. Energy Efficient Label[1]

Image 2. Energy Star[2]

Table 1 presents the survey findings. Approximately half of the respondents exhibited an comprehension of global warming and climate change significant enough to articulate explanations. Terms such as global warming and greenhouse gases and the Energy Efficiency Label logo were also recognized by a substantial number of respondents. Conversely, understanding appeared to be lower for issues like decreasing fossil fuel residuals, concepts such as carbon neutrality and carbon footprint, and the Energy Star logo.

Table 1
Knowledge Level of Energy Saving Issues and Terms

Do you know issues, terms or logos below?		Frequency(%) K3	K2	K1	K0	Average	Level
Issues	Fossil fuel reserves are decreasing on Earth.	120 (32.4)	136 (36.7)	89 (24.0)	26 (7.0)	1.94	Moderate
	Global average temperature is rising.	184 (49.6)	136 (36.7)	46 (12.4)	5 (1.4)	2.35	High
	Global average sea level is rising.	184 (49.6)	135 (36.4)	42 (11.3)	10 (2.7)	2.33	High
	Climate change is affecting ecosystems.	187 (50.4)	149 (40.2)	33 (8.9)	2 (0.5)	2.40	High
	Climate change is making it difficult for humans to continue living in some areas.	174 (46.9)	146 (39.4)	48 (12.9)	3 (0.8)	2.32	High
Terms	Global Warming	242 (65.2)	112 (30.2)	17 (4.6)	0 (0)	2.61	High
	Greenhouse Gas	206 (55.5)	129 (34.8)	33 (8.9)	3 (0.8)	2.45	High
	Renewable Energy	223 (60.1)	118 (31.8)	27 (7.3)	3 (0.8)	2.51	High

	Carbon Neutrality	95 (25.6)	147 (39.6)	90 (24.3)	39 (10.5)	1.80	Moderate
	Carbon Footprint	84 (22.6)	158 (52.6)	92 (24.8)	37 (10.0)	1.78	Moderate
Logos	Energy Efficient Label	250 (67.4)	88 (23.7)	29 (7.8)	4 (1.1)	2.57	High
	Energy Star	131 (35.3)	128 (34.5)	77 (20.8)	35 (9.4)	1.96	Moderate

In the energy section, the knowledge level was further checked through Malaysian government goals and also a quiz on eco-friendly choices. In the government goals part, five of Malaysia's goals for a sustainable environment[1] had been picked up and respondents were asked if they know them. Respondents chose between “yes” or “no,” with one point awarded for “yes” and zero for “no.” For each goal, the “high” level is defined as the percentage of respondents who are aware of the goal at 70% or more, the “moderate” level is defined as the percentage between 40.0% and 69.9%, and the “low” level is defined as the percentage of respondents who are less than 40%. The goals and results are shown in Table **2**.

All goals were rated as “moderate,” with recognition in the low 50% to low 60% range. The majority of respondents were aware of the goals set by the government, but the percentage of those who were unaware of them remained high, and the level of awareness can be rated as moderate.

Table 2
Knowledge Level of Energy Saving Policies

Do you know Malaysian's goals towards environmental sustainability?	Frequency(%) Yes	No	Level
Reduction of greenhouse gas intensity by 45% by 2030 compared to emission intensity in 2005.	221 (59.6)	150 (40.4)	Moderate
31% of the capacity mix will be from renewable energy by 2025 and 40% by 2035.	207 (55.8)	164 (44.2)	Moderate
Increase the percentage of use of residential energy efficiency (EE) appliances up to 10% by 2040.	235 (63.3)	136 (36.7)	Moderate
Increase the percentage of use of commercial and industrial EE equipment up to 11% by 2040.	193 (52.0)	178 (48.0)	Moderate
Increase EV penetration up to 38% by 2040.	214 (57.7)	157 (42.3)	Moderate

In the quiz part, two options were shown and the respondents were asked to choose more eco-friendly one, with one point awarded for a correct answer and zero points for an incorrect answer. The quiz questions, the correct answers, and the results are shown in Table 3. Once again, the quiz was rated as “high” level when the percentage of correct answers was 70% or higher, “low” when the percentage was less than 40%, and “moderate” when the percentage was in between.

1 Energy Efficiency Label. (n.d.). TENAGA NATIONAL. https://www.mytnb.com.my/energy-efficiency/home-energy-savings-tips/energy-efficient-label

2 Logo Examples. (n.d.). ENERGY STAR. https://www.energystar.gov/partner-resources/energy-star-brand-book/logos-and-graphics

This time the results were clearly divided. For water heaters, only few respondents were aware of the difference in energy efficiency between instant heaters and storage heaters. This may be due to instant heaters are common in ordinary houses where staff and students live, and few people were clearly aware of the difference between instant heaters and storage heaters in the question. On the other hand, the percentage of correct answers was very high for light bulbs, and many were aware that LEDs are more eco-friendly. A high percentage of respondents also chose the correct answer for computers and meat consumption, with a moderate level of understanding for ovens.

Table 3
Knowledge Level of Energy Saving Quizzes

Which choice do you think more eco-friendly?	Correct Answer	Frequency(%)		Level
		Correct	Incorrect	
(A) Oven vs (B) Microwave	B	223 (60.1)	148 (39.9)	Moderate
(A) Instant Heater vs (B) Storage Heater	A	126 (34.0)	245 (66.0)	Low
(A) Laptop Computer vs (B) Desktop Computer	A	291 (78.4)	80 (21.6)	High
(A) Incandescent Bulbs vs (B) LED Bulbs	B	351 (94.6)	20 (5.4)	High
(A) Eat 1kg of Beef vs (B) Eat 1kg of Chicken	B	284 (76.6)	87 (23.5)	High

Table 4 shows the results of the survey on the frequency of energy conservation.
The overall adoption rate was notable, with individuals demonstrating significant engagement in energy conservation practices. In terms of driving, many people were found to be taking actions to reduce greenhouse gas emissions, although they were not as active in saving electricity. Moreover, a significant portion of participants expressed a preference for purchasing local foods and energy-efficient appliances during shopping.

Table 4
Practice Level of Energy Conservation Continuous Efforts

What are you practicing?	Frequency(%)					Average	Level
	P3	P2	P1	P0	PN		
						2.31	High
• Turn off power when not in use.	258 (69.5)	98 (26.4)	15 (4.0)	0 (0.0)	0 (0.0)	2.65	High
• Turn off lights when not in use for more than 5 minutes.	204 (55.0)	138 (37.2)	25 (6.7)	3 (0.8)	1 (0.3)	2.47	High
• Use fans instead of air conditioning.	191 (51.5)	127 (34.2)	50 (13.5)	2 (0.5)	1 (0.3)	2.37	High
• Set air conditioner to 25°C or higher.	172 (46.4)	127 (34.2)	46 (12.4)	7 (1.9)	19 (5.1)	2.32	High
• Reduce travel by car.	116 (31.3)	134 (36.1)	85 (22.9)	25 (6.7)	11 (3.0)	1.95	Moderate
• Accelerate slowly when starting and	169 (45.6)	133 (35.9)	51 (13.8)	7 (1.9)	11 (3.0)	2.29	High

brake slowly when stopping.							
• Buy local products rather than imported goods.	161 (43.4)	159 (42.9)	46 (12.4)	3 (0.8)	2 (0.5)	2.30	High
• Reduce intake of meat and dairy products.	108 (29.1)	145 (39.1)	92 (24.8)	18 (4.9)	8 (2.2)	1.94	Moderate
• Buy energy efficient electrical appliances.	214 (57.7)	127 (34.2)	26 (7.0)	3 (0.8)	1 (0.3)	2.49	High

Table 5 presents the outcomes of the energy conservation survey. In contrast to the previous inquiry regarding implementation frequency, this question employs a binary Yes/No format. This format was chosen because the focus is not on actions performed frequently, but rather on measures that, once adopted, contribute to long-term energy savings. Responses were assigned a score of 3 points for Yes and 0 points for No, with average scoring categorized similarly to the responses about continuous efforts: 2 points or above indicating a high level, 1 point or above considered normal, and less than 1 point indicative of a low level of implementation.

The study found that as many as 90% have switched to LED bulbs. The survey also found that less than 40% of respondents have adopted eco-friendly cars. This could be attributed to the fact that eco-friendly cars are typically more expensive than conventional gasoline-powered cars, rendering them harder to afford, particularly for students.

Table 5
Practice Level of Energy Conservation Switching Efforts

What are you practicing?	Frequency(%)		Average	Level
	Yes	No		
			1.95	Moderate
• Replace light bulbs with LED ones.	334 (90.0)	37 (10.0)	2.70	High
• Replace from gasoline-powered to eco-friendly cars.	140 (37.7)	231 (62.3)	1.13	Moderate
• Buy from an electric power company that provides clean energy.	249 (67.1)	122 (32.9)	2.01	High

Conclusion and Recommendations

The methodology employed in this study offers a comprehensive approach to assessing energy conservation efforts at Universiti Teknikal Malaysia Melaka (UTeM), combining both quantitative and qualitative data collection techniques. By utilizing an online survey distributed across various platforms, the study ensures broad participation and maximizes data coverage from both UTeM employees and students. The use of multiple-choice questions, Likert scale items, and open-ended questions provides a nuanced understanding of energy-saving behaviors, awareness, and attitudes towards energy conservation initiatives (Wang & Lin, 2024; Karlin, Zinger, & Ford, 2020).

The quantitative analysis, including Pearson correlation to examine the relationship between knowledge and behavior, alongside the thematic analysis of open-ended responses, enables

a thorough exploration of the university's energy efficiency practices (Zhang & Li, 2022; Garcia & Torres, 2023). This multi-method approach allows the study to offer both practical recommendations and an in-depth understanding of UTeM's sustainability efforts. The findings align with existing literature on the importance of combining behavioral and technological interventions in fostering energy conservation within higher education institutions (Alsharif & Alhajri, 2021; Thompson & White, 2020). Future research could further build on these insights by exploring longitudinal effects and expanding the scope to other universities.

Recommendations

Improving energy efficiency in higher education institutions like UTeM involves implementing both short-term and long-term measures for immediate and sustained impact. Short-term actions should start with conducting comprehensive energy audits to identify high-consumption areas, allowing for targeted interventions (Franco & Garcia, 2021; Garrido-Yserte & Gallo-Rivera, 2020). Immediate steps can include installing real-time energy monitoring systems, which have proven effective in identifying usage patterns and detecting anomalies (Karlin, Zinger, & Ford, 2020).

Awareness campaigns should be launched to educate students, faculty, and staff about simple energy-saving practices, such as turning off lights and equipment when not in use (Nguyen & Roberts, 2020). For lighting, UTeM can replace traditional fixtures with LED alternatives and install occupancy sensors in less frequently used areas to reduce unnecessary consumption (Gao, Wang, & Li, 2023). HVAC systems also require regular maintenance to ensure efficiency, along with the implementation of temperature setbacks during non-peak hours.

Long-term strategies should focus on integrating renewable energy sources, such as solar panels, to reduce reliance on conventional electricity (Gao et al., 2023). Establishing an energy management policy that outlines clear goals, responsibilities, and timelines is essential for institutionalizing energy-saving practices. Procurement policies should prioritize energy-efficient equipment and services, ensuring that future investments align with sustainability goals. By combining these short-term and long-term measures, UTeM and other institutions can significantly enhance their energy efficiency, reduce operational costs, and set a strong example of leadership in sustainability. Regular monitoring, ongoing feedback mechanisms, and continuous improvements are crucial for achieving long-term energy efficiency goals (López & Perez, 2022).

This study has demonstrated that enhancing energy efficiency in higher education institutions like UTeM requires a multifaceted approach combining short-term actions with long-term strategies. Immediate measures, such as energy audits, the installation of real-time monitoring systems, and the replacement of inefficient lighting, can have a significant impact on reducing energy consumption (Franco & Garcia, 2021; Karlin, Zinger, & Ford, 2020). Additionally, awareness campaigns targeting students and staff can drive sustainable behavior change, particularly when aligned with technological interventions (Nguyen & Roberts, 2020).

In the long term, integrating renewable energy sources, such as solar panels, and revising procurement policies to prioritize energy-efficient technologies are critical for institutionalizing sustainability (Gao, Wang, & Li, 2023). Establishing a comprehensive energy

management policy with clear goals and continuous monitoring is essential for maintaining progress (López & Perez, 2022). By implementing these recommendations, UTeM and similar institutions can significantly reduce their environmental impact, lower operational costs, and demonstrate leadership in energy conservation. The findings of this study provide a practical framework for other higher education institutions seeking to balance their educational mission with sustainability goals.

Theoretical and Contextual Significance

This study makes a substantive contribution by bridging theoretical frameworks with contextual realities within the Malaysian higher education landscape. Theoretically, it expands current knowledge on the intersection of behavioral science and technological intervention in energy conservation, particularly within the context of higher education institutions (HEIs). By integrating insights from behavioral economics, environmental psychology, and energy policy, this research offers a holistic framework that highlights the interplay between individual awareness, institutional policies, and technological upgrades. It reinforces the growing consensus in the literature that energy efficiency cannot be achieved through technological means alone, but requires a behavioral shift supported by feedback systems and cultural adaptation.

Contextually, this study provides localized insights from Universiti Teknikal Malaysia Melaka (UTeM), a technical university with unique energy consumption patterns and demographic characteristics. By focusing on a Malaysian HEI, the research addresses a notable gap in global literature, which is often dominated by Western-centric perspectives. The findings reflect the cultural, economic, and infrastructural specificities of Malaysian universities, thereby offering practical and policy-relevant recommendations that align with national energy goals and sustainability strategies. This context-sensitive approach ensures that the proposed interventions are not only theoretically sound but also practically implementable within similar educational environments in Southeast Asia and other developing regions. Thus, this study serves as a valuable reference point for institutions seeking to align their operational practices with global sustainability agendas while considering local constraints and opportunities.

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