Low Carbon Awareness in UTHM Campus

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DOI: https://doi.org/10.30880/rmtb.2024.05.01.089

Abstract

Several ecological issues were brought by Malaysia's vast expansion, particularly the release of carbon dioxide (Co2). Total carbon emissions from vehicles in year 2023 counted to 291730.650 tones. This proves other causes contribute to carbon emission, such as carbon emission from vehicle smoke, although UTHM uses solar energy as an alternative to reducing carbon. This research explore is based on two objective which are to identify the level of awareness of low carbon practices in UTHM, Parit Raja campus and to recommend the concepts of Low Carbon practices in UTHM, Parit Raja campus. This research focused on the awareness of low carbon in UTHM campus. It also focuses on students and staff, which are 21,158 people, and the sample size is 379 respondents. Quantitative methods were used for data collection by distributing questionnaires to respondents. This study analysed the data using the computer intelligence Statistical Package for Social Science (SSPS) version 26. The data obtained was collected statistically. A descriptive statistical analysis of frequency distribution and mean score is required to determine the level of awareness among students and staff at UTHM campus. The result of the analysis of the level of awareness in environmental aspects is that the highest mean value of 4.06 is in the first place among the other three aspects. The research results for this low carbon practice recommendation show that using Sustainable vehicles has the highest mean value of 4.04 compared to the three low-carbon practices. In conclusion, this research help to increase the awareness to staff and students about low carbon by practicing low carbon practices towards campus sustainability.

1.   Introduction

This section describes the research background, problem statement, research questions, research objectives, research scope and significance of research.

1.1   Research Background

Malaysia has experienced significant economic development and growth due to industrial expansion and development in recent years. A high economic growth indicates a rapid industrial development indicating the use and demand of non-renewable energy is increasing. (Wu & Chen, 2017). Otherwise, There were several ecological issues brought on by Malaysia's expansive expansion, particularly the release of carbon dioxide (CO2). The

increase in state energy consumption, which increased by 210.7% between 1990 and 2004, was the primary source of the increase in carbon emissions (Safaai *et. al.*, 2011).

According to the report of the "International Energy Agency" (IEA), Malaysia's carbon emissions for the year 2011 were about 194 million tonnes, up almost (290.7%) from the year 1990 (Begum *et al.*, 2015). Studied the impact of wealth, population growth, and energy usage on CO2 emissions. (Alam *et al.* 2016). According to Shakya (2016), The impact of low-carbon development shows that it can reduce greenhouse gas emissions, local pollutant emissions and improve energy security. Hence, to better understand objectively where low carbon provides more benefits to ecosystem survival and human health. However, applying science will no doubt be an important component of these concerted actions. Reducing the impact of climate change involves a large part of the public's active cooperation in implementing mitigation strategies (Blake, 1999). Solving the climate change problem, often considered a challenge by politicians, scientists and engineers, also requires the active involvement of the public. Lastly, this research focusing on Low Carbon awareness among UTHM community.

1.2   Problem Statement

The community governance is looser than the low carbon industry parks. Many policies that have proven effective at the municipal and company levels, such as the target responsibility system (TRS), are difficult to implement at the community level (Liu, 2016). Concern over the issue is on the rise at the moment. This has considerably influenced how resources are used economically. Using optimization criteria has become more popular in recent years as a means of reducing the environmental consequences associated with the use of natural resources at all stages of the life cycle. Carbon emissions at UTHM are mostly caused by the burning of petroleum, which is the use of vehicles in the UTHM Area. Carbon dioxide is also caused by the release of smoke from vehicles.
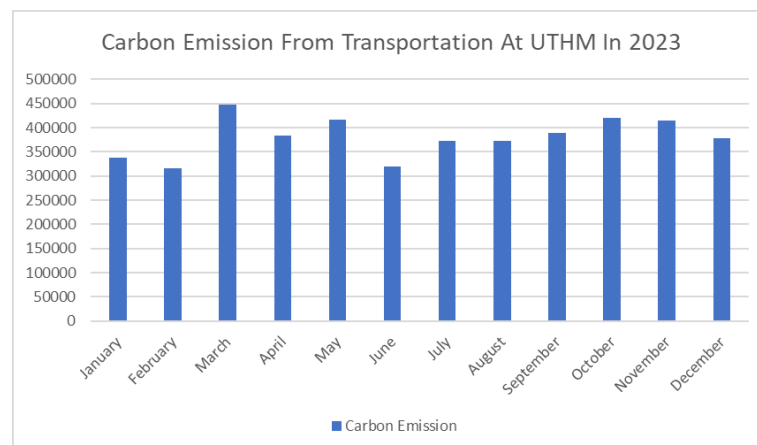
Fig 1 *Statistic carbon emission from transportation at UTHM in 2023 (source: sustainable campus, 2023)*

Based on Figure 1 shows the trend of carbon emissions from vehicles at UTHM in 2023 shows no consistency from January to December. Total carbon emissions from vehicles in 2023 amount to 291730.650 tones (Metro System Academy, 2023). Although UTHM uses solar energy in an effort to reduce carbon emissions, the burning of fossil fuels from vehicles is also a major problem in efforts to reduce carbon at UTHM.

From the problem statement that has been discussed, proved that excessive carbon emissions at UTHM are caused by several other causes such as from transportation sector by the UTHM community which can cause carbon emissions at UTHM. This shows that the level of awareness of low carbon by the UTHM community is still at a low level. This shows that there is a problem with the UTHM community that does not care about the increase in carbon dioxide (Neo *et al.*, 2016). When the awareness among the UTHM community decreases, the environmental initiatives held by UTHM are less well received among the UTHM community (Adzmi A. H., 2022). In addition, the one university in the Batu Pahat district where Tun Hussein Onn Malaysia University is located focuses on the low carbon city due to its density and is rapidly developing. But, Batu Pahat local authorities have embraced a contemporary low-carbon urban assessment methodology and system to transition the city to a low-carbon future. Awareness is regarded as the first stage of the learning process towards pro-environmental behaviour and is heavily impacted by various internal and external influences (Zsoka *et al.* 2013). Studying the awareness of the University Tun Hussein Onn Malaysia community about low carbon is an important step to reach the Universiti Tun Hussein Onn Malaysia

1.3   Research Question

This study aimed to address the following research question:

(i) What are the level of awareness of low carbon practices in UTHM campus?

(ii) How to recommend the concept of Low Carbon pratices in UTHM, Parit Raja campus?

1.4 Research Objective

The objectives of the research are:

(i) To identify the level of awareness of low carbon practices in UTHM, Parit Raja campus

(ii) To recommend the concepts of Low Carbon practices in UTHM, Parit Raja campus.

1.5 Research Scope

This research focused on assessing the level of low carbon awareness among students and staff. The study was conducted to address questions based on the research objectives. Emphasizing UTHM, the research aimed to align with MPBP's vision to transform Batu Pahat into one of the low carbon cities by 2030 (Astro Awani, 2019). UTHM was the only university in Bandar Penggaram, Batu Pahat, to fulfill both the Johor government's and MPBP's wishes (Astro Awani, 2019). The study conducted at UTHM involved a total of 21,158 people, including both students and staff. Researchers employed a quantitative approach and utilized a sample size of 379 people, following the guidelines provided by Krejcie and Morgan (1970). To collect data, a questionnaire was distributed, which was perceived by some as monotonous. The obtained data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, enabling the researchers to derive meaningful results from the study.

1.6 Significance of the research

The environment and human health are significantly impacted by carbon emission. Carbon dioxide (Co2) and other greenhouse gases are released into the atmosphere, which causes global warming and subsequent climate change. Limited research on awareness of low carbon in UTHM campus have been undertaken thus far. In this research, It will help to identify of awareness of low carbon in UTHM campus. The findings of this study will help UTHM in reducing and promote the carbon emission in the campus. The findings of this study also are expected to provide an approach to UTHM that increasing the level of awareness towards low carbon can provide good potential in practicing low carbon practices. In addition, it is hoped that this study can have a positive impact on the implementation of low carbon practices to the UTHM community. In addition, UTHM is also expected to be able to provide support and initiatives in efforts to reduce carbon emissions in the air, especially in the UTHM area. Apart from that, this research can raise awareness for UTHM to hold a campaign to reduce carbon and practice low carbon practices consistently to achieve UTHM towards sustainable campus.

2. Literature review

This section outlines the literature review pertinent to research's purpose.

2.1 Study definition

Table 1 *Definition of low carbon*

Object/Subject	Definition	Reference
	Low Carbon refers to that generates of greenhouse gases (GHG) only in amounts that nature can absorb, heralding a shift towards a simpler way of living that realises a higher quality of life in harmony with nature.	Abdul-Azeez, I. A. (2021)
Low Carbon	The global energy system is moving to a decarbonised system to minimise greenhouse gas (GHG) emissions and combat climate change.	United Nations (2015)

The World Bank's key areas of concentration are emission reduction potentials in energy efficiency, consumer management, renewable energy generation, and low-carbon transportation.	Ebinger (2009)
Low Carbon is one of the notions that evolved due to growing worry about global warming.	Muhammad Ernanda Pramadhika (2022)

Comparison of the object definitions utilised in this investigation is shown in Table 1. The definition is based on several journal articles. According to Abdul-Azeez, (2021), United Nations (2015), Ebinger (2009), and Muhammad Ernanda Pramadhika (2022), low Carbon is an initiative or effort to reduce carbon emissions in the air, which can harm the environment and life.

2.2 Low Carbon In Malaysia

Before the Paris Declaration, Malaysia's planned decrease in carbon emissions ranked 51st among countries in the projected climate change performance index until 2040. (Rasiah *et al.*, 2016). The serious issue of climate change has pushed the international community to explore long-term solutions to cut carbon emissions and alleviate the negative consequences of greenhouse gases. Climate change prompted Malaysia to develop the National Low Carbon Cities Masterplan to deal with climate change on a global scale and become a low-carbon country by 2050. As the primary carbon user, society is regarded to play a critical part in achieving the low carbon agenda by contributing to releasing Carbon into the environment through daily activities.

The Malaysian government has formulated many policies to reduce carbon emissions in line with rapid economic development and development. The policies that have been drafted have created various challenges in terms of socio-economics and the environment in the local area. In order to deal with the challenges that exist, the Malaysian Government has created various initiatives and efforts to deal with environmental issues and community awareness. The Malaysia Plan outlines Malaysia's commitment and efforts to become a sustainable, developed country. Malaysia's Post 2020 planning, the eleventh (RMK11), is based on environmental knowledge and practice. (Balkhis Norkhaidi, Mahat, Hashim, Nayan, Saleh Jabatan Geografi dan Alam Sekitar, *et al.*, 2017).

2.3 Low Carbon Awareness In Malaysia

Awareness and behaviour are the two strategies for raising community understanding of low carbon emissions. According to earlier research (Bai & Liu, 2013), local residents' actions could greatly impact low-carbon development. As a result of the proactive reaction to global climate challenges, more and more businesses are becoming aware of the need to reduce their carbon emissions, and their carbon reduction practises are progressively getting better (Peng *et al.*, 2022). However, there is still a significant disconnect between enterprise-wide awareness and behaviour, as well as discrepancies between awareness and behaviour (Wang & Wang, 2011).

A high level of awareness of low Carbon also requires a high level of knowledge. Knowledge of low Carbon is another crucial aspect of awareness. It is generally agreed upon that raising public awareness of the value of living a low-carbon lifestyle can increase low-carbon behavior and awareness (Bai & Liu, 2013). Various initiatives have been prepared to achieve a level of knowledge about low Carbon for the community. For example, This strategy for sustainability education has also been considered internationally to raise community knowledge of environmental protectionto address current global issues like climate change and global warming (Mahat *et al.*, 2017) Government and non-government organisations have carried out some initiatives, such as Low Carbon Schools, Green Schools, and Nature Schools in Malaysia (Shaharudin, Abdul Samad, & Ahmad Faiz, 2010). Numerous individuals believe that the most effective approach to address this issue is by altering the attitudes and everyday behaviors of society, shifting from a focus on self-interest (anthropocentric) to a focus on the environment (ecocentric) (Callicott, 2000). Laws and regulations play a crucial role in influencing the awareness levels when it comes to implementing environmental measures (Fischer, 2010). However, low-carbon behaviour is challenged when people lack knowledge of what, why and how to undertake a particular task (Goldblatt *et al.*, 2005).

2.4 Concept Of Low Carbon Practices

Low Carbon practises have emerged as a crucial pathway to mitigate greenhouse gas emissions and safeguard the health of our planet in the face of escalating global challenges brought on by climate change. Ecosystems and humans are inextricably linked in maintaining life and the environment's sustainability. Sustainability is the foundation for a country's goal of producing a sustainable or stable country in terms of economic, social, and political stability (United Nations, 2012). The formation according to Shaharudin (2013), A country's sustainable development should be the foundation of a post-carbon society. This sustainability effort can be demonstrated through global, national, institutional, and individual participation(Balkhis Norkhaidi, Mahat, Hashim, Nayan, Saleh Jabatan Geografi, *et al.*, 2017). Malaysia's ambition to become a sustainably developed country should be founded on environmental understanding and practice, as outlined in Malaysia Plan Eleventh (RMK11), Malaysia Post 2020 (Unit Perancang Ekonomi, 2015).

2.4.1 Use Renewable Energy

Vehicles with higher fuel efficiency and flawless hybrid vehicles are being produced due to technical improvement. Improvements are also required so that wind, solar, and hydrogen can become more valuable energy sources. One advantage of renewable energy supplies, such as wind and solar energy, is that they are constantly renewed and will never run out. The sun provides the majority of renewable energy, either directly or indirectly. Sunlight, or solar energy, can be utilised directly to heat and light homes and other buildings and generate electricity, hot water heating, solar cooling, and a range of commercial and industrial applications.

Renewable energy sources, such as solar and hydro, have little carbon content and are thus projected to contaminate the environment less than non-renewable energy sources (Adams & Acheampong, 2019). Bhattacharya et. al. (2017) said renewable energy significantly impacts economic growth and environmental quality for both developed and developing countries. It also helps generate growth and preserve the environment, contributing to long-term socioeconomic development (Astro Awani, 2023)

2.4.2 Energy Efficiency

Shi. A, (2001) and Li *et al.*, (2012) defined an economic activity's energy efficiency as the ratio of real GDP to energy usage in the country's currency per unit of energy use, i.e. GDP per capita divided by the total energy consumed. Using energy resources is required for human civilisation to function and progress. However, inefficient electricity consumption contributes greatly to climate change. Energy efficiency refers to efforts undertaken to reduce energy use, and it is currently one of the most prevalent issues in the energy market. It entails reducing energy use via a change in consumer behaviour, and the decrease in energy consumption can be achieved in conjunction with increased usage of energy-efficient products. (Oikonomou & colleagues, 2009).

Concerns about environmental issues such as climate change, greenhouse gases, global warming, and risks to biodiversity are driving increasing interest in energy conservation (Abrahamse *et al.*, 2005, Gardner & Stern, 2002). Malaysia's energy usage has been reported to expand faster than the country's economic development. According to the National Energy Balance (NEB), final energy consumption increased by 6.7% annually from 1971 to 2011 (NEB, 2012). Rising income necessitates a shift in the energy ladder from biomass to cleaner fuels like electricity.

2.4.3 Recycle

The increasing rate of progress does not immediately contribute to the increase in solid waste disposal and waste generation. According to Latif *et al.* (2012), human activities are the primary contributors to rubbish generation and addition in Malaysia. As a result, Latif *et al.* (2012) indicated that recycling is the best option for problem solutions and disposal of solid waste. Recycling, as defined by the Solid Waste Management Act And Public Proclamation 2007 (Act 672) (The Solid Waste Management Corporation and Public Cleaning, 2014), is the collection and separation of solid waste in order to produce output. This means no longer usable solid waste will be split into numerous sections before being transferred to a recycling centre to be processed into a new substance. Cans, plastic, paper, and glass are examples of recyclable solid waste.

Recycling is an alternate strategy that is becoming more popular as the world modernises. This is because recycling is the simplest method to implement daily, whether at home or work. Apart from recycling waste for the sake of sustainable development, numerous aspects of recycling can be implemented in the utilisation of original or current resources to avoid resource waste. Other characteristics include green area recycling, rain recycling, urban area recycling, and energy recycling (Lalbakhsh, 2012). The application of this feature can improve irrigation of green areas, weather, urban areas, and energy usage.

2.4.4   Use Sustainable Transportation

Low- and zero-emission, energy-efficient, and economical forms of transportation, such as electric and alternative-fuel cars, as well as indigenous fuels, are examples of sustainable transportation (Energy efficiency & renewable energy, 2023). Sustainable transportation planning is a comprehensive approach that considers the economic, social, and environmental effects of transportation networks. Its goal is to provide a transportation system that is accessible, efficient, safe, and ecologically responsible, all while promoting economic growth and improving quality of life.

Sustainable travel refers to the classification of the use of pedestrian transport, cycling, growing network public transport use, and vehicle sharing for flow or commuting to places of employment or educational aims that share the same direction (Norsyuhadah & Amiruddin, 2011). Sustainable transport networks are defined as sustainable and impactful transport systems that benefit the environment and socioecological systems (Bond & Steiner, 2006). Recent advancements in car-sharing technologies and the potential for self-driving vehicles highlight a much more sustainable use of automotive assets that could remove up to 90% of vehicles from the roads. This contributes to the continual technological advancement in engine and drive technology, which has resulted in lower vehicle emissions. This defies the transportation community's inclination towards emphasizing public transportation and non-motorized transportation as the major, if not single, method for sustainable transportation (Dr. Jean-Paul Rodrigue, 2017).

2.5   Research Gap

Table 2 *Research Gap*

No.	Author	Title	Method	Location /Country	Finding (research gap)
1	hudha *et al.*, (2020)	Low carbon education: a review and bibliometric analysis	quantitative	China and Malaysia	This study looks at how low-carbon education plays a role in increasing low-carbon awareness among students in developing countries
2	Hanifah *et al.*, (2020)	Transformation of education for sustainable development through low carbon schools community program	quantitative	Malaysia	low carbon school community can increase awareness and practices towards low carbon. Through education of sustainable development is successful transformed by the Low Carbon Schools community program so as to improve students' environmental literacy
3	Bai & Liu, (2013)	An exploration of residents' low-carbon awareness and behavior in Tianjin, China	Quantitative	China	The gap between attitude and awareness towards low carbon is huge. Therefore, this study identifies the cause of the

No	Author	Title	Method	Country	Findings
					problem that occurs
4	Chen & Taylor (2011)	Public Awareness and Performance Relating to the Implementation of a Low-Carbon Economy in China: A Case Study from Zhengzhou	Quantitative	China	The findings suggest that participants generally dis-play a high awareness towards LCE while their under-standing and knowledge of key issues is relative poorly developed, which is possibly derived from the lack of information
5	S. Moloney *et al* (2010)	Transitioning to low carbon communities—from behaviour change to systemic change: Lessons from Australia	Quantitative	Australia	Transitioning towards low carbon communities necessitates changing social practices along with the norms and values that influence and guide them.

In general, low Carbon needs to be achieved with low-carbon practices practised by the community. Based on Table 2 summarizes past studies on low-carbon practices listed in the reviewed articles. One low-carbon practice is the use of renewable energy. Adams & Acheampong (2019) and Bhattacharya *et al.* (2017) stated that using renewable energy can impact carbon reduction. Oikonomou and colleagues, (2009) and Abrahamse *et al.,* (2005) agreed that energy efficiency is the most efficient method for carbon reduction. Finally, using sustainable transport also plays an important role in reducing carbon emissions. This was confirmed by Latif et. al. (2012) and Norsyuhadah and Amiruddin (2011).

3. Research Methodology

This section describes the study's methodology.

3.1 Research Methodology Flow Chart

Based on Appendix A shows research methodology flowchart. In phase 1, the researcher determined the title through research background, problem statement, research questions, and research objectives. In phase 2, the researcher provided an overview of past research about awareness in Malaysia and the concept of low carbon practices. References were made through research by gathering information from books, newspaper clippings, articles, theses, journals, and the Internet. In phase 3, the research collected data through quantitative methods such as a survey form for primary data. Information about the literature review was collected through secondary data such as articles, journals, theses, reference books, newspapers, and the Internet. After collecting data, the researcher analyzed it using computer software, specifically the Statistical Package for Social Science (SPSS) software, which was employed to aid in the analytic process. This software statistically analyzed the collected data and could provide analytical results in graphs or pie charts, which were easier to interpret. In the last phase, the research concluded this study and provided recommendations.

3.2 Research Instruments

A quantitative was used to gather information about the level of awareness about low carbon among employees and students. This strategy is also used to promote the concept of low-carbon practices on the UTHM campus in the direction of campus sustainability. Students and staff from the UTHM campus filled out the questionnaire. This research also utilized descriptive study. The questionnaire is divided into three parts, A, B and C. Part A is more on the respondent's background, but Part B is about the research objective and part C is about recommendation and suggestion. The questionnaire structure it shows in Table 3 to fulfil the objective of this study.

Table 3 *Questionnaire structure*

Part	Description
Part A	Respondent background
Part B	Research Objective
Part C	Suggestion And Recommendation

As for sampling, the sample used is clustered sampling, which is selected based on the population crowd. Through this method, the researcher uses the location where the sample is first as a group. Accordingly, the respondents are staff and students at the UTHM Campus. The total number of staff and students is 2220 people. According to the sampling method by Krejcie and Morgan (1970), the total number of questionnaires to be obtained is as many as 377 people among students and staff. The total score for the questions in Part B is calculated using this Likert scale. The score is based on a scale of 1 to 5, with 1 indicating significant disagreement and 5 indicating strong agreement. Table 4 and 5 show score in scale and description.

Table 4 *Likert scale is used to measure the level of awareness*

Scale	1	2	3	4	5
Description	Very Low	Low	Medium	High	Very High

Table 5 *Likert scale is used to measure the concept of practices low carbon suitable to recommend*

Scale	1	2	3	4	5
Description	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3.3 Population and Sample

Respondents for this research were students and staff UTHM. Students and UTHM staff were chosen as respondents because universities are the primary channel for providing knowledge, skills, pure values, and the right actions in dealing with environmental issues to today's society (N. Hidayah *et al,* 2013; Hanifah *et al.*, 2015). As a result, it is critical and appropriate to conduct this research to learn more about low carbon awareness among students and staff. It is also a factor that determines the success of the UTHM campus.

As for sampling, the sample used is clustered sampling, which is selected based on the population crowd. Through this method, the researcher uses the location where the sample is first as a group. Accordingly, the respondents are staff and students at the UTHM Campus. The total number of staff and students is 21,158 people. According to the sampling method by Krejcie and Morgan (1970), the total number of questionnaires to be obtained is as many as 379 respondents among students and staff.

3.4 Data Analysis

Data analysis is the step at which the obtained data must be analyzed and evaluated. During this stage, data obtained and received from respondents via literature review and questionnaires that have been examined and studied will be compiled and analyzed using acceptable procedures. It attempts to make it easier to hold discussions, draw conclusions, and provide good ideas about the topic under consideration. Data analysis of pertinent information was performed to meet the research's objectives. As a result, computer software, specifically the statistical package for social science (SPSS) software, will be employed to aid in the analytic

process. This software statistically analyses the collected data. It can also provide analytical results in graphs or pie charts, which are easier to interpret.

There are many interpretations for this questionnaire response in this study. The question in part B and Part C is a Likert-scale pattern is rated on a variable depending on the level of agreement shown by respondent who complete the surveys. It may be done by calculating the frequency and percentage and the mean and mean average of the response to the questions. To determine the variable examined in this study, the guidelines of the mean score have been fixed, as shown in Table 6 and Table 7 shows the level of agreement based on the mean index range. If the value is between 3.80-5.00 it shows high interpretation while between 1.00-2.49 shows low interpretation.

Table 6 *Scale and average index (souce: Majid & McCaffer, 1997)*

	Likert Scale	Average Index
Strongly Low	1	$0.00 \leq mean \geq 1.50$
Low	2	$1.50 \leq mean \geq 2.50$
Medium	3	$2.50 \leq mean \geq 3.50$
High	4	$3.50 \leq mean \geq 4.50$
Strongly High	5	$4.50 \leq mean \geq 5.00$

Table 7 *Central Of Tendency (source: Tasmin & Woods, 2008)*

Index Average	Scale
1.00-2.00	Low
2.34-3.67	Medium
3.68-5.00	High

4. Data Analysis and Discussion

This chapter encompasses the analysis of the findings derived from this study.

4.1 Reliability Test

Based on the questionnaire survey, the researcher employed Cronbach's Alpha (α) as a reliability test. Reliability testing assesses how consistently a measurement instrument gauges the concept it intends to measure. On the other hand, validity testing assesses how well an instrument, originally developed for a specific concept, accurately measures that concept.

Table 8 *Cronbach's Alpha Classification (source: George & Mallery, 2003)*

Cronbach Alpha	Internal Consistency
α > 0.9	Excellent
0.80-0.89	Good
0.70-0.79	Acceptable
0.60-0.69	Questionable
0.50-0.59	Poor
α < 0.50	Unacceptable

According to Table 8, the Cronbach's Alpha coefficient is utilized to evaluate the internal consistency among measurement items within a construct. In this context, alpha values above 0.6 are considered satisfactory for a relatively new measurement instrument, while values above 0.7 are deemed sufficient. An alpha value exceeding 0.70 signifies that the scales are internally consistent (Bernardi, 1994) and indicates the reliability of the measurements. Conversely, if the Cronbach's Alpha score is less than 0.6, it suggests potential issues with the clarity of questions or redundancies. In such cases, questions that do not meet the satisfactory level should be

restructured or eliminated to ensure instrument reliability. This testing was carried out during both the pilot test and the actual research to confirm that the survey questionnaires were at a satisfactory level of reliability.

4.2 Pilot Test

Table 9 *Pilot Test*

Cronbach's Alpha	N-Respondent	N of Items
0.955	30	27

The researcher conducted a pilot test to assess the reliability of the study. According to the data presented in Table 8, the Cronbach's Alpha coefficient stands at 0.804. The survey was administered to 30 participants, and it consisted of 27 questions. The reliability of the questionnaire items was evaluated based on this coefficient, and it was determined that they were of high quality and met acceptable standards. The Cronbach's Alpha value was 0.955, indicating strong reliability and consistency in the measurement items used in this study. Consequently, this research suggests that the questionnaire items are reliable and consistent in their measurement.

4.3 Response Rate

Table 10 *Questionnaire response rate*

Sample Size	Number of questionnaires distributed	Returned (Valid)	Response Rate (%)
379	189	189	50

Table 10 demonstrates that the researcher effectively administered 189 questionnaires to both students and staff at UTHM. The sample size for this study consisted of 341 respondents. These questionnaires were distributed using Google Forms, and out of them, 189 were completed and considered valid. Consequently, the response rate for this survey stands at 50%. According to Cleave (2022), looking at research on survey distribution methods, the average response rate of online surveys is currently around 30%. This statement is supported by Chung (2022) in which a good survey response rate is between 5% to 30%. A very good response rate is 50% or higher. To address the issue of lack of representativeness, Brick and Kalton (1996) propose a method of adjusting the study sample segments through weighting to better align with the broader population characteristics. However, the researcher was unable to obtain responses from 379 potential respondents due to a lack of cooperation and responsiveness.

4.4 Respondent Background

This survey was administered to individuals affiliated with UTHM, specifically staff and students at the Parit Raja campus, utilizing the Google Form platform through online digital survey channels such as Email and WhatsApp. A total of 341 questionnaire sets were disseminated, and a response rate of 50%, equivalent to 189 completed responses, was obtained from the respondent. According to Cleave (2022), looking at research on survey distribution methods, the average response rate of online surveys is currently around 30%. This statement is supported by Chung (2022) in which a good survey response rate is between 5% to 30%. A very good response rate is 50% or higher.

The entire background of the respondents includes gender, age, level of Education and level of residency as shown in Table 11. Based on table 10, it can be seen that men are more dominant in this study which is 108 equal to 52.14%. Next, as many as 32.8% or 62 respondents of them are respondents aged 20-30 years which is the largest number who gave feedback. In addition, respondents with an education level from the degree group recorded the highest percentage of 80 respondent equal to 42.3%. Based on Table 12 demonstrated the residency level of respondent are primarily student, with 133 respondent (70.37%). Next, the staff composed with 56 respondent (29.6%). Hence, the result show that the majority for residency level from the student because majority in UTHM are student.

Table 11 *Respondent Background Analysis*

Characteristics		Frequency	Percentage (%)
Gender	Male	108	57.14
	Female	81	42.86
Age	20-30 years old	62	32.8
	31-40 years old	24	12.7
	41-50 years old	12	6.3
	51-60 years old	43	22.8
	61 years old and above	48	25.4
Education Level	Diploma	30	15.9
	Degree	80	42.3
	Master	53	28.0
	PhD	26	13.8
Residency Level	Staff	56	29.6
	Student	133	70.4

Table 12 *Frequency of level residency*

Residency Level	Frequency	Percentage
Staff	56	29.6
Student	133	70.4

4.5 Level of low carbon awareness in UTHM campus, Parit Raja Analysis

Table 13 *Level of low carbon awareness in UTHM campus, Parit Raja analysis*

Bil	Description	Mean	Scale
B1	Social Aspect		
a.	Sustainable development education is effective in increasing low carbon awareness.	3.95	High
b.	Acquiring knowledge is important in conveying awareness of low carbon practices through the education sector.	3.98	High
c.	Living a low-carbon lifestyle can increase low-carbon behaviour and awareness	3.97	High
d.	Following a low carbon program whether formal or informal.	3.93	High
	Total Average Mean Score	3.95	High
B2	Environment Aspect		
a.	Knowing the effects and causes of carbon emissions.	4.15	High
b.	The existence of continuous and comprehensive environmental education	3.96	High
c.	Public involvement influences decisions related to government plans, policies or actions	4.07	High
	Total Average Mean Score	4.06	High
B3	Legislation Aspect		
a.	Support and initiatives from the government are essential to promote low carbon practices	4.08	High
b.	Provide a plan to be used as a guide towards low carbon	4.01	High
c.	Manage and use natural resources sustainably	4.00	High
	Total Average Mean Score	4.03	High

Based on Table 13, the highest mean value is item (B1. B.) which is 3.98. This shows that the respondents achieved a high level of awareness with the statement that acquiring knowledge is important in conveying awareness of low carbon practices through the education sector. The researcher define that these education sector can solve various problem based on increasing gas emission by using knowledge of science and technology from the point of view of everyday life to achieve a low carbon society. Low carbon practices in education sector is a teaching pattern based on energy saving, low energy consumption, and low energy awareness (Li & Yao, 2014). Item (B1. C.) gives the second highest mean value which is at a value of 3.97 where respondents show a high awareness of the following statement which is living a low-carbon lifestyle can increase low-carbon behavior and awareness. The researcher define that the daily activity of the society towards environment could define out the concern of the on protecting the environment is high or low this is because the concern of the society will contribute the low carbon. Behavior, way of life, and societal norms significantly impact energy consumption and the resulting emissions. Implementing changes such as stabilizing or reducing consumption, transitioning to a sharing-based economy, and embracing other shifts in behavior offer substantial potential for mitigating these impacts (Edenhofer *et al.*, 2014).

While (B2. A.) ranked first highest in the environmental aspects section at a value of 4.15. This shows that the level of awareness of the statement knowing the effects and causes of carbon emissions is high. Therefore, Internal variables refer to the factors that impact or mold an individual's mental processes, including their consciousness, understanding, beliefs, attitudes, actions, logical thinking, emotional conditions, and deeply ingrained routines. These factors can differ among individuals and can also change within a person based on their life stage and the circumstances they are in (Moloney *et. al.*, 2010). Meanwhile, the second highest mean value is item (B2. C.) which is 4.07. This shows that respondents achieve a high level of awareness of the statement of public involvement influences decisions related to government plans, policies or actions. It becomes clear that a state need given the widely recognized climate crisis and the necessity for a significant shift in society, it is apparent that public involvement can be regarded as a crucial factor in achieving the transformation of communities toward climate resilience and carbon neutrality through local and regional decision-making (Burton, P., & Mustelin, J., 2013). Therefore, the researcher gets to identify through this factor on how much the public involvement put effort in helping to give decision to government to make plan, policies, or actions. Item (B3. A.) shows the highest mean value of 4.08. This shows that the respondents achieved a high level of awareness through the statement of support and initiatives from the government are essential to promote low carbon practices. Therefore, it is imperative for the government to take an active role in providing incentives for low-carbon practices. For instance, encouraging educational institutions to participate in a community-driven movement focusing on management, curriculum development, facilities planning, and eco-friendly practices can be an effective strategy (Hanifah *et al.*,2020). These actions could also contribute to raising awareness in society about low-carbon practices. Therefore, the average mean value for the environmental aspect variable shows the highest value of 4.06 compared to other variables. In the majority, all items have a high mean value tendency. Therefore, the results from the data analysis can show that most respondents achieved a high level of awareness with the items that have been stated by the researcher.

4.6   Analysis of suggestion from respondent on ways to identify level of low carbon awareness in UTHM campus, Parit Raja

Table 14 *Suggestion from respondent on ways to identify level of awareness in UTHM campus, Parit Raja*

No.	Suggestion
B1	Social Aspect
a.	Campaigns
b.	Outdoor Program
c.	Seminars
B2	Environment Aspect
a.	Reduce the use of own vehicle on campus

Based on Table 14, respondents have offered numerous suggestions that can aid in gauging the extent of low-carbon awareness among students and staff. In terms of social aspects, a significant number of respondents propose activities such as campaigns, outdoor programs, and seminars that educate society on implementing low-carbon practices. Evaluating the effectiveness of programs like the low-carbon awareness campaign becomes crucial in ensuring that students understand the benefits of adopting environmentally friendly practices, ultimately inspiring them to embrace eco-conscious behaviors. Furthermore, it is imperative for the government

to introduce impactful initiatives for promoting environmental education, particularly within university settings. Including courses related to low-carbon practices in the university curriculum is essential to enhance students' knowledge. In addition, conducting community programs in close proximity to the UTHM campus is vital. These programs should focus on creating awareness within the community regarding the advantages of adopting low-carbon practices. Moreover, the degree of low-carbon awareness among UTHM students and staff can be ascertained by monitoring the volume of waste generated. Observing the quantity of garbage produced serves as a tangible indicator of the effectiveness of awareness programs and the adoption of low-carbon practices in the university environment. For environment aspect, there are several suggestions on identify the level of low carbon awareness among student and staff. For example, reduce the use of own vehicles on campus. The researcher can use these suggestions to identify whether the level of awareness of student and staff is high or low by referring to the usage of vehicle.

4.7 Recommend the concept of low carbon practices in UTHM campus, Parit Raja analysis

Table 15 *Recommended the concept of low carbon practices in UTHM campus, Parit Raja*

No.	Description	Mean	Level Of Agreement
C1	Using Renewable Energy		
a.	Encourage the use of solar, wind and thermal energy	4.07	High
b.	Encourage the use of solar energy in every building	3.97	High
c.	Establish a green fund or sustainability fund that can be used to invest in renewable energy projects on campus.	3.97	High
d.	Use renewable energy comprehensively	3.99	High
Total Average Mean Score		4.00	High
C2	Using Energy Efficiently		
a.	Changes in society behavior in energy use.	4.00	High
b.	Using an energy-saving control system.	3.98	High
c.	Use energy efficient electrical items	3.93	High
d.	Provide a good air inlet and outlet system	3.87	High
e.	Upgrade the roof system and thermal insulation of the building	3.94	High
Total Average Mean Score		3.95	High
C3	Recycle		
a.	Reward those who do recycling activities	4.04	High
b.	Increase recycling bins	3.97	High
c.	Organize an effective campaign through time and physical media	4.04	High
d.	Using available resources without involving waste such as rain harvesting	3.94	High
Total Average Mean Score		3.90	High
C4	Using sustainable transportation		
a.	Carpool	4.05	High
b.	Use the bus as transportation	4.01	High
c.	Providing hybrid transportation such as hybrid buses	4.08	High
d.	Increasing transportation facilities that do not use fossil fuels such as bicycles and electric scooters	4.04	High
Total Average Mean Score		4.04	High

Based on Table 15, the highest mean value is item (C1. A.) which is 4.07. This shows that respondents agree with the statement that encourage the use of solar, wind and thermal energy. The researcher indicates that the use of solar, wind and thermal energy can help to reduce carbon dioxide while significantly reduce initial investment costs, making solar, wind and thermal energy a viable and economically prudent option in the long term. It also helps generate growth and preserve the environment, contributing to long-term socioeconomic development (Haikal Raman, 2023). Item (C1. D.) gives the second highest mean value which is at a value of 3.99. Respondents expressed their agreement to the following statement which is to provide a good air inlet and outlet

system. The study underscores the limited nature of natural resources, emphasizing the necessity to employ them judiciously for increased cost savings and efficiency, ultimately reducing carbon dioxide emissions. The impact of renewable energy on both economic progress and environmental quality is markedly significant (Bhattacharya *et. al*, 2017). Whereas, item (C2. A.) shows the highest mean value of 4.00. Respondents agreed with the statement that changes in society behavior in energy use can increase the efficient use of energy. This is because the concern of society in energy use should prove it by the action so that it could help to identify awareness of society of how much important of their behaviour to reduce the use of energy. The societal concern has not only resulted in protests but frequently prompted altered behaviors (Brundtland, 1987). In addition, the second highest mean value is item (C2. B) which is 3.98. At this value, respondents agree that using an energy-saving control system can increase energy consumption efficiently. It is important to use energy-saving control system facilitates the identification of inefficiencies in each unit, be it direct or indirect. Therefore, occupancy sensing-based energy-saving systems typically demonstrate 17–60% energy savings depending on occupant usage patterns (Von Neida *et. al*., 2001).

The mean value of items (C3. A.) and (C3. C.) shows the highest which is 4.04. This shows that respondents agree with the statement that reward those who do recycling activities and organize an effective campaign through time and physical media can give awareness to the importance of recycling. This is because the reward can give motivation and awareness to society to do recycle activities with consistency. Additionally, implementing a reward system for individuals can encourage them to participate in recycling by earning points (Satta Sarmah, 2013). In addition, the second highest mean value for item (C3. B.) of 3.97. Respondents expressed agreement with the following statement that increasing recycling bins can increase awareness of the importance of recycling. For example, The addition of recycling bins in each building can provide facilities for students or staff to recycle trash and can also provide knowledge to students and staff. Recycling waste materials lowers these expenses since it minimizes pollution and lowers the need for fresh resources like wood to manufacture paper, gasoline to make plastic, and so on (EPA, 2009). In the meantime, the high mean value is item (C4. C.) which is 4.08. This shows that respondents agree with the statement that providing hybrid transportation such as hybrid buses can reduce carbon emissions. Hybrid electric vehicles (HEVs) provide an energy-efficient alternative by integrating an electric motor-driven system with the traditional internal combustion engine (ICE). This combination aims to minimize both fuel consumption and emissions from the vehicle (I. Husain,2003). Finally, the second highest value is item (C4. A.) which is 4.05. This shows that the respondents agree with the statement that has been made that carpool can reduce carbon emissions in the air. Furthermore, participating in carpooling can lead to savings on fuel expenses and contribute to alleviating traffic congestion. It proves to be a compelling transportation practice for both individuals and businesses, as it has the potential to lower transportation expenses and directly impact the reduction of CO2 emissions (Bruck *et al.*, 2017) Next, the average mean value for the practice of using sustainable transport is higher which is 4.04 compared to other low carbon practices. The results of the data analysis show that the level of agreement of the respondents is at a high level, that is, there are items that have been stated by the researcher, all of which are agreed by the respondents.

4.8 Analysis of suggestion from respondent on the concept of low carbon practices in UTHM campus, Parit Raja.

Table 16 *Suggestion from respondent on the concept of low carbon practices in UTHM campus, Parit Raja*

No.	Suggestion
C1	Using Sustainable Transportation
a.	Use public transport
b.	Provide electric scooter
B2	Renewable Energy
a.	Use energy solar

Based on Table 16, the respondent has provided a lot of concept of low carbon practices that could help to reduce carbon in UTHM campus, Parit Raja. For using sustainable transportation most of the respondent suggest that encourage use public transport. The use of public vehicles such as buses, text or e-hailing can reduce the emission of smoke in the air containing carbon dioxide gas. The university must play an important role in providing many buses to accommodate the number of students and staff. Besides, university should provide electric scooter as sustainable transportation. The university can strengthen law to the staff and student where they should use scooter at certain time. The self-awareness of an individual should also high so that could help the growth of the use of sustainable transportation. For use renewable energy, there are several suggestions on

the concept of low carbon practices in UTHM campus. For example, apply a car park covered with solar panels throughout each faculty.

5.   Conclusion And Recommendations

This section explains the summary and conclusion of the research findings that have been carried out.

5.1   Conclusion of the study

In conclusion, this study has achieved the objectives that have been set.

(a) Objective 1: To identify the level of awareness of low carbon in UTHM, Parit Raja campus

Table 17 records 3 aspects that influence the level of low carbon awareness at UTHM, Parit Raja campus among students and staff. Arithmetic mean analysis shows that the findings collected from student and staff respondents can find out that the highest aspect ranking is the environmental aspect, followed by the legislation aspect and the social aspect that can contribute to the level of low carbon awareness in the UTHM campus.

Table 17 *Aspect influencing the level of low carbon awareness at UTHM, Parit Raja*

Aspect	Ranking
Environment	1
Legislation	2
Social	3

(b) Objective 2: To recommend the concepts of Low Carbon practices in UTHM, Parit Raja campus.

Table 18 records the 4 low carbon practice concepts that have the highest mean value. Arithmetic mean analysis shows that the findings collected from student and staff respondents can find out that the highest low-carbon practices are sustainable transportation, using renewable energy, using efficient energy and recycling that are able to reduce carbon emissions at UTHM.

Table 18 *The concept of low carbon practices at UTHM, Parit Raja campus.*

Concept Of Low Carbon Practices	Ranking
Using sustainable transportation	1
Using Renewable Energy	2
Using energy efficiently	3
Recycle	4

5.2   Research Limitations

Throughout the research process, both objectives were successfully achieved. Nevertheless, the researcher encountered several limitations. Firstly, due to time constraints, the sample distribution among UTHM students and staff was not completed at a 100% rate. Secondly, the research method relied on self-reported answers from respondents in the questionnaire, potentially introducing self-biased perceptions and resulting in slight inaccuracies in the research results. Lastly, the limited number of respondents from the targeted research area may lead to sampling errors, as the sample may not adequately represent the entire population.

5.3   Recommendation and suggestions

The research results propose several key recommendations for future investigations at Universiti Tun Hussein Onn Malaysia (UTHM) regarding awareness and implementation of low carbon practices among students and staff. Primarily, there is a suggestion for detailed studies focusing on specific elements that could elevate awareness levels concerning low carbon initiatives, with the goal of shaping the future of sustainable practices within the university community. Additionally, the research advocates exploring enhanced methods and approaches to effectively assess the existing awareness levels of low carbon practices among students and staff, involving the development of targeted tools for a nuanced understanding.

Acknowledgement

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design:** Hilman Hafiz Afandi Fikri, Mohd Hilmi Izwan Abd Rahim; **data collection:** Hilman Hafiz Afandi Fikri; **analysis and interpretation of results:** Hilman Hafiz Afandi Fikri; **draft manuscript preparation:** Hilman Hafiz Afandi Fikri, Mohd Hilmi Izwan Abd Rahim. All authors reviewed the results and approved the final version of the manuscript.*

Appendix A: Research Methodology Flow Chart
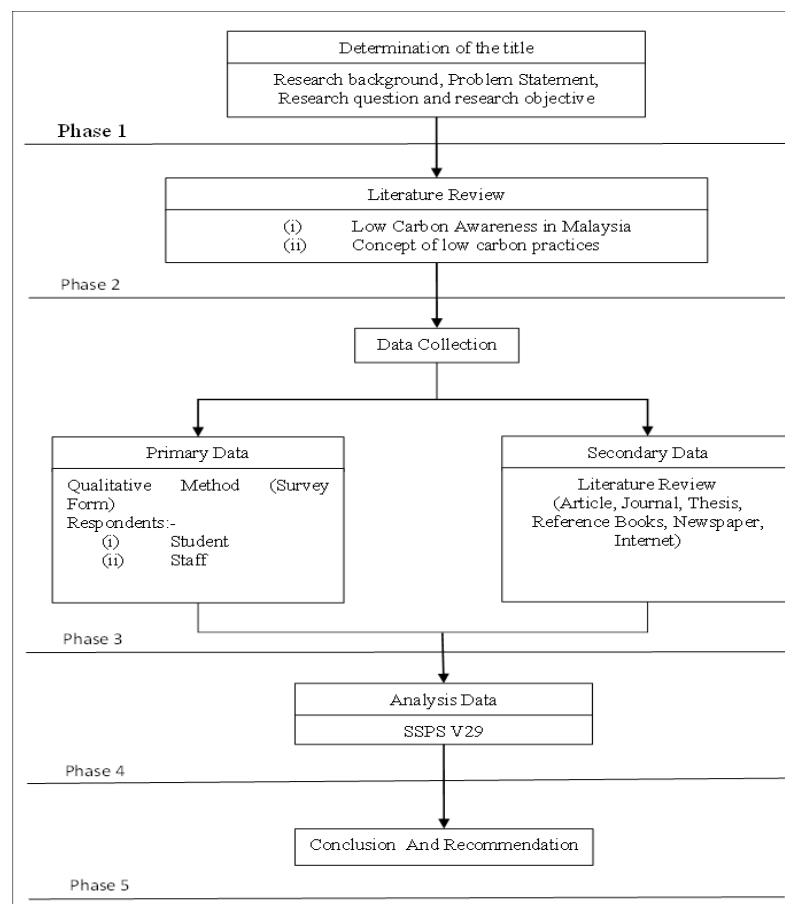
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