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Understanding University Students' Perceptions and Attitudes towards Low Carbon Initiatives in the Context of Climate Change: A Malaysian Perspective

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Abstract

Climate change has a wide range of impacts on various aspects of human life and the environment. The main driver of climate change is caused by increases in greenhouse gases due to anthropogenic activities. Some of those activities that contribute to these issues come from lack of awareness to practice a low-carbon lifestyle. Therefore, by using a conventional survey, a study has been conducted regarding the level of environmental awareness and the adoption of low-carbon practices among 225 private university college students in southern part of Malaysia. By becoming aware of the essential role that the younger generations play in shaping the future, it is important to know the current state of environmental awareness among university college students and suggest an effective strategy for them to enhance their commitment to promote and practice low carbon lifestyle. Hence, by referring to existing literature, survey data, and successful case studies, this paper aims to contribute to the growing body of knowledge on sustainable behavior and uplift the universities to play a crucial role in fostering environmentally responsible citizens.

Keywords: Climate Change, Low Carbon, Malaysia, Sustainability, University Students.

Introduction

Climate change is defined as long-term variations in local, global, or regional temperature and weather caused by anthropogenic activity. For thousands of years, the link between life forms and weather has been delicately balanced, allowing all life forms to exist on this planet (1). This balance has steadily changed since the industrial revolution, with the change becoming noticeable in the middle of the twentieth century. It has now emerged as a significant threat to human well-being and biodiversity sustainability (1). Global climate change has quickly grown into one of humanity's most significant environmental issues (2). For instance, global warming has already led to a 1°C temperature increase. This warming is producing a wide range of effects. Heat waves, for example, are getting more intense and impacting humans and animals; rivers in certain areas are flooding more frequently as a result of heavy rainfall; and droughts in other regions of the world are affecting agriculture (3). Climate change is defined as long-term changes in environmental temperature, precipitation, atmospheric pressure, and humidity (4). As a result, these changes significantly impact existing agricultural cropping systems, productivity, and food security for people regionally and Worldwide (5).

Malaysia could be considered a haven from climatic disasters. However, moderate climate-related disasters have become increasingly common in recent years. Climate change in Malaysia could lead to sea level rise, decreased crop yields, increased diseases among forest species, biodiversity loss, coastline erosion, increased flood intensity, and coral bleaching (6). Not only that, but the past study also stated that climate change not only affected the ecosystem of the community but also the sustainability of tourism industry (7). Climate change has disrupted the supply and demand for tourism services, compromising environmental quality and management. This highlights the necessity for

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appropriate climate policy for tourism sites (8). Besides that, Malaysia is the fourth greatest producer of greenhouse gases in ASEAN, after Indonesia, Vietnam, and Thailand. It accounts for 0.52% of global carbon emissions (6). To solve this problem, all parties should prioritize addressing these concerns to protect the human environment by it.

Despite growing awareness of climate change and its impacts, there is a notable gap in research that specifically examines the perspectives and engagement of Malaysian university students in low-carbon initiatives and climate change mitigation. To address climate change, it is crucial for governments, NGOs, and the general public, particularly universities, to increase awareness about its causes. Universities should motivate their staff and students to engage with climate change issues, empowering them to become proactive contributors in advancing research and developing strategies for mitigation and adaptation (9). Universities play a crucial role in educating and empowering future leaders, and still little is known about how Malaysian students perceive climate change and their willingness to participate in efforts to address it. This study aims to fill this gap by investigating Malaysian university students' attitudes, behaviors, and involvement in low-carbon practices, highlighting the need for targeted strategies to increase awareness and action among this influential demographic.

By exploring student engagement with climate issues, this research will contribute to a deeper understanding of how universities can enhance their role in fostering a proactive, climate-conscious generation, and align with national and global efforts to mitigate the effects of climate change. This paper investigates into the current level of environmental awareness among university college students in southern state of Malaysia and proposes strategies to promote and practice low carbon lifestyle on campuses. Climate change mitigation is a hotly debated topic around the world. Based on a report published by the European Commission and the European Parliament in 2008, climate change is regarded as the world's second most significant problem. As a result, it is vital to increase public understanding of climate change (10). Malaysia has set an ambitious promise to reduce the intensity of its carbon emissions, specifically by 40% (compared to 2005 levels) by 2020 and 45% (compared to 2005 levels) by 2030 (11). In order for Malaysia to achieve this goal, raising community awareness is crucial for developing effective adaptation strategies. A study conducted among younger generations in Germany has showed a result that participants who are aware of climate change have a higher probability of following a climate-friendly diet, while, surprisingly, the undecided group is much closer to the climate deniers in their attitudes and dietary patterns (10). Hence this paper is deemed necessary to get young generations to live a low-carbon lifestyle, which will lead to a better nation to combat climate change challenges currently, and in the future.

This paper sets out to propose what could be done to increase awareness on climate change among the university students. The present study wanted to present the theoretical foundation regarding university students' perception of climate change; evaluate the current level of awareness about climate change among university students; analyze the factors influencing their perception of climate change; and suggesting various methods to enhance climate change awareness. These debates indicate that universities should support climate change education further than current measures, focusing on a collaborative effort with selected stakeholders toward climate change issues. Hence, this approach is trying to make sure students understand the larger and more profound challenges around the issue.

Anthropogenic Causes of Climate Change

Climate change is already affecting and will in the future affect a number of areas of concern related to human life and well-being, from food and water supply to the production and consumption of energy. It is said that human health will be eliminated and there will be the worst effect of climate change conditions and in spread of diseases (12). Socio-economic structures will be threatened, since climate change can impair poverty and regional disparities by causing changes in livelihoods and raising the costs of living. Furthermore, lives can change and adapt to something new, such as the environment and the pressure from which resources are little.

Governance and Political Stability Climate-induced stresses can cause conflicts over resources and force governments to manage increasing numbers

of more intense natural disasters, undermining governance and political stability. Climate change can also disrupt international trade by harming infrastructure, changing agricultural productivity and shifting the availability of goods. Migration flows will move away from the most affected to the less affected areas (13), with major implications for future levels of urbanization and potential social tensions in receiving areas.

Changes in temperature and rainfall over extended periods like air pressure and moisture levels play a significant role in shaping climate change (14). These elements have the potential to influence weather patterns resulting in increased weather occurrences, rising sea levels and shifts in ecosystems and biodiversity. It is essential to comprehend and address these effects to protect both communities and the environment. With that being said, the most prominent domestic and worldwide repercussions of climate change include the rise in sea level, the shrinking of global ice sheets, and irregular weather patterns (14). Although the atmosphere can be warmed by natural events like sun or volcanic eruptions, it is essential to acknowledge that people's action is causing even more significant changes in weather patterns which in turn affect our lives in various ways (15).

Besides that, greenhouse gases from anthropogenic activities including motorized transportation, industrialization, and mechanized agriculture are the primary causes of climate change and biodiversity loss. Natural, economic, and human resources are under tremendous strain due to the world's population growth, which has also led to an increase in demand for products and services (15). Based on research that has been conducted by World Health Organization in 2019, about 13,000,000 human deaths are linked to climate change environmental hazards which may have been avoided. These human activities are directly or indirectly causing climate changes leading to modified atmospheric composition (16). Therefore, understanding of theoretical climate change framework is important for comprehending its environmental impact.

Lack of Awareness about Climate Change among Universities Students

World Health Organization (WHO) mentioned that climate change is the biggest threat to global health in the 21st century. People fear climate change because of shortage of food and water, increased floods and heat waves, higher rates of diseases and financial losses (17). To address this issue, it is important to spread awareness about the environment to the students. Environmental awareness is a measure of students' knowledge, attitudes, behaviors, and problem-solving skills related to the environment (18).

For instance, a study has been done in Vietnam whereby young people especially students, have become increasingly aware of their role in facing this problem in recent years (19). Based on the previous study, it shows that the generation of Vietnamese students, have partly realized that this natural threat comes from their ignorance and indifference towards the environment with the knowledge obtained from teachers as well as through updating news or researching articles inside and abroad (20).

Besides that, there is 55.3% of respondents equivalent to 467 sample in Malaysia from three main groups which are university students, public and government servants are not aware towards the impact of climate change (17). It shown that the level of awareness and behavior among the respondents was also weak and fragile even though Malaysian government has promoted its initiatives and policy about climate change. Thus, environmental education is essential as an effort to create awareness among the students and a part of climate change prevention and mitigation (21).

Hence, the studies strongly suggest that it is crucial to introduce an initiative focused on climate change that is strategically incorporated across sectors such as schools, universities, industries and communities. There is a pressing need for relevant initiatives to inform people about the consequences of climate change on the ecosystem, economy and public health (19, 21). To achieve this goal universities could offer videos and discussions highlighting the impact of climate change on nature and human wellbeing. Additionally, both government entities and non-governmental organizations should conduct awareness campaigns and educational initiatives to enhance knowledge about climate change.

Role of Higher Institutions

In Malaysia, climate change's impact especially in coastal areas such as sea level rise causes coastal flooding and the sinking of lower-level coastal area, saltwater intrusion and inundation (22). This

issue led to major concern among coastal communities in peninsular Malaysia as it threatened socio-economic livelihood, health and safety (22). To overcome this problem, the role of universities in contributing generally to sustainable development and in particular to climate change adaptation and mitigation is needed (9).

Sustainable development has emerged as a prominent area of study that explains the roles and responsibilities that universities should play in society (23). Many people believe that universities may play a significant role in lowering carbon emissions by lowering their own emissions through campus greening, working with other local actors to reduce emissions, and increasing community awareness through interventions (9). Integration of climate change with instructional strategies and informed decision making are important to response about global warming (24). Thus, higher education institutions (HEIs) and universities should play a crucial part in people's education on climate change.

For several reasons, universities should carry the responsibility to teach their students about sustainable education because they have the obligation to offer their students a well-rounded education that equip them for future challenges (25). A sustainable future is guaranteed by educating and encouraging students to be informed about climate change. Students at universities could create technology and policies to assert social changes. Hence, is it important to make sure they are well acknowledged and skilled about climate change because students are more equipped to positively impact society and the environment if they receive instruction in sustainable behaviors and ethical consumption.

As we are aware, the main reason for climate change is from human action. For that reason, many studies have mentioned that the future generations are responsible for shaping the world as we are living today, especially the students to be in alert mode towards environmental pollution (9, 17, 24). In summary, since universities educate younger generations, higher education also has an important role in shaping the future leaders in many different areas. These young generations are also playing prominent role among a growing group that be acquainted with the need to defend environmental issues among homes, businesses, and even cities they lived in.

Conceptual Framework

The diagram (Figure 1) illustrates the interconnectedness between climate change issues and the role of higher education at the university level in addressing these challenges. It highlights two primary concerns related to climate change.

Anthropogenic Causes of Climate Change refers to the human activities contributing to climate change, such as greenhouse gas emissions from burning fossil fuels, deforestation, and industrial processes. Universities play a crucial role in educating students about these causes, promoting research on mitigation strategies, and developing innovative solutions to reduce human impact on the environment.

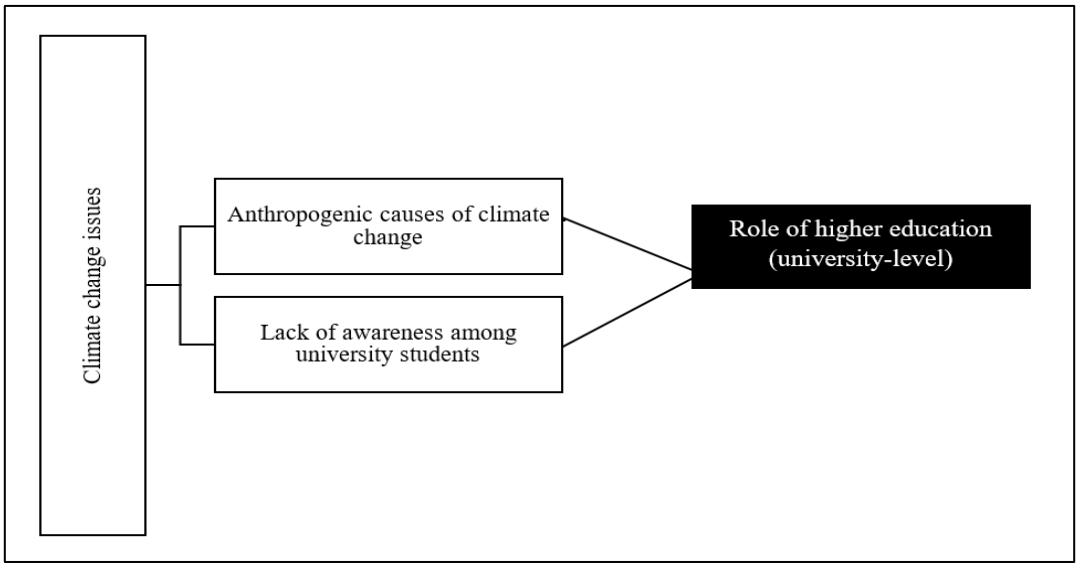

Figure 1: Conceptual Framework for the Research Project

Lack of Awareness among University Students signifies the insufficient understanding and knowledge about climate change issues among students. Universities are in a unique position to bridge this gap by incorporating climate change education into their curricula, organizing awareness campaigns, and encouraging active participation in climate-related events and initiatives.

By addressing these two concerns, universities can effectively enhance their role in combating climate change. They can empower students with the knowledge and skills needed to understand the complexities of climate change and become proactive agents in advocating for sustainable practices and policies. This dual focus on education and awareness can prepare future professionals to tackle the far-reaching challenges posed by climate change and contribute to a more sustainable future.

Methodology

To gain a comprehensive understanding of university students' perceptions and attitudes toward low-carbon initiatives, a carefully structured sampling procedure was employed in this study. The research team implemented a community-based program utilizing an online survey to collect data from participants. A total of 225 university students, aged between 19 and 23, were recruited for the six-month program. The recruitment process was voluntary, with students self-selecting to participate after learning about the program through university-wide announcements, social media platforms, and posters on campus. To ensure a diverse sample, efforts were made to reach students across different faculties and disciplines.

The study employed a pre-test and post-test design to measure changes in participants' knowledge, attitudes, and behaviors related to low-carbon practices. At the outset, participants completed an initial survey questionnaire, which consisted of 30 items designed to assess their existing knowledge of climate change, their attitudes toward environmental conservation, and their current behaviors in relation to energy use, transportation, and waste management. This questionnaire provided a baseline understanding of participants' awareness of climate change impacts and their engagement with low-carbon behaviors.

Following the pre-test, participants engaged in a series of educational and community-based interventions, including training sessions on low-carbon practices, community engagement activities, and knowledge transfer programs in collaboration with local villagers at a designated field site. The study also featured a composting initiative and concluded with a large-scale beach clean-up event that involved not only the university students but also 35 additional participants from the local community. Throughout the program, the researchers monitored students' active participation and engagement to assess the efficacy of the interventions.

At the end of the six-month program, participants were administered a post-test survey to evaluate their changes in knowledge and attitudes. The post-test focused on low-carbon practices, environmental impacts, and individual responsibility in reducing carbon emissions. Additional sections covered topics such as organic waste decomposition and the role of composting in sustainable waste management. Quantitative analysis, specifically using descriptive statistics, was applied to both pre-test and post-test responses to assess the overall effectiveness of the interventions in shaping participants' attitudes and behaviors toward low-carbon practices. Descriptive statistics, including frequency distributions, means, and standard deviations, were calculated to summarize and describe the central tendencies and variability in the data.

Frequency statistics were used to determine the proportion of participants who expressed particular attitudes or behaviors before and after the intervention. This allowed the researchers to identify patterns and shifts in participants' responses, providing a clear picture of how the intervention influenced the group's overall perceptions of climate change mitigation. Additionally, measures of central tendency (such as the mean) were employed to offer insight into the average level of engagement with low-carbon practices, while measures of dispersion (such as standard deviation) were used to understand the variability in participants' responses. These descriptive methods were chosen because they provide a straightforward yet informative overview of the data, without making assumptions about the underlying population or requiring

inferential tests. By focusing on descriptive statistics, the researchers gained valuable insights into the general trends and patterns of behavior change, while maintaining a simple and accessible analysis framework that highlights the overall effect of the interventions on the participants.

Results

In order to determine the level of environmental consciousness among university students, the findings of the research were critically examined. In identifying the main reasons why sustainability behaviors thrive or fail within such a community, it was necessary to look into this issue. Thus, the study aimed at establishing specific components that form eco-friendly habits and attitudes of learners by establishing what motivates them as well as what hinders their success. Citing actual projects done under these models served two main purposes. Firstly, they acted as real-life examples for effective measures that have been put in place towards sustainability, and secondly, it provided guidelines through which similar programs can be made more practical and beneficial to students within the context of enhancing environmental conservation awareness.

Section A

225 NMUC students were involved as respondents for the post-study on the low-carbon project.

In Table 1, the demographic characteristics of the sample (N = 225) reveal a nearly equal split between male (48%) and female (52%) participants. Most respondents fall within the 19-21 age group (69%), with smaller percentages in the 22-24 (29%) and 25-27 (2%) age ranges. The majority are Malay (53%) and Muslim (55%), while other ethnic groups, including Chinese, Indian, and others, along with different religious affiliations, contribute to the sample's diversity.

In Table 2, the data shows that a majority of the sample (64%) participate in volunteering activities, with 144 respondents indicating "Yes." In contrast, 81 respondents (36%) do not engage in volunteering, making up the remainder of the total sample (N = 225).

Table 1: Demographic Characteristic of Participants of the Research

Demographic Characteristics	**Total Sample, N = 225** **N (%)**
Gender	
Male	109 (48)
Female	116 (52)
Age (years old)	
19 – 21	155 (69)
22 – 24	65 (29)
25 – 27	5 (2)
Race	
Malay	119 (53)
Chinese	12 (5)
Indian	30 (13)
Others	64 (29)
Religion	
Islam	123 (55)
Buddha	10 (4)
Hindu	20 (9)
Others	72 (32)

Table 2: Number of Students Interested in Joining the Environmental Volunteer Club

Volunteering	**Number**
Yes	144
No	81
Total	225

Section B

Respondents were given a set of questionnaires containing six components, namely:

- Knowledge about Merambong Island
- Knowledge about low carbon
- General knowledge about the decomposition/decomposition process
- Low carbon practice
- Practical for maintaining marine life
- Practical for the decomposition/decomposition process

The following is a data analysis for each component stated.

Knowledge about Merambong Island: On average, respondents scored a 3.9 regarding their understanding pertaining to Pulau Merambong. Such a rating shows that they have relatively little knowledge or consciousness about Pulau Merambong. Generally, a score of 3.9 implies that the respondents lack comprehensive information on its features, importance as well as any environmental issues connected with it. If respondents disagreed with questions or statements testing their knowledge, it means there is a wide gap in what people know and should know maybe addressed through specific teachings or sensitization campaigns. Understanding more about Pulau Merambong may be very important in creating awareness of its ecological significance and encouraging efforts towards conservation.

Knowledge about Low Carbon: Respondents' average score on low carbon knowledge for this project is 4.5. This implies that they largely sustain statements aimed at evaluating their knowledge about low carbon principles thus signifying a strong understanding of the topic. Students have good knowledge on the need to cut carbon footprints, as a score of less than 5 score would suggest. They also have a decent understanding on level concerning low carbon actions and the relationship between carbon emissions and climate change. They have insights into different resources for renewable energy, energy efficiency facilities, and sustainable strategies necessary for attaining low carbon outputs according to this score. Understanding this kind of information is very important when it comes to backing up effective policies as well implementing projects geared towards achieving them at lower levels within organizations or regions (17).

General Knowledge of the Decomposition Process: On average, respondents scored 4.2 in their general knowledge about the decomposition process. This score indicates that respondents generally agree with statements assessing their understanding of how decomposition works, demonstrating a good level of knowledge on the subject. A score of 4.2 suggests that the respondents are fairly well-informed about the biological and chemical processes involved in decomposition, including the breakdown of organic matter by microorganisms, the stages of decomposition, and the environmental factors that influence it. This level of understanding is essential for comprehending broader ecological concepts and the importance of decomposition in nutrient cycling and waste management (14). The respondents' knowledge reflects a strong awareness of how decomposition contributes to ecosystem health and sustainability.

Low Carbon Practice: On average, respondents scored 4.1 in their knowledge about low carbon practices. This score indicates that respondents generally agree with statements evaluating their understanding of low carbon practices, showing that they are quite knowledgeable on this topic. A score of 4.1 suggests that the respondents are well-informed about various strategies and actions that can help reduce carbon emissions. This includes practices such as using renewable energy sources, improving energy efficiency, adopting sustainable transportation methods like cycling or using electric vehicles, and supporting carbon offset initiatives. Their level of knowledge reflects an awareness of the significance of reducing carbon footprints to mitigate climate change and promote environmental sustainability (1). This understanding is crucial for the adoption and advocacy of low carbon practices in their daily lives and communities.

Practical for the Preservation of Marine Life: On average, respondents scored 4.4 in their practical knowledge of marine life preservation. This score indicates that respondents generally agree with statements assessing their understanding and ability to apply practices aimed at preserving marine life, demonstrating a high level of knowledge in this area. A score of 4.4 suggests that the respondents are well-informed about effective strategies for protecting marine ecosystems and species. This includes knowledge about

conservation techniques such as habitat restoration, pollution control, sustainable fishing practices, and the establishment of marine protected areas. It also reflects an understanding of the importance of biodiversity, the threats facing marine environments, and the actions necessary to mitigate these threats. The respondents' strong grasp of these practices highlights their readiness to support and engage in efforts to preserve marine life, which is essential for maintaining healthy and resilient ocean ecosystems.

Practical to the Decomposition/Decomposition Process: On average, respondents scored 4.0 in their practical knowledge of the decomposition process. This score indicates that respondents generally agree with statements assessing their understanding and ability to apply knowledge related to decomposition, showing that they are quite knowledgeable about the process. A score of 4.0 suggests that the respondents have a solid grasp of the practical aspects of decomposition, including how organic materials break down, the role of microorganisms in this process, and the environmental conditions that facilitate efficient decomposition. Their knowledge likely extends to practical applications such as composting, waste management, and soil health improvement. This understanding is crucial for implementing effective practices that enhance the natural decomposition process, promoting sustainability and environmental health (26). The respondents' competence in this area reflects their readiness to engage in and support activities that rely on or benefit from the natural breakdown of organic matter.

The same respondents during the pre-study were involved for the post-study for the low-carbon project (Table 3). They were given the same set of research questions as the previous pre-study. This aims to see the level of knowledge of the respondents before and after the study was conducted.

Overall, the score for the practicality of the decomposition process is increased in the post-study stage when compared to the pre-study stage. This shows that the respondents are more knowledgeable and understand how to practice the decomposition process after the post-study stage.

Table 3: Differential Analysis of Pre-Test and Post-Study Data

	Component	Pre-test		Post-test	
A	Knowledge about Merambong Island	3.7	Disagree	3.9	Disagree
B	Knowledge about low carbon	4.0	Agree	4.5	Agree
C	General knowledge about the decomposition/decomposition process	3.5	Disagree	4.2	Agree
D	Low carbon practice	4.0	Agree	4.1	Agree
E	Practical for maintaining marine life	4.3	Agree	4.4	Agree
F	Practical for the decomposition/decomposition process	3.9	Disagree	4.0	Agree

Discussion

Promoting Environmental Awareness

Promoting environmental awareness among university students as a means to foster low-carbon practices in daily life is crucial not only within individual nations but also in the context of the global fight against climate change. Universities serve as key hubs of learning and innovation, exposing students to cutting-edge research and ideas related to environmental sustainability. This is supported by a study in Germany, which found that students with pre-instilled climate change knowledge demonstrated a greater understanding and proactive engagement with environmental challenges (10). Similarly, universities worldwide have begun to integrate sustainability into their curricula, cultivating a generation of environmentally conscious individuals capable of reducing carbon emissions and adopting sustainable practices.

The diversity of student populations on university campuses enhances the impact of these initiatives, fostering global conversations on climate action. A study from Jordan highlights how university students increasingly spread environmental awareness, signaling the influence of young people in advancing eco-friendly behaviors across diverse societies (24). By promoting environmental awareness across such culturally varied communities, universities can unite students behind the common goal of mitigating climate

change. This diversity mirrors broader societal structures, enabling universities to act as microcosms where sustainable habits and mindsets take root before spreading to the wider population.

Furthermore, universities often serve as living laboratories for sustainability, providing students with hands-on opportunities to engage in climate action. For example, in China and Singapore, university campuses have adopted sustainability strategies that involve students in implementing and experimenting with innovative environmental solutions, positioning them as agents of change beyond the academic setting (25). This global trend of empowering youth to take an active role in climate mitigation reflects the broader potential for university students to be at the forefront of the low-carbon transition. Through a combination of academic learning, practical initiatives, and community engagement, universities are nurturing a generation equipped to drive meaningful, long-term changes in the fight against climate change.

Digital platforms and social media have emerged as powerful tools in promoting environmental awareness, especially in shaping students' perceptions of low-carbon initiatives. The integration of these platforms in educational strategies provides an accessible and engaging way to disseminate information about environmental sustainability. Students, who are digital natives, frequently use social media for communication, information sharing, and education, making it an effective medium to influence their understanding of global issues such as climate change and low-carbon living. In addition, educational institutions and government bodies are increasingly using digital platforms to integrate low-carbon topics into their curricula and extracurricular activities. Virtual seminars, workshops, and webinars hosted on platforms like Zoom, Google Meet, or even YouTube Live enable students to interact with environmental experts, ask questions, and learn about sustainable practices from a global perspective. Digital education campaigns on sustainability, often paired with social media challenges or competitions, also inspire students to take action in their communities by reducing waste, conserving energy, or using alternative transportation. In conclusion, digital platforms and social media are pivotal in shaping students' perceptions of low-carbon initiatives, offering accessible, engaging, and real-time information on environmental sustainability.

Implementing Low Carbon Practices

This paper found that the understanding of the low carbon concept among the university students was low. This is a serious issue that could hinder the national effort to achieve carbon neutrality in 2050. Therefore, practical approaches to incorporate low carbon understanding into teaching and learning are necessary (27). Consequently, such understanding would encourage students to infuse low carbon practices, such as decomposing and tree planting, in their daily lives. Other similar practices may include energy conservation, waste reduction, and promoting eco-friendly transportation options.

To effectively meet the objectives of fostering sustainable practices, educators—including teachers, trainers, lecturers, and others—must be well-equipped with the necessary knowledge and skills related to low-carbon initiatives. The findings of this study highlight the importance of integrating these concepts into educational settings, which aligns with key theoretical frameworks on environmental education and behavioral change, such as the Theory of Planned Behavior and Environmental Literacy Framework. These frameworks suggest that fostering knowledge and positive attitudes toward sustainable practices can lead to stronger intentions and actions in favor of reducing carbon footprints.

A crucial step in achieving this integration is for the Ministry of Education (MOE) and the Ministry of Higher Education (MOHE) to collaborate with the Ministry of Natural Resources, Environment, and Climate Change (NRECC) in developing a specialized module on low-carbon practices. This module should be incorporated into the national curriculum across all educational levels. By embedding theoretical concepts such as socio-ecological systems thinking and environmental responsibility, the curriculum would not only teach low-carbon practices but also cultivate a deeper, more systemic understanding of climate change and its impacts.

This initiative supports the long-term goal of building a generation that is both knowledgeable and committed to environmental stewardship. Research has consistently shown that early and consistent exposure to sustainability concepts, grounded in educational theory, can significantly

enhance both the perception of climate change and the willingness to engage in mitigating behaviors (28). Moreover, such efforts align with the Environmental Education for Sustainability (EES) framework, which advocates for embedding sustainability into all aspects of learning to foster critical thinking and problem-solving skills related to global environmental challenges.

Malaysia's commitment to low-carbon development is underscored by key national initiatives such as the Green Technology Masterplan and the Low Carbon Cities Framework (29). These policies provide a foundational structure for promoting sustainable urbanization and reducing greenhouse gas emissions across sectors. By incorporating these initiatives into the educational curriculum, future generations will be better prepared to lead and support the country's low-carbon transition, contributing to both national and global climate goals.

The collective impact of individual actions can be significant, especially when multiplied across a large student population. By reducing carbon emissions and resource consumption, university students contribute to mitigating climate change, conserving natural resources, and protecting ecosystems. The adoption of low carbon practices can help universities achieve their sustainability goals and contribute to broader efforts to address environmental challenges (25). Universities are centers of learning and knowledge dissemination. By incorporating low carbon practices into various aspects of campus life, such as transportation, energy consumption, waste management, and food sourcing, students are not only exposed to sustainable behaviors but also learn practical ways to reduce their carbon footprint. This hands-on experience reinforces classroom teachings on environmental stewardship and sustainability.

In conclusion, implementing low carbon practices among university students is not only a practical response to environmental challenges but also a transformative educational experience that empowers individuals to become informed, engaged, and responsible global citizens committed to building a more sustainable future.

Recommendations for Future Project

Young individuals studying in schools and colleges are being seen as the leaders who will have a significant impact on tackling climate change. As they step into leadership positions within their communities, these young people can influence discussions on climate change, promote choices and lifestyle adjustments needed to lessen carbon emissions (18). Their active participation is crucial for nurturing a mindset of sustainability and readiness to face issues at a community level. Youth, particularly university students, play a critical role in promoting low-carbon initiatives both within Malaysia and on a global scale. As future leaders and innovators, students possess the knowledge, creativity, and enthusiasm necessary to drive sustainable practices. Studies have shown that young people, especially those in higher education, are more likely to advocate for environmental causes and adopt eco-friendly behaviors. For instance, research conducted by the International Institute for Environment and Development (IIED) highlights how university students can contribute to climate action through community engagement, sustainable campus initiatives, and influencing national policies.

For them to be in a position to address this issue, it is crucial for them to have adequate knowledge on climate change, outlining some of the causes, effects and possible solutions to this natural occurrence (4). Education in climate change enables them to acquire knowledge and apply appropriate skills in making the right decisions and influencing the attitudes of other people towards taking the right actions in the mitigation and prevention of the effects of climate change. In Malaysia, universities have increasingly recognized this potential by incorporating climate action programs and green initiatives into their curriculums, fostering a generation equipped to combat climate change. Globally, youth-led movements like Fridays for Future have also demonstrated the profound impact young people can have in accelerating low-carbon transitions. By leveraging their education and passion, students can be pivotal in creating a sustainable future for all

Moreover, integration of climate change education into the curriculum is a viable strategy towards achieving the national and global efforts to address impacts of climate risks. Hereby, considering the knowledge and perception of climate change among students, we could identify whether the tertiary institutions are enabling the students adequately towards the addressing of these challenges. It can show advantages and

disadvantages in the current strategies and patterns being advocating in schools, discussing the role of academic institutions in combating climate change (30). This brings into strident focus the need to apply improvements to educational processes or curricula, so that graduates are well-informed and ready to take up educational programs to ensure that graduates are well-prepared to lead efforts in sustainability and climate resilience.

Conclusion

Our study sheds light on the intricate interplay between university students, climate change awareness, and low carbon initiatives within the Malaysian context. Through our research, we have uncovered valuable insights into the perceptions and attitudes of university students towards addressing climate change through low carbon initiatives. Our findings suggest that while there is a growing awareness of climate change among Malaysian university students, there remains a significant gap between awareness and meaningful action. Despite the recognition of the importance of low carbon initiatives, many students expressed challenges in translating their concerns into tangible behaviors and lifestyle changes. Factors such as lack of knowledge, limited access to resources, and competing priorities emerged as barriers to adopting sustainable practices.

Moreover, our study underscores the need for targeted educational campaigns and policy interventions to bridge this gap and empower university students to become active agents of change in combating climate change. By fostering a culture of sustainability within university campuses and providing students with the necessary tools and support, we can cultivate a generation of environmentally conscious individuals who are committed to reducing carbon emissions and mitigating the impacts of climate change (31). Moving forward, it is imperative for stakeholders at all levels—universities, government agencies, non-profit organizations, and the private sector—to collaborate and develop comprehensive strategies that prioritize sustainability education and advocacy among Malaysian university students. Only through collective effort and commitment can we effectively address the challenges posed by climate change and create a more resilient and sustainable future for generations to come.

The authors also believe that it is recommended for future research to explore how different demographic groups, such as age, gender, income level, or educational background, participate in low-carbon initiatives. Understanding these variations can provide insights into the barriers and motivations that influence different groups' engagement with sustainability efforts. This knowledge can help tailor policies and programs to ensure broader and more inclusive participation in low-carbon practices across all sectors of society. As most university students were aware of climate change and strongly supported general mitigation measures, their knowledge and practical application were lacking. It is highly recommended that climate change education for youth focuses on its causes and explains its connection to daily activities, enabling them to adopt climate-friendly practices. University students view climate change education as a way to shape their attitudes and equip them with the necessary skills and knowledge to influence others (24). Their awareness of climate change is closely connected to their field of study and involvement in climate-related events. Additionally, students' understanding of climate change risks differs based on gender, age, and academic background. The study recommends that universities incorporate climate change topics into their curricular and extracurricular programs to better prepare future professionals for the extensive challenges posed by climate change.

Abbreviation

Nil.

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Author Contributions

Aiman Muqri Ahmad Shukri and Farah Syazwani Hayrol Aziz contributed equally to the conceptualization, methodology, data analysis, and writing of the article. Mohamad Ismail Masran provided expertise on marine aspects and climate change. Siti Nur Fasihah Harun focused on data analysis, while Hadzirah Kursiah Mohamed Johar was responsible for conceptualizing and administering the questionnaire.

Conflict of Interest

The authors declare no conflict of interest.

Ethics Approval

Not applicable.

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