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Environmental sustainability and its antecedents among millennial and Gen-Z students in a public higher learning institution

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ABSTRACT

Numerous segments have long discussed environmental sustainability as a significant topic. This is due to its importance to the environment's sustainable future. Many studies have focused on the issue of environmental sustainability. As a result, this study will add to the existing literature by identifying the distribution of environmental sustainability antecedents across gender, age, faculties, and area of residence among millennial students from a Malaysian higher education institution. We conducted this study using a cross-sectional research design. We designed a questionnaire and gathered information through an online survey. We used the Structural Equation Modelling Partial Least Square (SEM-PLS) algorithm, specifically SMART PLS 3.2.7, to analyze the data for hypothesis testing. We find that the distribution of knowledge, perceptions, awareness, actions, and initiatives on environmental sustainability remains consistent across gender, age, and area of residence categories. However, other findings from the survey indicated that there is a statistically significant difference in the distribution of perceptions, actions, and initiatives on environmental sustainability across areas of study (faculties). It is evident from the results of the analysis that the context of the study could influence the level of environmental sustainability knowledge, attitude, and behaviour among millennials.

Contribution/ Originality: This study uniquely investigates environmental sustainability perceptions among Malaysian millennial students, revealing variations across demographics. Employing Structural Equation Modelling, it sheds light on how educational contexts shape sustainability actions, offering valuable insights into young adults' environmental attitudes and behaviors.

1. INTRODUCTION

It is unfathomable to imagine a world without any more space for humans to live in. A worse scenario can also be imagined if the air is no longer safe for breathing, acid rain and chemical discharges contaminate rivers and beaches, and the land is covered with heaps of garbage. If development projects destroy their habitats or extract natural resources to the point of total depletion, rare plant and animal species cannot survive anymore. All of the

scenarios mentioned can possibly occur if the importance of caring for the environment is ignored or if stewardship behaviours towards the environment are no longer practiced.

Bakshi and Gupta [1] highlight that responsible environmental behavior is fundamentally about the ethical duty of humans to use natural resources judiciously, mitigate environmental harm, and ensure future sustainability. This entails not only a deeper understanding of environmental issues and their impacts but also the adoption and implementation of environmental principles for responsible management. This concept is crucial for the protection of tourism resources and the local natural, cultural, and ecological environments, underpinning sustainable tourism by providing strategies for the conservation of tourist destinations [2].

In recent times, there has been a notable increase in public concern for environmental protection. This shift has positioned behavioral attitudes and awareness as critical elements in fostering green behavior, which is pivotal for environmentally sustainable economic development [3]. Studies by Ramkissoon, et al. [4] and Ramkissoon, et al. [5] have further illustrated how pro-environmental behavior enhances place attachment and life quality, underscoring the beneficial effects of such behavior on individuals' lives [6].

The urgent need for action is underscored by recent natural disasters and the IPCC's forecast of a 1.5 degrees Celsius rise in global temperatures by 2030. These developments call for immediate adaptation and mitigation strategies to counter climate change, with environmental pollution being a key contributor. There is a pressing need for a generation that is not only well-informed about environmental issues but also actively practices environmentally friendly principles and policies. Chen, et al. [7] have identified environmental belief and conservation commitment as key drivers of responsible behavior. Pratiwi, et al. [8] argue for the pivotal role of education in altering harmful behaviors by nurturing environmental attitudes and responsibility, suggesting that education can significantly influence and promote environmental responsibility values within communities. This ties back to the understanding that environmental responsibility is interlinked with a variety of factors, including socio-economic [9, 10] socio-ecological [11] and socio-cognitive aspects [12].

The impetus for this study was a fundamental question: What are the factors or sources that develop perceptions, knowledge, awareness, and engagement in environmental sustainability among millennial and Gen Z students in higher educational institutions? Realising the importance of environmental behaviour and environmental sustainability, especially among the younger generation, the objective of this study is to identify the distribution of environmental sustainability antecedents across gender, age, faculties, and area of residence among millennial students from a Malaysian higher educational institution. More research is still needed with regard to questions of whether people act differently when behaving in an environmentally or socially responsible way, and how environmentally and socially responsible behaviours differ regarding their antecedents [13]. Indeed, many studies have focused on responsible environmental behaviours from various dimensions, but this study will fill the gap by identifying the distribution of environmental sustainability antecedents across gender, age, faculties, and area of residence.

The literature review section, which focuses on attitudes and responsible environmental behavior, the methodology section; the result and discussion section; and finally, the research conclusion, limitations, and future recommendations, divide this article into several parts.

2. LITERATURE REVIEW

2.1. Demographic Perspectives on Environmental Sustainability Traits

Recent research has delved into the complex interplay of socio-demographic factors, including gender, age, and educational attainment, in shaping the landscape of environmentally conscious consumer behavior. Ketelsen, et al. [14] presented a thought-provoking perspective by suggesting that men exhibit a heightened sensitivity to the environmental attributes of packaging in contrast to women, underscoring the nuanced impact of demographic variables on consumers' responses to green packaging. This insight challenges conventional assumptions and

emphasizes the need for a tailored understanding of diverse consumer segments. The influence of age emerges as a pivotal factor, with older individuals demonstrating a proclivity to invest more in ecologically friendly packaging, driven by an elevated interest in the intricacies of package materials and their environmental repercussions. This highlights the evolving dynamics across age groups and points to the necessity of targeted strategies to resonate with distinct generational preferences. Moreover, the educational dimension plays a crucial role, as individuals with higher education levels exhibit a heightened consideration of packaging material. This underlines the importance of educational interventions and campaigns in fostering a more ecologically conscious consumer base. In essence, this body of literature illuminates the intricate connections between socio-demographic factors and environmentally conscious consumer choices, urging businesses and policymakers to tailor their approaches in recognition of these nuanced patterns.

Shifting the focus to gender, existing studies consistently suggest that women exhibit greater environmental concern and awareness than men. This heightened environmental consciousness among women is reflected in their purchasing behavior, with females being significantly more influenced by environmental factors in their decision-making processes. Eco-friendly products appear to have a more positive impact on female consumers, as indicated by research conducted by Cater and Serafimova [15] and Lazaric, et al. [16]. Examining consumer categories based on environmental consciousness reveals that women predominantly comprise the most environmentally conscious groups. This trend underscores the significant role gender plays in shaping consumer attitudes towards sustainability.

Moreover, an interesting dynamic emerges in relation to age demographics. The youngest consumers, typically representing the emerging generation, tend to be the least environmentally conscious. This finding raises intriguing questions about the factors that influence younger people's environmental awareness. Chirilli, et al. [17] delve into these questions through their study, revealing distinct expectations about sustainability conveyed through food labels among diverse consumer groups. This age-based divergence in environmental consciousness highlights the importance of understanding and addressing the unique perspectives of different age cohorts in the broader context of sustainable consumer behavior. The interplay of gender and age in shaping environmental attitudes adds layers of complexity to the dynamics of consumer behavior, necessitating targeted strategies for businesses and policymakers to effectively engage diverse demographic segments.

The influence of age on environmentally conscious behavior remains a topic of extensive research, yielding varied outcomes. Some studies, such as those by Jaderná and Volfová [18] assert that younger customers exhibit a heightened understanding of the imperative for environmental preservation and express a more profound interest in sustainability. This perspective aligns with the notion that the emerging generation, often characterized by millennials and Gen Z, demonstrates a greater awareness of global environmental challenges. Conversely, other studies, including the research by Cater and Serafimova [15] and Lazaric, et al. [16] establish a positive association between age and environmental concern, specifically emphasizing the proactive engagement of older individuals in recycling activities. This dichotomy in findings underscores the complexity of the relationship between age and environmental attitudes. It prompts further exploration into the nuanced factors shaping the environmental consciousness of different age cohorts and emphasizes the importance of recognizing diverse perspectives within generational demographics. As businesses and policymakers seek to formulate targeted strategies for sustainable initiatives, a comprehensive understanding of age-related influences becomes crucial for effective engagement with varied consumer groups.

The link between educational attainment and environmental consciousness has been a focal point in numerous studies, consistently demonstrating a positive correlation. Research, such as that conducted by Zhao, et al. [19] consistently points to the notion that individuals with higher educational levels tend to exhibit greater environmental awareness and sensitivity. This association extends beyond mere awareness, influencing their actual consumption behaviors. Higher-educated individuals are more likely to engage in green consumption habits,

emphasizing a heightened commitment to environmentally friendly choices. The positive relationship between educational attainment and environmental consciousness is further underscored by insights from studies like Chekima, et al. [20] revealing that elevated knowledge levels significantly enhance the likelihood of purchasing sustainable goods, particularly when accompanied by eco-labels. This implies that higher education equips individuals with the knowledge and discernment needed to make informed and environmentally responsible choices, highlighting the pivotal role of education in shaping sustainable consumer behavior. As businesses and policymakers seek effective strategies for fostering sustainability, recognizing the influential role of educational attainment becomes imperative for tailored and impactful initiatives.

H_1: There are differences in the distribution of knowledge, perception, awareness, and environmental sustainability initiatives across gender.

H_2: There are differences in the distribution of knowledge, perception, awareness, and environmental sustainability initiatives across age categories.

2.2. The Importance of Sustainability Traits to Society/Millennial/Gen-Z Group

Millennials, marked by their unique set of attitudes and experiences forged in an era of rapid technological advancement, globalization, and economic upheaval, stand out for their unwavering commitment to sustainability. Even amid one of the most challenging economic environments in recent history, millennials emerge as a demographic willing to invest significantly in sustainable products. A striking revelation from the study shows that more than three-quarters of millennial respondents are ready to pay a premium for brands dedicated to fostering a positive social and environmental impact. This contrasts sharply with their counterparts from the baby boomer generation. Only 51 percent of baby boomers express a similar inclination. The willingness of millennials to prioritize personal values over individual benefits, such as cost or convenience, further underscores their dedication to sustainable practices. Moreover, their advocacy extends beyond individual choices to a broader support for environmental initiatives, encompassing backing for stricter regulations, belief in the anthropogenic contribution to global warming, and endorsement of policies promoting green energy and financial incentives for sustainability [21].

The challenges associated with consumer acceptance of remanufacturing processes constitute a critical aspect of sustainable consumption patterns. Historical studies indicate a prevalent reluctance among consumers to fully embrace remanufactured products, often attributing lower quality and value to such items. This skepticism poses a substantial barrier to the widespread adoption of environmentally friendly practices. Additionally, consumers exhibit a discerning approach to their consumption behaviors, influenced by the perceived efficacy of their choices. The pivotal role of perceived consumer efficacy in shaping green buying decisions is emphasized, with users carefully weighing the benefits and drawbacks of opting for environmentally sustainable purchases. This strategic evaluation reflects a nuanced consideration of the potential impact on the environment and the well-being of future generations [22, 23]. Furthermore, the dynamic nature of social values is recognized as a significant driver of customers' green behavior, as illustrated in the insightful findings from the Suki [24]. These collective insights underscore the multifaceted nature of consumer decision-making processes in the realm of sustainability and emphasize the need for targeted interventions to address specific barriers and leverage evolving social values.

While millennials have been identified as a demographic willing to invest in sustainable products, it is crucial to acknowledge the nuanced nature of their pro-environmental behaviors. Contrary to the prevailing narrative, Bonera, et al. [25] present compelling evidence suggesting that millennials' shopping habits may not consistently align with ecological friendliness. The revelation that nearly half of the respondents within this cohort abstain from purchasing recycled paper items or using reusable bags highlights a significant incongruity in their environmental practices—deviating from the expected trends. This disparity prompts a critical examination of the factors that influencing millennials' choices, extending beyond general demographic trends. Recent research introduces the

concept of the "Green Personality," shedding light on the connection between specific personality traits and pro-environmental behavior [26, 27]. The identified traits, including openness, extraversion, agreeableness, and neuroticism, play a pivotal role in shaping individuals' green behaviors. Consequently, the conclusion emerges that millennials' pro-environmental beliefs and practices are not universally homogenous but intricately tied to their distinct personalities. This recognition underscores the necessity of personalized and targeted approaches to promoting sustainable consumer behavior, acknowledging the diverse motivational factors inherent in millennials' green choices.

Generation Z exhibits a greater emphasis on the principles of environmental awareness and sustainability compared to earlier generations. They also possess numerous social and ecological objectives. Additionally, members of Gen Z have a tendency to circumvent the accumulation of information by prioritising aspects unrelated to their immediate concerns, such as limited time or insufficient expertise [28]. There is evidence to support the claim that Gen Z's environmental awareness and concern have a positive impact on their perception of Indonesia's energy transition, according to a study by Wijaya and Kokchang [29]. Attitude and perceived behavioural control positively influence the intention to assist the energy transition, while desire and perceived behavioural control positively influence Generation Z's pro-environmental behaviour. However, the subjective standard is not purpose-driven. To enhance Generation Z's endorsement of the energy transition, it is crucial to conduct interventions that focus on the favourable factors influencing their pro-environmental behaviour.

2.3. Difference between Areas of Living

The results of the previous study shed light on the critical need for enhanced solid waste management education within rural educational institutions. The insufficient expertise among students underscores the importance of targeted interventions to bridge knowledge gaps. This limitation, coupled with the identified requirement for financial incentives among a significant percentage of students (41%), suggests that pragmatic approaches may be necessary to encourage widespread engagement in recycling programs. This finding not only highlights the role of incentives in motivating environmentally responsible behavior but also emphasizes the importance of addressing economic considerations in sustainable initiatives. The recommendation for the institution to transition to a circular economy through various measures, including environmental education and participatory initiatives, aligns with the broader goal of fostering a holistic and sustainable approach to waste management. In essence, the study's findings advocate for a comprehensive strategy that combines educational efforts, practical incentives, and systemic changes to create a more environmentally conscious and actively engaged community within the educational institution [30].

The study by He, et al. [31] in two distinct locations in China provides valuable insights into the environmental knowledge of students across varying socio-economic backgrounds. The findings reveal a concerning overall low level of environmental understanding among the sampled students, despite their expressed optimism for change. This disconnection between optimism and knowledge suggests the need for targeted educational interventions to bridge the gap. The significant variation in environmental knowledge among students from rural and urban environments underscores the influence of socio-economic factors on access to information and educational resources. The observed weak correlation between knowledge, attitude, and perception, as indicated by multiple studies, highlights the complexity of influencing environmentally responsible behavior solely through traditional educational means. It emphasizes the importance of considering multifaceted approaches that go beyond knowledge dissemination, acknowledging the intricate interplay of factors shaping individuals' attitudes and perceptions towards the environment. In conclusion, this study contributes to the understanding that addressing environmental knowledge gaps requires nuanced strategies considering socio-economic disparities and the interrelation between knowledge, attitudes, and perceptions.

The assertion that children in urban areas predominantly spend their time indoors carries significant implications for their overall development and connection to the environment. Studies consistently highlight the limitations of opportunities for urban children to engage with natural settings, potentially hindering their understanding of ecological systems and environmental appreciation. The 2009 survey in the United Kingdom provides concrete evidence of this trend, revealing a stark decline in outdoor play among children compared to previous generations. The substantial difference between the reported outdoor play percentages for children and adults' underscores a concerning shift in behavior and raises questions about the long-term impact on environmental awareness. Similarly, the situation in Portugal and other southern European nations, where classes, school activities, and scientific experiments in natural environments remain infrequent, further supports the argument that urbanization may contribute to a disconnection from nature during formative years. Addressing this trend becomes crucial for fostering a generation with a strong environmental ethic, emphasizing the need for urban planning and educational initiatives that prioritize outdoor experiences and ecological education [32, 33].

Additionally, the identification of regional differences in public climate change engagement by Rickard, et al. [34] and the evidence presented by Chen, et al. [35] regarding heightened environmental concern among Chinese individuals in large cities compared to smaller towns underscore the intricate relationship between geography, economic conditions, and environmental attitudes. Rickard, et al. [34] findings imply that diverse regional contexts may lead to varying levels of climate change engagement, emphasizing the need for targeted strategies that account for regional nuances. Chen, et al. [35] evidence supports the argument that urbanization and the availability of economic options play a pivotal role in shaping environmental concerns, with residents of larger cities often exhibiting heightened awareness. The suggestion of geographical disparities in environmental awareness and concern raises questions about the accessibility of information, educational resources, and economic opportunities in smaller economies, especially in emerging nations. The lack of economic options in these regions may contribute to resource degradation, creating a concerning cycle that necessitates comprehensive and context-specific interventions to address environmental challenges effectively.

The literature consistently emphasizes the critical link between place attachment and pro-environmental behavior. This connection often arises from a combination of social and natural factors [36] suggesting a complex relationship between individuals and their surroundings. However, Ramkissoon, et al. [4] introduce an additional dimension, proposing that a person's behavior may not only be influenced by their attachment to a place but also by the pleasure derived from the neighborhood. Their analysis of survey data from Australian national park visitors reveals that both place connection and place satisfaction play pivotal roles in influencing pro-environmental behavior. Moreover, this influence extends beyond urban settings; Takahashi and Selfa [37] find that even the rural population exhibits comparable behaviors, emphasizing that a positive sense of place in rural environments contributes favorably to pro-environmental attitudes and actions. This evidence collectively highlights the intricate interplay of emotional, social, and environmental factors in shaping individuals' pro-environmental behaviors across diverse settings.

H_5: There are differences in the distribution of knowledge, perception, awareness, and environmental sustainability initiatives across the rural and urban area.

2.4. Differences across Faculty (Field of Study)

The preceding study delves into the realm of environmental education within higher education institutions, exploring the nuances of waste management policies and programs. It specifically scrutinizes the behaviors, engagement levels, and environmental awareness among students in the scientific and social departments at Syiah Kuala University in Indonesia. The inquiry extends to understanding the impact of campus waste management initiatives on behavioral disparities, involvement levels, and environmental comprehension. A comprehensive dataset from 279 students, encompassing both social science and scientific disciplines, was collected. The study,

involving 123 male and 156 female participants with an average age of 18.4 years, employed a questionnaire to extract information on environmental behavior, engagement, and waste management knowledge. The results reveal positive environmental attitudes and substantial engagement and knowledge regarding waste management, aligning with prevailing regulations and programs. Noteworthy is the prominence of environmentally conscious behavior among social science majors, with science majors exhibiting superior performance in both environmental engagement and knowledge. These findings underscore the significant influence of environmental conservation programs and regulations on fostering positive environmental behavior, active involvement, and knowledge essential for waste-free, sustainable development. The study advocates for institutions at all levels to implement diverse policies and initiatives, emphasizing the crucial role of environmental education in maintaining a waste-free environment [38].

Then, the series of studies under consideration delves into the integration of sustainability instruction within architectural programs, with a specific focus on the distinctive curricula of various educational institutions. The research team conducted a comprehensive examination of three tertiary education providers situated across diverse continents—Oceania, Europe, and North America. These institutions offered research-focused, professionally accredited undergraduate and postgraduate architectural programs. The evaluation centered on the impact of these programs on student designs, particularly in relation to sustainability considerations. The findings underscore a consensus among the majority of students regarding the significance of sustainability in their education. However, a nuanced perspective emerges when assessing student opinions on sustainability outcomes in designs, revealing substantial variability. This diversity appears to be intricately tied to the unique objectives and design emphasis of each program. By gaining a deeper understanding of the outcomes generated by the array of courses across architecture curricula, this research contributes to the assessment of teaching strategies and student learning outcomes. The insights drawn from these studies provide valuable support for current and future curriculum development initiatives at the three universities, fostering a meaningful comparison with global trends [39].

H_5: There are differences in the distribution of knowledge, perception, awareness and environmental sustainability initiatives across faculty (field of study).

3. METHODOLOGY

3.1. Respondents and Procedures

We conducted this study as cross-sectional research. We designed a questionnaire and assessed the information using an online survey. Universiti Malaysia Kelantan (UMK) students from all faculties across three (3) different campuses - City Campus, Bachok Campus, and Jeli Campus - comprised the sampling population, which included 320 full-time undergraduate and postgraduate students from undergraduate and postgraduate programmes at the time of data collection.

The study limited the sample to Universiti Malaysia Kelantan because it is the only entrepreneurial university on Peninsular Malaysia's east coast, and the institution is still considered to be in its infancy, having only been in operation for 16 years. Meanwhile, it is important to evaluate the level of understanding about sustainability, particularly the environment, to see if there is a difference in the students' understanding compared to that of other universities located in urban areas or the central region of Peninsular Malaysia. All undergraduate students had the potential to be randomly selected in this study as they fell into the millennial group, born roughly between 1981 and 1996, in the age range of 25 to 40 years old (Institute for Capital Market Research Malaysia, 2021). Nonetheless, this study also included students aged 20 and older.

3.2. Sample Size

The required sample size is 84 since a power of 0.95 with an effect size of 0.15 was obtained from G-Power version 3.1 after the model was tested with three predictors. We calculated the appropriate sample size using G-

Power version 3.1 to test the model with three predictors. The required sample size is 84, with a power of 0.95 and an effect size of 0.15. However, we surveyed a total of 320 millennial students online to eliminate any flaws resulting from a small sample size.

3.3. Research Instrument

A demographic question was prepared for the use of this study and asked for several pieces of information, including gender, marital status, age, religion, race, level of studies, faculty, and hometown areas. For hypotheses testing, there are four latent variables covered for this study, namely awareness, knowledge, action, and sustainability.

For these latent variables, the items were adopted from different sources, such as Msengi, et al. [40]; Sunthonkanokpong and Murphy [41] and Wee, et al. [42].

The 24 items for awareness and perceptions were adopted from Alsaati, et al. [43]; Msengi, et al. [40], Putri, et al. [44] and Wee, et al. [42] which inculcate the millennial students' awareness and perceptions on current environmental and sustainability issues. The eighteen items for knowledge were adopted from Michael, et al. [45] to describe the student's knowledge level on environmental sustainability issues.

The eighteen items for action were adopted from Michael, et al. [45] and Wee, et al. [42] to exhibit the attitude of millennial students towards environmental sustainability. The eleven items for sustainability initiatives were adopted from Mamat, et al. [46] to highlight students' evaluation of the institution's implementation of sustainability practices in the campus area. The study incorporated the five Likert scales. We used the Structural Equation Modelling Partial Least Square algorithm (SEM-PLS) analysis method in SMART PLS 3.2.7 to test the hypotheses.

4. RESULTS

4.1. Demographic

Cronbach's Alpha is utilized to assess the intercorrelations among indicators, providing an estimate of their reliability. In contrast, the Shapiro-Wilk test, with a significance level set at $p < .05$, evaluates the distribution's normality.

As detailed in Table 1, the Cronbach's Alpha values for various dimensions—such as knowledge, perceptions, awareness, actions, and environmental sustainability—all exceed 0.7, indicating that the construct is consistently reliable. However, the observation that the p-values for these constructs are all below 0.005 suggests a departure from normal distribution. Consequently, to analyse the distribution accurately, this study has opted for the non-parametric Independent-Samples Kruskal-Wallis Test.

Table 1. Descriptive, normality, and reliability.

Const.	Items	Mean	SD	Shapiro-Wilk test (p value)	C alpha (α)
KN	18	3.171	0.960	0.000	0.977
PE	9	4.134	0.751	0.000	0.937
AW	15	3.570	0.600	0.001	0.898
ACT	13	4.045	0.650	0.000	0.948
ES	55	3.730	0.556	0.001	0.964

Note: KN: Knowledge; PE: Perceptions; AW: Awareness; ACT: Action; ES: Environmental sustainability.

Table 2 indicates that the distribution of knowledge, perceptions, awareness, actions, and environmental sustainability is similar across gender.

Table 2. Environmental sustainability – cross gender analysis.

Const.	Mean rank		Kruskal Wallis test
	Male	Female	
KN	177.60	154.51	0.050
PE	156.09	162.04	0.612
AW	170.23	157.09	0.265
ACT	161.72	160.07	0.889
ES	171.54	156.63	0.206

Note: KN: Knowledge; PE: Perceptions; AW: Awareness; ACT: Action; ES: Environmental sustainability.

Table 3 indicates that the distribution of knowledge, perceptions, awareness, and environmental sustainability is similar across the age category. However, the distribution of actions shows a statistically significant difference across the age category.

Table 3. Environmental sustainability – cross age analysis.

Const.	Mean rank				Kruskal Wallis test
	18-22 years old	23-27 years old	28-32 years old	33-37 years old	
KN	159.23	158.29	158.07	220.00	0.333
PE	156.74	160.50	241.29	197.06	0.070
AW	159.48	158.89	194.00	175.63	0.756
ACT	160.05	149.93	237.57	207.50	*0.047
ES	156.02	161.69	223.57	221.63	0.063

Note: *Significance at 0.05 level of significance.
KN: Knowledge; PE: Perceptions; AW: Awareness; ACT: Action; ES: Environmental sustainability.

According to the results presented in Table 4, there is a statistically significant difference in the distribution of perceptions, actions, and environmental sustainability across the seven faculties of entrepreneurship and business; hospitality, tourism, and wellness; creative technology and heritage; architecture and ekistics; agro-based industry; bioengineering and technology; and veterinary medicine. The faculty of veterinary medicine has the highest perceptions, actions, and environmental sustainability, with mean ranks of 206.80, 228.40, and 204.40, respectively, while the faculty of bioengineering and technology has the lowest, with mean ranks of 58.55, 64.76, and 88, respectively. Meanwhile, the two distributions of knowledge and awareness are similar across the seven faculties in this study.

Table 4. Environmental sustainability – cross-faculty analysis.

Const.	Mean rank							Kruskal Wallis test
	Entrepreneurship and business	Hospitality, tourism and wellness	Creative technology and heritage	Architecture and ekistics	Agro-based industry	Bioengineering and technology	Veterinary medicine	
KN	177.10	162.97	122.75	180.64	191.89	159.00	148.65	0.193
PE	188.50	158.18	132.51	206.50	172.72	58.50	206.80	*0.040
AW	187.83	162.11	124.54	170.14	155.72	101.25	181.00	0.144
ACT	176.62	160.20	131.60	147.79	185.56	64.76	228.40	*0.046
ES	194.62	159.71	117.56	184.29	187.11	88.00	204.40	*0.011

Note: *Significance at 0.05 level of significance
KN: Knowledge; PE: Perceptions; AW: Awareness; ACT: Action; ES: Environmental sustainability.

Based on the results highlighted in Table 5, the distribution of knowledge, perceptions, awareness, actions, and environmental sustainability are similar across the area of residence (hometown). Those living in rural areas have the highest knowledge, with a mean rank of 166.14, while those living in urban areas have the lowest, with a mean rank of 152.88. Urban areas have the highest distribution of perceptions, with a mean rank of 165.63, while rural areas have the lowest, with a mean rank of 153.71. Awareness is the highest among those living in urban areas, with a mean rank of 170.39, and the lowest among those living in suburban areas, with a mean rank of 153.82. The distribution of actions is highest among those living in urban areas, with a mean rank of 169.72, and lowest among those living in rural areas, with a mean rank of 144.04. Environmental sustainability is the highest among those living in urban areas, with a mean rank of 164.72, and the lowest is among those living in rural areas, with a mean rank of 154.50.

Table 5. Environmental sustainability – cross area of residence analysis.

Const.	Mean rank			Kruskal Wallis test
	Rural	Suburban	Urban	
KN	166.14	164.86	152.88	0.483
PE	153.71	161.42	165.63	0.608
AW	153.98	153.82	170.39	0.295
ACT	144.04	167.61	169.72	0.074
ES	154.50	161.77	164.72	0.692

Note: KN: Knowledge; PE: Perceptions; AW: Awareness; ACT: Action; ES: Environmental sustainability.

5. DISCUSSION

The findings from this study have shown that there is a statistically significant difference in the distribution of perceptions, actions, and environmental sustainability across the seven faculties of entrepreneurship and business; hospitality, tourism, and wellness; creative technology and heritage; architecture and ekistics; agro-based industry; bioengineering and technology; and veterinary medicine. Perceptions, actions, and environmental sustainability are noted to be the highest in the faculty of veterinary medicine and the lowest in the faculty of bioengineering and technology. Meanwhile, the two distributions of knowledge and awareness are similar across the seven faculties in this study.

Dagiliūtė and Niaura [47] have provided evidence to corroborate these findings. According to their study, incorporating sustainability issues into university courses effectively enhances students' knowledge about the environment. However, as previously mentioned in the literature review, while students may gain additional knowledge, their attitudes may not undergo a substantial transformation. According to the study's findings, there is no direct correlation between knowledge and students' attitudes. While the patterns of knowledge and awareness may be consistent across faculties, there are still differences in perceptions, actions, and the promotion of environmental sustainability. Students in the faculty may attribute this disparity to environmental factors or the academic context they experience. Correia, et al. [48] conducted a study that demonstrates the occurrence of similar scenarios, highlighting the variations in knowledge, perceptions, and student involvement across diverse institutional statuses or natures.

This study also found that the distribution of knowledge, perceptions, awareness, actions, and environmental sustainability is similar across the area of residence (hometown). People living in rural areas tend to have the highest knowledge, while those living in urban areas have the lowest knowledge. Urban residents exhibit the highest distribution of perceptions, while rural residents exhibit the lowest. Awareness is the highest among those living in urban areas and the lowest among those living in suburban areas. Contrary to the study by Nahar, et al. [49] these data indicate that the city residents have robust environmental perceptions and attitudes, but their level of environmental awareness is comparatively lower. The distribution of actions is highest among individuals residing in urban areas, while it is lowest among those residing in rural areas. Urban residents exhibit the greatest

level of environmental sustainability, whereas rural residents exhibit the lowest level. These findings are consistent with the findings of Rajapaksa, et al. [36] indicating that individuals residing in rural, urban, and slum settings exhibit distinct behaviours in terms of environmental action. It is important to consider the spatial elements and community heterogeneity that influence environmental action.

6. CONCLUSION

Using a questionnaire survey, this article attempted to determine the distribution of environmental sustainability antecedents across gender, age, faculties, and area of residence among millennial students in a higher educational institution located on Malaysia's east coast. We constructed the survey to encompass several aspects that align with the study's objective, including demographics, awareness and perceptions, knowledge, attitude, and action in environmental sustainability.

According to the findings of this study, the distribution of knowledge, perceptions, awareness, actions, and initiatives on environmental sustainability is similar across genders. Other findings from the analysis indicate that the distribution of antecedents is also similar across the age category. However, findings from the survey also indicate a statistically significant difference in the distribution of perceptions, actions, and initiatives on environmental sustainability across areas of study (faculties). Furthermore, the area of residence (hometown) does not reflect any differences in the distribution of environmental sustainability antecedents. It is clear from the results analysis that the study's background plays a role in shaping the level of knowledge, attitude, and actions of a millennial group on environmental sustainability.

As a result, relevant agencies or policymakers play an important role in developing sustainable policies, recognizing individuals, and implementing the integration of sustainable measures and practices. To achieve the Sustainable Development Goals (SDGs), we must acknowledge individuals, societies, and institutions accordingly. Formal education should teach environmentally responsible conduct to help achieve these goals. Environmentally responsible conduct should be taught through formal education to help achieve these goals. The most influential segment of society, as well as students, must recognise the value of environmental and natural sustainability. Educational institutions have a crucial role in fostering environmental consciousness and responsible behaviour among students [1].

6.1. Recommendations and Future Implications

a) Higher educational institutions play a significant role in educating, fostering, and cultivating a positive attitude towards environmentally responsible behaviour by introducing and implementing a relevant course that exposes students to the fundamental principles of the environment and the consequences of disregarding the environment's needs. Additionally, the student council or student representatives should coordinate additional environmental activities and programmes, either on or off campus. This hands-on or practical program is intended to supplement classroom-based instruction.

b) Teaching should be in line with the current needs of sustainability trends. It must be concurrent and relevant, which is critical for the development and preparation of the next generation of professionals and future leaders.

c) Universities should implement additional green orientation initiatives and programmes to encourage students to engage in ecologically responsible behaviour. Among the initiatives are recycling stations, water and electricity conservation, tree planting, and a reduction in campus carbon emissions. In addition, institutions could encourage students to complete final-year projects that incorporate environmental concepts or sustainability, for which they would receive funds or incentives. Moreover, to improve and broaden students' understanding of sustainability, particularly responsible environmental behaviour,

universities may increase the frequency of workshops and lectures on sustainability by inviting experts to speak or by hosting sustainability conferences and encouraging students to attend.

d) In addition to universities, local authorities and agencies should also play an active role in matters related to environmental protection. In addition to providing recycling stations, the party can run a campaign through advertising and related programs to raise awareness and shape responsible environmental behavior among community members. We can implement joint efforts to clean rivers, drains, and public parks, along with tree planting.

6.2. Limitations of the Study

The study's interpretation of respondent data and measurement of effective implementation of educational recommendations may be limited. To illustrate, the study was limited to individuals who are currently enrolled in a Malaysian institution on the east coast and their attitude towards environmentally responsible behaviour. Therefore, it is evident that this data cannot be utilised to generate inferences about how adolescents in secondary or primary schools, or even people in general, feel about environmental stewardship.

It is advised that future studies use a wider range of respondents in order to evaluate environmental responsibility in a broader context. As a result, it can serve as a benchmark for the state of society in terms of environmental concerns. Consequently, suitable policies can be formulated.

This study focused solely on responsible environmental behaviour, but there are many other factors that contribute to sustainability and community well-being, such as social and economic. As asserted in SDG, there are many components for humankind to achieve to reach a sustainable world. Thus, more research is required to assess the attitudes or behaviour of those practising a sustainable way of life.

In conclusion, we can extend the study to other higher educational institutions in Malaysia, given its limited scope within a single university on Peninsular Malaysia's east coast. This study can be used as a path to conduct further studies to identify an attitude towards responsible environmental behaviour among students in other higher educational institutions to cover all states in Malaysia. Additionally, we can introduce more variables or parameters to further enhance the research field, thereby contributing to the current body of knowledge in pursuit of a better and more sustainable world.

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REFERENCES

[1] R. Bakshi and J. Gupta, "A study of responsible environmental behaviour in relation to gender, stream, and locale," *Indian Journal of Natural Sciences*, vol. 12, no. 70, pp. 38701-38709, 2022.

[2] M. Sahabuddin, Q. Tan, I. Hossain, M. S. Alam, and M. Nekmahmud, "Tourist environmentally responsible behavior and satisfaction; study on the world's longest natural sea beach, Cox's Bazar, Bangladesh," *Sustainability*, vol. 13, no. 16, p. 9383, 2021. https://doi.org/10.3390/su13169383

[3] S.-I. Wu and J.-Y. Chen, "A model of green consumption behavior constructed by the theory of planned behavior," *International Journal of Marketing Studies*, vol. 6, no. 5, pp. 119-132, 2014. https://doi.org/10.5539/ijms.v6n5p119

[4] H. Ramkissoon, L. G. D. Smith, and B. Weiler, "Relationships between place attachment, place satisfaction, and pro-environmental behaviour in an Australian national park," *Journal of Sustainable Tourism*, vol. 21, no. 3, pp. 434-457, 2013. https://doi.org/10.1080/09669582.2012.708042

[5] H. Ramkissoon, F. Mavondo, and M. Uysal, "Social involvement and park citizenship as moderators for quality-of-life in a national park," *Journal of Sustainable Tourism*, vol. 26, no. 3, pp. 341–361, 2018. https://doi.org/10.1080/09669582.2017.1354866

[6] D. Li, L. Zhao, S. Ma, S. Shao, and L. Zhang, "What influences an individual's pro-environmental behavior? A literature review," *Resources, Conservation and Recycling*, vol. 146, pp. 28-34, 2019. https://doi.org/10.1016/j.resconrec.2019.03.024

[7] Y.-S. Chen, Y. H. Lin, and Y.-J. Wu, "How personality affects environmentally responsible behaviour through attitudes towards activities and environmental concern: Evidence from a national park in Taiwan," *Leisure Studies*, vol. 39, no. 6, pp. 825-843, 2020. https://doi.org/10.1080/02614367.2020.1778773

[8] R. D. Pratiwi, R. Rusdi, and R. Komala, "The effects of personality and intention to act toward responsible environmental behavior," *Jurnal Pendidikan Biologi Indonesia*, vol. 5, no. 1, pp. 169-176, 2019. https://doi.org/10.22219/jpbi.v5i1.7120

[9] J. M. Ngwaru and K. Opoku-Amankwa, "Home and school literacy practices in Africa: Listening to inner voices," *Language and Education*, vol. 24, no. 4, pp. 295–307, 2010. https://doi.org/10.1080/09500781003678985

[10] B. K. Thakur, "Impact of environmental degradation on human health," *International Research Journal of Management, IT and Social Sciences*, vol. 3, no. 1, pp. 1-6, 2016.

[11] A. Rechkemmer and L. V. Falkenhayn, "The human dimensions of global environmental change: Ecosystem services, resilience, and governance," *The European Physical Journal Conferences*, vol. 1, pp. 3–17, 2009. https://doi.org/10.1140/epjconf/e2009-00906-y

[12] M. Desfandi, "Creating a society with a character that cares about the environment through the Adiwiyata program," *Sosio Didaktika: Social Science Education Journal*, vol. 2, no. 1, pp. 31–37, 2015. https://doi.org/10.15408/sd.v2i1.1661

[13] M. Hosta and V. Zabkar, "Antecedents of environmentally and socially responsible sustainable consumer behavior," *Journal of Business Ethics*, vol. 171, no. 2, pp. 273-293, 2021. https://doi.org/10.1007/s10551-019-04416-0

[14] M. Ketelsen, M. Janssen, and U. Hamm, "Consumers' response to environmentally-friendly food packaging-A systematic review," *Journal of Cleaner Production*, vol. 254, p. 120123, 2020. https://doi.org/10.1016/j.jclepro.2020.120123

[15] B. Cater and J. Serafimova, "The influence of socio-demographic characteristics on environmental concern and ecologically conscious consumer behaviour among macedonian consumers," *Economic and Business Review*, vol. 21, no. 2, pp. 213-241, 2019. https://doi.org/10.15458/ebr.84

[16] N. Lazaric, F. Le Guel, J. Belin, V. Oltra, S. Lavaud, and A. Douai, "Determinants of sustainable consumption in France: The importance of social influence and environmental values," *Journal of Evolutionary Economics*, vol. 30, no. 5, pp. 1337-1366, 2020. https://doi.org/10.1007/s00191-019-00654-7

[17] C. Chirilli, M. Molino, and L. Torri, "Consumers' awareness, behavior and expectations for food packaging environmental sustainability: Influence of socio-demographic characteristics," *Foods*, vol. 11, no. 16, p. 2388, 2022. https://doi.org/10.3390/foods11162388

[18] E. Jaderná and H. Volfová, "Influence of czech consumers' education level on preferences for sustainable retailers and products," *Marketing Science & Inspirations*, vol. 17, no. 2, pp. 26-41, 2022.

[19] H.-h. Zhao, Q. Gao, Y.-p. Wu, Y. Wang, and X.-d. Zhu, "What affects green consumer behavior in China? A case study from Qingdao," *Journal of Cleaner Production*, vol. 63, pp. 143-151, 2014. https://doi.org/10.1016/j.jclepro.2013.05.021

[20] B. Chekima, S. A. W. S. K. Wafa, O. A. Igau, S. Chekima, and S. L. Sondoh Jr, "Examining green consumerism motivational drivers: Does premium price and demographics matter to green purchasing?," *Journal of Cleaner Production*, vol. 112, pp. 3436-3450, 2016. https://doi.org/10.1016/j.jclepro.2015.09.102

[21] I. Naderi and E. Van Steenburg, "Me first, then the environment: Young millennials as green consumers," *Young Consumers*, vol. 19, no. 3, pp. 280-295, 2018. https://doi.org/10.1108/yc-08-2017-00722

[22] Y. Joshi and Z. Rahman, "Factors affecting green purchase behaviour and future research directions," *International Strategic Management Review*, vol. 3, no. 1-2, pp. 128-143, 2015. https://doi.org/10.1016/j.ism.2015.04.001

[23] C. Bulut, M. Nazli, E. Aydin, and A. U. Haque, "The effect of environmental concern on conscious green consumption of post-millennials: The moderating role of greenwashing perceptions," *Young Consumers*, vol. 22, no. 2, pp. 306-319, 2021. https://doi.org/10.1108/yc-10-2020-1241

[24] N. M. Suki, "Consumer environmental concern and green product purchase in Malaysia: Structural effects of consumption values," *Journal of Cleaner Production*, vol. 132, pp. 204-214, 2016. https://doi.org/10.1016/j.jclepro.2015.09.087

[25] M. Bonera, A. P. Codini, and G. Miniero, "The great Millennials' trouble: Leading or confused green generation? An Italian insight," *Italian Journal of Marketing*, vol. 2020, no. 4, pp. 289-308, 2020. https://doi.org/10.1007/s43039-020-00015-4

[26] Y.-T. Chiang, W.-T. Fang, U. Kaplan, and E. Ng, "Locus of control: The mediation effect between emotional stability and pro-environmental behavior," *Sustainability*, vol. 11, no. 3, p. 820, 2019. https://doi.org/10.3390/su11030820

[27] C. Brick and G. J. Lewis, "Unearthing the "green" personality: Core traits predict environmentally friendly behavior," *Environment and Behavior*, vol. 48, no. 5, pp. 635-658, 2016. https://doi.org/10.1177/0013916514554695

[28] B. Kılıç, A. Bekar, and N. Yozukmaz, *The new foodie generation: Gen Z. in generation Z marketing and management in tourism and hospitality: The future of the industry*. Cham: Springer International Publishing, 2021, pp. 223-247.

[29] D. I. Wijaya and P. Kokchang, "Factors influencing generation Z's pro-environmental behavior towards Indonesia's energy transition," *Sustainability*, vol. 15, no. 18, p. 13485, 2023. https://doi.org/10.3390/su151813485

[30] O. M. Owojori, R. Mulaudzi, and J. N. Edokpayi, "Student's knowledge, attitude, and perception (KAP) to solid waste management: A survey towards a more circular economy from a rural-based tertiary institution in South Africa," *Sustainability*, vol. 14, no. 3, p. 1310, 2022. https://doi.org/10.3390/su14031310

[31] X. He, T. Hong, L. Liu, and J. Tiefenbacher, "A comparative study of environmental knowledge, attitudes and behaviors among university students in China," *International Research in Geographical and Environmental Education*, vol. 20, no. 2, pp. 91-104, 2011. https://doi.org/10.1080/10382046.2011.564783

[32] R. McCormick, "Does access to green space impact the mental well-being of children: A systematic review," *Journal of Pediatric Nursing*, vol. 37, pp. 3-7, 2017. https://doi.org/10.1016/j.pedn.2017.08.027

[33] M. J. Feio *et al.*, "Effect of environmental education on the knowledge of aquatic ecosystems and reconnection with nature in early childhood," *Plos One*, vol. 17, no. 4, p. e0266776, 2022. https://doi.org/10.1371/journal.pone.0266776

[34] L. N. Rickard, Z. J. Yang, and J. P. Schuldt, "Here and now, there and then: How "departure dates" influence climate change engagement," *Global Environmental Change*, vol. 38, pp. 97-107, 2016. https://doi.org/10.1016/j.gloenvcha.2016.03.003

[35] X. Chen *et al.*, "Effects of attitudinal and sociodemographic factors on pro-environmental behaviour in urban China," *Environmental Conservation*, vol. 38, no. 1, pp. 45-52, 2011. https://doi.org/10.1017/s037689291000086x

[36] D. Rajapaksa, M. Islam, and S. Managi, "Pro-environmental behavior: The role of public perception in infrastructure and the social factors for sustainable development," *Sustainability*, vol. 10, no. 4, p. 937, 2018. https://doi.org/10.3390/su10040937

[37] B. Takahashi and T. Selfa, "Predictors of pro-environmental behavior in rural American communities," *Environment and Behavior*, vol. 47, no. 8, pp. 856-876, 2015. https://doi.org/10.1177/0013916514521208

[38] R. Yusuf and I. Fajri, "Differences in behavior, engagement and environmental knowledge on waste management for science and social students through the campus program," *Heliyon*, vol. 8, no. 2, p. e08912, 2022. https://doi.org/10.1016/j.heliyon.2022.e08912

[39] P. Boarin, A. Martinez-Molina, and I. Juan-Ferruses, "Understanding students' perception of sustainability in architecture education: A comparison among universities in three different continents," *Journal of Cleaner Production*, vol. 248, p. 119237, 2020. https://doi.org/10.1016/j.jclepro.2019.119237

[40] I. Msengi *et al.*, "Assessment of knowledge and awareness of "sustainability" initiatives among college students," *Renewable Energy and Environmental Sustainability*, vol. 4, p. 6, 2019. https://doi.org/10.1051/rees/2019003

[41] W. Sunthonkanokpong and E. Murphy, "Sustainability awareness, attitudes and actions: A survey of pre-service teachers," *Issues in Educational Research*, vol. 29, no. 2, pp. 562-582, 2019. https://doi.org/10.1142/9789811228001_0124

[42] M. I. Wee, F. N. Ariffin, T. F. Ng, and A. F. A. Shabudin, *Awareness and attitudes towards sustainable development amongst higher education students in penang, malaysia in handbook of theory and practice of sustainable development in higher education*. Cham: Springer, 2017, pp. 49-64.

[43] T. Alsaati, S. El-Nakla, and D. El-Nakla, "Level of sustainability awareness among university students in the eastern province of Saudi Arabia," *Sustainability*, vol. 12, no. 8, p. 3159, 2020. https://doi.org/10.3390/su12083159

[44] N. T. Putri, E. Amrina, and S. Nurnaeni, "Students' perceptions of the implementation of sustainable campus development based on landscape concepts at Andalas University," *Procedia Manufacturing*, vol. 43, pp. 255-262, 2020.

[45] F. L. Michael, H. Sumilan, N. Bandar, H. Hamidi, V. Jonathan, and N. M. Nor, "Sustainable development concept awareness among students in higher education: A preliminary study," *Journal of Sustainability Science and Management*, vol. 15, no. 7, pp. 113-122, 2020.

[46] L. Mamat, N. E. A. Basri, S. M. Zain, and E. Rahmah, "Determining the level of environmental sustainability practices at campus dormitories using green indicators," *Asian Social Science*, vol. 11, no. 12, p. 25, 2015. https://doi.org/10.5539/ass.v11n12p25

[47] R. Dagiliūtė and A. Niaura, "Changes of students' environmental perceptions after the environmental science and biology courses: VMU case," *Procedia-Social and Behavioral Sciences*, vol. 141, pp. 325-330, 2014. https://doi.org/10.1016/j.sbspro.2014.05.056

[48] E. Correia, F. Conde, R. Nunes, and C. Viseu, "Students' perceptions of HEI regarding environmental sustainability–a comparative analysis," *International Journal of Sustainability in Higher Education*, vol. 21, no. 4, pp. 629-648, 2020. https://doi.org/10.1108/ijshe-10-2019-0320

[49] N. Nahar, Z. Hossain, and S. Mahiuddin, "Assessment of the environmental perceptions, attitudes, and awareness of city dwellers regarding sustainable urban environmental management: A case study of Dhaka, Bangladesh," *Environment, Development and Sustainability*, vol. 25, no. 8, pp. 7503-7531, 2023. https://doi.org/10.1007/s10668-022-02354-y