SUSTAINABLE E-WASTE MANAGEMENT IN THE AGE OF SMART DEVICES: A STUDY BASED ON THE KAP MODEL

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ABSTRACT
Objective: The study aims to assess the level of knowledge, attitudes, and practices (KAP) related to e-waste management among students of Kolej Komuniti Bentong (KKBEN) in the context of increasing smart device usage. It also examines the relationships among these three factors to better understand the determinants of sustainable e-waste management behavior.
Research Method: A quantitative survey design was employed involving 120 students selected through simple random sampling. Data were collected using a structured questionnaire covering demographic information and students' knowledge, attitudes, and practices regarding e-waste management. Descriptive and inferential analyses, including correlation tests, were conducted using SPSS Version 27.
Findings: Students demonstrated moderately high levels of knowledge (M = 3.56, SD = 0.93), attitude (M = 3.55, SD = 0.95), and practice (M = 3.40, SD = 1.02) toward e-waste management. Correlation results revealed significant positive relationships between knowledge and attitude ($r = 0.678$, $\rho < .001$), knowledge and practice ($r = 0.487$, $\rho < .001$), and attitude and practice ($r = 0.539$, $\rho < .001$). These findings indicate that higher knowledge and more positive attitudes are associated with better e-waste management practices.
Originality: This study provides empirical validation of the KAP model within the context of e-waste management among Malaysian community college students. It highlights the critical role of environmental education, awareness initiatives, and institutional support in shaping sustainable behaviors, particularly within technical and vocational education settings.
Keywords: e-waste management, smart devices, sustainability, KAP model

1. INTRODUCTION

The widespread usage of smart devices and the rapid advancement of digital technology have transformed modern lifestyles, particularly among students in higher education institutions. Students are among the most active users of these devices (Chin & Chee, 2025), using them to access learning materials, connect online, and complete academic tasks. While these technologies enhance communication, learning, and access to information, they have also accelerated the generation of electronic waste (e-waste), which has become one of the most pressing global environmental challenges. E-waste is currently one of the world's fastest-growing waste streams. According to the World Health Organization, more than 62 million tons of e-waste are generated annually, yet only about 22% is properly recycled (Baldé et al., 2024; Department of Environment, 2025). Improper disposal can release hazardous substances such as lead, mercury, and cadmium, posing serious risks to both human health and the environment (Chin & Chee, 2025).

In Malaysia, increased electronic device consumption—driven by economic development and digitally oriented lifestyles—has contributed to rising e-waste generation. The Department of Environment has identified multiple categories of electrical and electronic equipment classified as e-waste, with the total quantity increasing yearly (Department of Environment, 2021). Although awareness initiatives have been implemented, evidence suggests that public knowledge and practices concerning e-waste

management, particularly among students, remain only moderate (Goh & Sukri, 2025). This issue is especially relevant in educational settings such as community colleges, where students frequently upgrade devices for academic and social needs, yet may not fully understand appropriate disposal pathways (Chin & Chee, 2025; Goh & Sukri, 2025).

At Kolej Komuniti Bentong (KKBEN), this concern is increasingly evident, as most students own more than one device (e.g., smartphones, laptops, tablets) for learning and daily use. The growing dependence on smart devices has consequently increased e-waste generation, creating environmental sustainability risks if end-of-life electronics are not managed responsibly (Yusof et al., 2023). Observations indicate that outdated devices are often stored at home, discarded with household waste, or resold through informal channels without consideration of environmental impacts (Tun Ismail et al., 2025; Azlan et al., 2021). Prior studies also highlight that awareness alone does not necessarily translate into responsible disposal behavior, particularly when collection facilities are limited and disposal mechanisms are unclear (Syahrul Eidham et al., 2022; Goh & Sukri, 2024; Tun Ismail et al., 2025). In this context, the limited availability of structured e-waste collection or official recycling programs for students further strengthens the need to understand students' actual readiness and behaviors related to sustainable e-waste management (Goh & Sukri, 2024; Tun Ismail et al., 2025).

KKBEN is part of Malaysia's Technical and Vocational Education and Training (TVET) system, which aims to develop skilled and environmentally responsible graduates. Therefore, understanding how students manage their e-waste is important for planning future sustainability programs and educational efforts. However, despite the growing concern, there is no specific study that has assessed students' knowledge, attitudes, and practices (KAP) toward e-waste management at KKBEN (Yusof et al., 2023). Addressing this gap is crucial to identify weaknesses, inform targeted interventions, and strengthen institutional strategies that support sustainable e-waste behavior aligned with Malaysia Madani (Tun Ismail et al., 2025).

The Knowledge–Attitude–Practice (KAP) model provides a useful framework for this study. The model suggests that knowledge shapes attitudes and that attitudes influence actual practices (Hassan & Rosli, 2022). Using this framework, Sustainable E-Waste Management in the Age of Smart Devices: A Study Based on the KAP Model aims to assess the levels of knowledge, attitudes, and practices among KKBEN students in managing e-waste and to examine the relationships among these three components. Evidence from prior research indicates that knowledge and attitude are often strongly related, while attitude may serve as a key mechanism translating knowledge into practice (Hassan & Rosli, 2022; Tukiman et al., 2021). Thus, the findings of this study are expected to support educators and institutional management in designing effective educational interventions, awareness campaigns, and e-waste management initiatives that promote sustainable behaviors among students and contribute to broader national sustainability goals (Goh & Sukri, 2025; Tun Ismail et al., 2025).

2. LITERATURE REVIEW

2.1 STUDENTS KNOWLEDGE ON E-WASTE MANAGEMENT

Knowledge plays a vital role in shaping individuals' understanding, perception, and behavior toward e-waste management. The level of students' knowledge determines their awareness of environmental and health risks associated with improper e-waste disposal. Several studies have found that people who are more aware of e-waste hazards are more inclined to dispose of it responsibly. In Malaysian context, Azlan et al. (2021) found that students exhibited only a moderate level of knowledge regarding e-waste management. Similarly, it was found that while most students were familiar with the general concept of recycling, few possessed detailed knowledge of e-waste categories, safe disposal methods, or existing government initiatives (Rahman & Dusim, 2024). Furthermore, knowledge of e-waste hazards and recycling processes has been identified as a strong predictor of

environmentally responsible behavior (Nuruddin, 2022).

In a related context, Nordin et al. (2025) found that exposure to environmental education positively influenced students' knowledge and motivation toward sustainable e-waste management. However, the improvement was not uniform across all disciplines, as students in technical and engineering programs tended to display higher awareness levels than those from non-science fields (Hassan & Rosli, 2022). Beyond formal education, students' knowledge is also shaped by exposure to media campaigns, institutional policies, and peer influence (Tawok & Saidin, 2025). Despite these factors, increased awareness and knowledge do not always translate into significant behavioral changes (Goh & Sukri, 2025). Similarly, Ahmad et al. (2025) demonstrated that both formal education and direct exposure to recycling campaigns and infrastructure play a critical role in enhancing students' understanding of e-waste management.

In conclusion, students exhibit a growing awareness of e-waste issues, yet their overall knowledge remains moderate. This highlights the need for structured educational initiatives to deepen understanding and encourage more sustainable e-waste management practices.

2.2 STUDENTS ATTITUDES TOWARD E-WASTE MANAGEMENT

Attitudes toward e-waste management and disposal play a crucial role in shaping individuals' intentions and commitment to act sustainably. According to Mohd Yahya & Tengku Hamzah (2025), respondents with higher educational backgrounds and women tended to have more positive attitudes toward e-waste recycling. While Azlan et al. (2023) emphasized that social norms, moral responsibility, and government influence or incentives contribute to fostering positive attitudes toward e-waste management. However, many studies have shown that positive attitudes do not necessarily translate into actual practices. For instance, Sofian Azizi et al. (2023) found that although students demonstrated relatively high levels of knowledge and positive attitudes, their actual engagement in e-waste management remained limited. This indicates that while attitude formation is essential, external factors may either facilitate or hinder the translation of intention into practice. Therefore, understanding the determinants that shape or constrain positive attitudes among technical college students is crucial for designing effective intervention strategies.

Moreover, several studies have explored differences in attitudes among student groups. Factors such as field of study, prior exposure to environmental education, gender, and urban versus rural background can lead to significant variations in attitudes toward e-waste management (Omar et al., 2025; Sofian Azizi et al., 2023). Understanding these differences helps in creating more focused and relevant awareness programs. Integrating attitude-based education and awareness campaigns with practical support such as recycling facilities, clear disposal guidelines, and incentives mechanisms can more effectively encourage students to adopt responsible e-waste management practices (Zahra Ahmad et al., 2025).

2.3 STUDENTS PRACTICES ON E-WASTE MANAGEMENT

Actual practices such as retaining, reselling, recycling, or disposing of e-waste often lag the levels of knowledge and attitudes reported in many studies. In Malaysia, students' actual practices in e-waste management remain inconsistent despite generally positive levels of knowledge and attitudes (Hamzah et al., 2020). Numerous studies have shown that awareness does not necessarily translate into responsible disposal behavior. Many students still to keep old electronic equipment at home, sell them through informal channels, or dispose of them together with general waste (Azlan et al., 2021; Kasbun et al., 2023). These behaviors are largely attributed to limited access to convenient collection facilities and a lack of clear disposal mechanisms. According to Syahrul Eidham et al. (2022), students showed limited recycling engagement due to poor access to collection facilities and lack of institutional encouragement.

Similarly, research by Tengku Hamzah et al. (2022) confirmed that demographic factors and accessibility strongly influenced students' e-waste disposal patterns. A study

by Suhaili & Abdullah (2023) reported similar findings among youth, where most respondents were aware of environmental issues but lacked regular recycling habits. Further evidence has reinforced that awareness campaigns alone are insufficient without adequate facilities and proper policy enforcement (Goh & Sukri, 2024; Tun Ismail et al., 2025). In support of this, Nordin et al. (2025) identified facility support as key factors influencing recycling behavior. Overall, while students generally demonstrate high levels of knowledge about the 3R (Reduce-Reuse-Recycle) principle, their actual waste management practices remain moderate (Laeequddin et al., 2022), suggesting that the translation of knowledge into behavior is still incomplete.

2.4 RELATIONSHIP BETWEEN KNOWLEDGE, ATTITUDE AND PRACTICE (KAP)

The interrelationship between knowledge, attitude, and practice (KAP) in e-waste management has been a central focus of numerous studies in recent years. According to Azlan et al. (2021), while students displayed a moderate understanding and positive attitudes toward e-waste management, their actual practices were still limited. Similarly, Yaacob et al. (2025) found that both students and lecturers demonstrated high levels of awareness and understanding of e-waste issues. However, their actual disposal practices remained limited, indicating a persistent gap between intention and behavior. However, significant correlations were found between knowledge and attitude, and between attitude and practice (Azlan et al., 2021). Using PLS-SEM analysis, Hassan & Rosli (2022) found that attitude served as a key mediating factor between knowledge and practice.

Existing studies consistently demonstrate that knowledge, attitude, and practice are interrelated components within the KAP framework. Knowledge enhances environmental awareness and shapes positive attitudes, while attitude serves as a critical link that translates awareness into concrete behavioral outcomes (Tukiman et al., 2021). Overall, there are three main perspectives regarding the relationships within the KAP model, namely that knowledge is positively correlated with attitude, attitude positively influences practice, and the relationship between knowledge and practice tends to be stronger when influenced by attitude. This indicates that improving e-waste management practices among students requires not only enhancing their knowledge but also strengthening positive environmental attitudes and ensuring institutional support that facilitates sustainable behavior.

3. METHODOLOGY

A quantitative cross-sectional survey design was employed to examine students' knowledge, attitudes, and practices (KAP) related to sustainable e-waste management in the context of increasing smart device usage. The study was conducted at Kolej Komuniti Bentong (KKBEN) during Session 1, 2024/2025. The target population comprised KKBEN students who actively use smart devices such as smartphones, laptops, and tablets for academic and daily activities. A total of 120 students from four academic programmes, Electrical Technology, Building Construction Technology, Information Technology, and Business Operations, were selected using simple random sampling to ensure equal probability of participation among eligible respondents.

Data were collected using a structured questionnaire grounded in the Knowledge–Attitude–Practice (KAP) model and informed by established literature on e-waste and environmental management behaviour. The instrument consisted of four components: demographic information, knowledge of e-waste and its management, attitudes toward responsible and sustainable e-waste handling, and self-reported practices relating to the handling and disposal of e-waste. Items measuring the KAP constructs were assessed using a five-point Likert scale to capture the degree of agreement with each statement.

Prior to administration, the questionnaire was reviewed to enhance clarity, relevance, and alignment with the objectives of the study. The reliability of the instrument was evaluated using Cronbach's alpha, demonstrating high internal consistency for all constructs: knowledge ($\alpha = 0.923$), attitude ($\alpha = 0.960$), and practice ($\alpha = 0.952$). Data collection was conducted online using Google Forms, and responses were automatically

recorded for analysis.

All analyses were performed using SPSS Statistics (Version 27). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondent demographics and to describe overall levels of knowledge, attitude, and practice. Pearson's correlation coefficient was applied to examine the relationships among knowledge, attitude, and practice, specifically testing the associations between knowledge and attitude, knowledge and practice, and attitude and practice. Statistical significance was evaluated using conventional thresholds to support interpretation of the findings.

4. RESULTS AND DISCUSSIONS

The study findings were analyzed quantitatively according to the questions posed in the questionnaire. Data analysis is categorized based on the four objectives.

4.1 ANALYSIS OF RESPONDENT BACKGROUND DATA

Descriptive technique was used to examine the demographic distribution of respondents in Section A. This data includes age, gender, race and academic program. The data was analyzed using frequency distribution and percentage techniques, as shown in Table 1.

Table 1: Distribution of Respondent Backgrounds

Assessment Item		Program				Accumulated Percentage (%)
		SKE	STPB	STM	SPP	
Gender	le	75	20	5	4	86.7
	nale	2	5	4	5	13.3
Age	17 - 19 years	68	23	8	8	89.3
	20 - 22 years	5	1	1	1	6.6
	23 - 25 years	4	1	-	-	4.1
Race	Malay	73	25	8	8	95
	Chinese	-	-	1	1	1.7
	Indian	4	-	-	-	3.3

According to the data in Table 1, a total of 120 respondents participated in the study, which are 104 males (86.7%) and 16 female (13.3%). This response consists of four programs: SKE, STPB, STM and SPP. Through the survey, it was found that the highest age group participating is between 17 to 19 years old, with a total of 109 (89.3%) respondent. While the lowest age group participating is between 23 to 25 years old, with only 5 (4.1%) respondents. It was found that 114 (95%) respondents are Malay, 4 (3.3%) respondent is Indian, and 2 respondent (1.7%) is Chinese ethnicity.

4.2 STUDENTS' KNOWLEDGE OF E-WASTE MANAGEMENT

The first objective aimed to determine the level of knowledge among KKBEN students regarding e-waste management in the age of smart devices. Descriptive findings based on Table 2 showed that the overall level of knowledge was moderately high, with overall mean equal to 3.56 where the average scores between 3.47 and 3.60. most students understood the basic concept of e-waste such as they knew that old or damage smartphones are classified as e-waste and that these items can be harmful to the environment if not disposal of properly. They also recognized that correct disposal methods can help protect both the environment and human health.

Table 2: Mean Score of Students' Knowledge on E-Waste Management

Item	Statement	Mean Score	Standard Deviation	Interpretation
1.	I know that e-waste refers to damaged or unused electronic equipment.	3.58	0.875	Medium High
2.	I know that old or broken smartphones are also considered as e-waste.	3.60	0.893	Medium High
3.	I know that e-waste contains hazardous chemicals such as lead and mercury.	3.59	0.893	Medium High
4.	I know that improper disposal of e-waste can harm the environment.	3.58	0.875	Medium High
5.	I know the correct and safe methods for e-waste disposal.	3.47	1.012	Medium High
6.	I know that e-waste should not be discarded with household waste.	3.53	0.983	Medium High
7.	I am aware of the existence of e-waste recycling centers in Malaysia.	3.52	0.952	Medium High
8.	I know that participating in proper e-waste disposal methods benefits both the environment and human health.	3.59	0.886	Medium High

However, their understanding was lower in practices areas, such as knowing the correct ways to dispose of e-waste or where official e-waste collection centers are located. This suggests that while students have general awareness, they may not know how or where to act when it comes to recycling their electric and electronic devices.

This result is consistent with finding by Azlan et al. (2021), who observed that Malaysian university students exhibited a moderate understanding of e-waste management, especially about proper disposal procedures. Similarly, Nordin et al. (2025) reported that many young people know that e-waste is dangerous but do not fully understand how to manage it correctly.

Overall, the findings indicate that while students are generally aware of what e-waste is and understand its environmental implication, many lack sufficient knowledge of how to manage it effectively. Their awareness tends to remain at conceptual level rather than being translated into concrete actions (Tukiman et al., 2025). To address this gap, interactive learning activities and visible recycling initiatives within the college environment should be implemented to transform awareness into meaningful and sustainable practices.

4.3 STUDENTS' ATTITUDES TOWARDS SUSTAINABLE E-WASTE MANAGEMENT

The second objective of this study was to investigate students' attitudes toward the importance of managing e-waste in a sustainable manner. The findings based on Table 3 show that the overall mean scores for this section are equal to 3.55 with range between 3.51 and 3.59, which indicates a moderately high positive attitude among students.

Table 3: Mean Score of Students' Attitudes toward E-Waste Management

Item	Statement	Mean Score	Standard Deviation	Interpretation
1.	I believe that e-waste management is everyone's responsibility.	3.59	0.930	Medium High
2.	I feel that proper disposal of e-waste is important.	3.56	0.924	Medium High
3.	I believe that participating in proper e-waste disposal methods is part of my responsibility toward society and the environment.	3.57	0.932	Medium High
4.	I am interested in learning more about e-waste.	3.55	0.924	Medium High
5.	I think the community college should provide more exposure to e-waste management.	3.53	0.934	Medium High
6.	I am willing to participate in e-waste awareness campaigns if given the opportunity.	3.51	0.987	Medium High
7.	I believe that reusing or repairing electronic devices is a wise practice.	3.55	0.929	Medium High
8.	I support the college community's efforts to provide e-waste disposal facilities.	3.56	0.933	Medium High

Most Students agreed that managing e-waste is a shared responsibility and that proper disposal is important to protect the environment and the community. This shows that they are generally concerned and supportive of sustainable waste management. However, the slightly lower mean scores for the items related to active participation such as joining awareness campaigns or supporting college recycling programs. It suggests that students' positive attitudes do not always translate into action. This result aligns with previous research by Mohd Yahya & Tengku Hamzah (2025), which found that although the public showed positive attitudes toward e-waste recycling, their participation remained low due to limited facilities and lack of exposure. Similarly, Goh & Sukri (2025) reported that students' attitudes toward e-waste management were strongly influenced by social and institutional factors such as peer influence and the availability of recycling programs.

In summary, students at KKBEN demonstrate a positive mindset toward sustainable e-waste management, but they still need more motivation, exposure and institution support to turn that attitude into consistent practice. Strengthening environmental education, organizing awareness campaigns and providing visible opportunities for involvement could encourage students to move from positive thinking to active environmental participation.

4.4 STUDENTS' ACTUAL PRACTICES IN E-WASTE MANAGEMENT

The third objective of this study was to identify students' actual practices in managing and disposing of e-waste. The findings based on Table 4 show that the mean scores for this section range between 3.29 and 3.49 with overall mean score equal to 3.40. This indicates a moderately high level of practice among students.

Table 4: Mean Score of Students' Actual Practices in E-Waste Management

Item	Statement	Mean Score	Standard Deviation	Interpretation
1.	I separate e-waste from general waste at home.	3.49	0.995	Medium High
2.	I avoid throwing electronic devices into household trash bins.	3.49	0.962	Medium High
3.	I usually store old electronic devices because I do not know how to dispose of them properly.	3.44	0.984	Medium High
4.	I prefer repairing electronic devices instead of buying new ones to reduce e-waste.	3.42	0.966	Medium High
5.	I used to resell or donate old electronic devices.	3.36	1.087	Medium High
6.	I once sent e-waste to a recycling center.	3.29	1.075	Medium High
7.	I limit the purchase of new electronic devices unless necessary.	3.36	1.036	Medium High
8.	I encourage other to recycle e-waste properly.	3.38	1.062	Medium High

Most respondents indicated that they separate damages electronic devices from regular household waste and avoid throwing e-waste into normal trash bins. This shows a basic level of responsible behavior and awareness of proper waste segregation. However, only a small number of students had brought their e-waste to recognized recycling centers. This indicates that their actual recycling participation is still relatively low.

This result aligns with other studies such as Ahmad et al. (2025), who noted that although the public generally understands the importance of recycling, their actual participation remains limited due to the lack of accessible facilities and convenience. Similarly, Hassan & Rosli (2022) found that although university students demonstrated positive attitudes towards waste management, their actual behaviors remained moderate and need stronger community and institutional support. Interestingly, some students mentioned that they repair, reuse or sell their old devices, which can be seen as informal recycling behavior aligned with the principles of circular economy (Chinchkhede, 2024). These practices are commendable but need to be formalized and supported through official programs to ensure that e-waste is handled safely and sustainably.

In summary, while students at KKBEN demonstrate awareness and some positive actions related to e-waste management, their practices are still not fully consistent or systematic. Many students engage in responsible behaviors such as separating e-waste from regular trash. However, participation in formal recycling programs remains limited. This gap between awareness and consistent action suggests that students need greater institutional support, accessible recycling facilities and continuous education to encourage regular engagement in sustainable practices. Increasing this element effectively can transform students' basic awareness into sustainable and responsible e-waste management practices that are in line with the goals of the country's sustainability agenda.

4.5 RELATION BETWEEN KNOWLEDGE, ATTITUDE AND PRACTICE (KAP) IN E-WASTE MANAGEMENT

The fourth objective of this study was to analyze the relationship between students KAP towards sustainable e-waste management. Pearson correlation analysis was conducted to determine the strength and significance of this relationship as shown in Table 5.

Table 5: The Relationship Between knowledge, attitude, and practice (KAP) toward sustainable e-waste management

		Knowledge	**Attitudes**	**Practices**
owledge	rson Correlation	1	.678**	.487**
	. (2-tailed)		.000	.000
		120	120	120
itudes	rson Correlation	.678**	1	.539**
	. (2-tailed)	.000		.000
		120	120	120
ctices	rson Correlation	.487**	.539**	1
	. (2-tailed)	.000	.000	
		120	120	120
Correlation is significant at the 0.01 level (2-tailed)				

The results indicated that all three relationships were positive and statistically significant (ρ<001). Specifically, there was a strong correlation between knowledge and attitude (r=0.678), a moderate correlation between knowledge and practice (r=0.487) and strong correlation between attitude and practice (r=0.539). These findings indicate that students with higher levels of knowledge about e-waste management are more likely to develop positive attitudes, which subsequently lead to improved management practices (Tukiman et al., 2021). The strong relation between knowledge and attitude indicates that educational exposure plays a crucial role in shaping students' environmental values. When students understand the environment and health risks associated with improper e-waste disposal, they are more likely to develop favorable attitudes and personal responsibility toward sustainable management (Yaacob et al., 2025)

Meanwhile, the positive correlation between attitude and practices (r=0.539) implies that students with stronger environmental values are more likely to translate their attitudes into real actions. However, external factors like limited facilities and weak institutional support often restrict the consistency of these behaviors. The moderate relationship between knowledge and practice (r=487) also suggests that awareness alone is not sufficient to ensure sustainable behavior. Although TVET students have strong environmental knowledge, their actual recycling participation is modest due to limited infrastructure ang engagement programs (Wan Yusoff et al., 2024). In summary, the correlation analysis demonstrates a strong interconnection between knowledge, attitude and practice. These three elements play an important role in shaping students' sustainable e-waste management behavior.

5. CONCLUSIONS

In conclusion, this study based on the KAP model demonstrated that students at KKBEN possess moderately high levels of knowledge and positive attitudes towards e-waste management, yet their actual practices remain limited. The significant correlations among knowledge, attitude and practice highlights that awareness and environmental values are essential foundations for fostering sustainable behavior but require stronger institutional commitment and infrastructural support to be effectively translated into action.

Based on the findings, several recommendations are proposed to enhance sustainable e-waste management among students at KKBEN. From an institutional perspective, these findings emphasize the importance of integrating environmental education and sustainability goals within Malaysia's TVET framework. The college administration should establish accessible e-waste collection facilities on campus in collaboration with local authorities and certified recycling agencies to promote responsible disposal practices. Furthermore, the Department of Polytechnic and Community College Education (JPPKK) can utilize these insights to embed sustainability modules and e-waste awareness programs into the Green TVET curriculum. At the campus level, targeted initiatives such as awareness

campaigns, peer-led workshops and competitions can be implemented to create a strong sustainability culture of environmental responsibility. These programs can encourage student participation in e-waste recycling and transform awareness into tangible collective action. These strategies not only promote behavioral change but also align with Malaysia's national sustainability goals and the Malaysia Madani vision.

Finally, future research could expand the scope of this study by including multiple community college or other higher education institutions across different regions in Malaysia. Comparative studies can help identify variations in e-waste awareness, attitudes and practices across diverse educational contexts. Additionally, incorporating qualitative methods such as interviews or focus groups would offer deeper insights into students' motivations and perceives barriers towards sustainable e-waste behavior. Such evidence-based findings can guide JPPKK and educational institutions in formulating comprehensive strategies that align educational practices with Malaysia's long-term sustainability goals.

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