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Electronic Waste Management among University Students: Knowledge, Attitudes, Practices, and the Role of Policy Perception

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The rapid increase in electronic waste (e-waste) poses significant environmental and public health challenges, particularly in developing countries such as Indonesia. This study assessed the relationship between knowledge, attitudes, perceptions of government regulations, and e-waste management practices among public health students at Universitas Andalas. This research employed a cross-sectional quantitative design, and data were collected from 298 undergraduate students in Padang, West Sumatra, selected through stratified systematic random sampling. Research instrument used validated questionnaires measured independent variables related to e-waste such as knowledge, attitudes, perceptions, and dependent variable (practices). Univariate, bivariate, and multivariate analyses used SPSS software. Results revealed that although the majority of students (63.4%) had good knowledge, more than half demonstrated negative attitudes (52.3%) and poor practices (52.7%) regarding e-waste management. There was a significant association between attitude and practice ($p < 0.001$), as well as between perception of government regulation and practice ($p < 0.001$). In contrast, the relationship between knowledge and practice was not statistically significant ($p = 0.222$). These findings underscore that while knowledge is important, positive attitudes and perceptions toward regulatory frameworks are more crucial in influencing responsible e-waste behaviour. The study concludes that fostering positive attitudes and trust in government regulation is vital for improving e-waste management practices among students. Educational interventions and policy reforms emphasizing knowledge enhancement and attitudinal and perceptual shifts are essential for promoting sustainable e-waste management in Indonesia.

Keywords: Electronic Waste, Pollution, Toxic, Waste Management

INTRODUCTION

The definition of Electronic waste, commonly known as e-waste or Waste Electrical and Electronic Equipment (WEEE), varies across different studies and regions, with some definitions encompassing all electronic devices that have been discarded by users, ranging from household appliances to consumer electronics and computers (Kshtriya & Anchala, 2023; Pérez-Belis et al., 2014). The European Union defines e-waste as "Electrical or electronic equipment which is waste, including all components, sub-assemblies, and consumables, which are part of the product at the time of discarding" (Mmereki et al., 2016). This comprehensive definition reflects the broad scope of items that fall under the category of e-waste. Electronic waste includes a variety of discarded electronic devices such as computers, laptops, televisions, mobile phones, and MP3 players (Wath et al., 2010). E-waste consists of outdated electronic and electrical items that are no longer used and are typically sent for recycling or recovery (Paranjape & Yadav, 2022). This category also encompasses unwanted electronic appliances like cell

phones, music players, telecommunication equipment, and laptops (Popoola et al., 2019).

The rapid proliferation of electronic gadgets like mobile phones and laptops has led to e-waste becoming the fastest-growing global waste category (Ghulam & Abushammala, 2023). E-waste poses a significant environmental and health hazard due to the presence of various toxic substances that can contaminate the environment and endanger human health if not managed properly (Alam & Bahauddin, 2015). The composition of e-waste is diverse, including a mix of glass, plastics (with additives like flame retardants), metals (including rare-earth elements), and metalloids (Purchase et al., 2020). This diversity in composition highlights the complexity of managing e-waste and emphasizes the need for effective recycling and disposal strategies.

The global production of e-waste has steadily increased, with approximately 50 million metric tons generated in 2019 (Ghimire & Ariya, 2020). The data emphasize the considerable and continuously growing scale of global electronic waste generation. Furthermore,

the same authors highlight that in 2019, the total amount of e-waste produced globally was estimated to be around 53.6 million metric tons, emphasizing the magnitude of the e-waste challenge. Moreover, the Global E-waste Statistics Partnership (GESP) monitors e-waste issues worldwide. It produces statistical data on e-waste at the global, regional, and country levels (Hesham Lotfy Hassan Rabie et al., 2021). This partnership contributes to a better understanding of the scale and impact of e-waste on a global scale.

Additionally, a significant portion of the estimated 50 million tons of e-waste generated globally is shipped to developing countries in Africa and Asia for recycling and disposal, highlighting the international dimensions of e-waste management (Purchase et al., 2020). The study by Cruz-Sotelo et al. provides further context by indicating that in 2014, approximately 42 million tons of electrical and electronic waste devices were generated worldwide, reflecting the ongoing trend of increasing e-waste production (Cruz-Sotelo et al., 2017). These data highlight the urgent necessity for implementing sustainable management practices to address the escalating challenges posed by e-waste. Furthermore, e-waste is a significant environmental problem globally, with discarded electronic devices contributing to ecological effects and soil pollution, further highlighting the multifaceted impact of e-waste (Liu et al., 2015).

E-waste management is a critical issue that requires attention at both the national and international levels. Improper disposal of e-waste can lead to the release of heavy metals into the environment, posing risks to both human health and ecosystems (Abbas et al., 2015). The increasing quantities of e-waste and hazardous and valuable materials within electronic devices highlight the importance of prioritizing e-waste management to ensure sustainable practices (Kusch, 2017). The lack of efficient e-waste management, particularly in the Information and Communications Technology (ICT) sector, underscores the need for improved environmental management practices to mitigate the risks associated with electronic waste (Alaskar et al., 2022). E-waste presents a complex and growing challenge in today's technologically driven world. The diverse nature of e-waste and its environmental and health implications necessitate robust management strategies to address this issue effectively. Adopting sustainable practices, implementing proper recycling techniques, and raising awareness about the importance of responsible e-waste disposal can mitigate the adverse impacts of electronic waste on the environment and human health.

In addition to the quantitative data on e-waste generation, qualitative studies shed light on the social and economic dimensions of e-waste management. Informal waste workers in the Global South face challenges as corporate recyclers engage in e-waste recycling, impacting livelihoods and raising questions about equity and sustainability in e-waste management practices (Corwin, 2019). This perspective underscores the importance of considering the volume of e-waste generated and the

social implications of e-waste management strategies. Overall, the data presented in these references collectively paint a comprehensive picture of the global landscape of electronic waste. From the sheer volume of e-waste generated annually to the environmental, social, and economic challenges associated with its management, these studies highlight the complex and multifaceted nature of the e-waste issue. Addressing the growing problem of e-waste requires a holistic approach that considers not only the quantitative aspects of waste generation but also the broader implications for sustainability, environmental health, and social equity on a global scale.

The study conducted by Goswami and Tjprc illustrates the critical function of communities and consumers in managing electronic waste. It brings to the forefront the decisive influence of public engagement in identifying obsolete electronic devices and overseeing their disposal, thereby reframing the responsibility from producers, policymakers, or recycling entities to community members (Goswami & Tjprc, 2019). Additionally, producers face challenges in managing e-waste due to weak legislation, inadequate recycling infrastructure, and a lack of public awareness. The research examines the implications of Extended Producer Responsibility (EPR) regulations on e-waste management practices, emphasizing the importance of regulatory frameworks in promoting sustainable waste management (Nyakudya et al., 2022). Furthermore, the research focused on students' awareness of managing e-waste, provides insights into the knowledge and attitudes of students towards e-waste management, which can inform the development of effective e-waste management policies and initiatives targeted at educational institutions (Goyal, 2023).

In Indonesia, the management and regulation of electronic waste (e-waste) have become increasingly crucial due to the growing volume of discarded electronic products and the environmental and health risks associated with improper disposal practices. Research on electronic waste management involving students and communities is crucial for understanding the dynamics of e-waste generation, disposal, and recycling. By exploring the perspectives of students, communities, and producers, these studies contribute to developing sustainable e-waste management practices that involve all stakeholders in the waste management process. Collaborative efforts among students, communities, producers, and policymakers are essential to address the challenges posed by electronic waste and promote environmentally friendly waste management practices. This research aims to examine the relationship between knowledge, attitudes, perception of government involvement, and practices in electronic waste management among university students.

METHODS

Study Design and Setting

This research employed a quantitative, cross-sectional design to assess the relationships between knowledge, attitudes, perceptions of regulations and

government roles (independent variables), and e-waste management practices (dependent variable) among public health students at Universitas Andalas, Indonesia. Data were collected at a single time point, aligning with the descriptive and correlational objectives of the research.

Population and Sample

The target population comprised all undergraduate students enrolled in the academic years 2020–2023 (N = 1,268). This cohort was selected to account for potential variations in e-waste awareness across academic levels (e.g., senior students may have greater exposure to environmental health curricula). A minimum sample size of 298 participants was calculated using Slovin's formula. A stratified systematic random sampling technique was applied to ensure proportional representation across class years (2020–2023). The sampling procedure included Stratification (dividing the population into four strata based on academic year and Systematic Sampling (selecting participants at fixed intervals within each stratum using a student registry).

Variables and Operational Definitions

There are three independent variables: knowledge, attitudes, and perception of government involvement. Knowledge is defined as students' understanding of e-waste management; attitudes are evaluative statements that reflect a person's feelings/perceptions towards e-waste management; and perception of government involvement is a direct response (reception) to something or the process of a person knowing several things through their five senses. Practice in e-waste management is the dependent variable and is defined as an act or practice against e-waste management.

Data Collection Procedures

Quantitative data were collected through interviews using in-house-developed questionnaires containing questions about students' knowledge, attitudes, perceptions, and practices regarding e-waste management, which had been validated and tested for reliability. Validity test used Pearson Correlation, and reliability test used Cronbach's alpha. Data collection began by providing respondents with an informed consent form to prove their willingness to participate in the study.

This study received ethical approval from the Research Ethics Commission, Faculty of Public Health, Universitas Andalas, under approval number B/78/UN16.12.D/PP/2025.

Data Analysis

Data analysis for this study used univariate, bivariate, and multivariate analysis. Univariate analysis will present the frequency and percentage distribution for each variable. In this study, the analysis was used to describe students' knowledge levels, attitudes, perceptions, and practices regarding e-waste management, presented in a frequency distribution table. Bivariate analysis is used to determine the relationship between independent variables and dependent variables. This bivariate analysis used the Statistical Product and Service Solutions (SPSS) computer program and the chi-square statistical test.

RESULT AND DISCUSSION

Characteristic of respondents

Table 1 shows that the majority of respondents were female (87.3%). More than a third of the participants were 19 years old (38.6%) and 20 years old (30.8%). All respondents reported owning at least one electronic device, reflecting the widespread accessibility of electronic devices within the sample population. Regarding awareness, more than half of the respondents had previously heard or read about electronic waste (e-waste). Among those exposed to information about e-waste, the most common source was social media (46.6%), and a notable proportion (39.3%) reported never having heard or read about e-waste.

In terms of active engagement in e-waste-related programs, merely 1.7% of respondents had ever participated in counselling or training sessions on e-waste management, while the vast majority (98.3%) had never received such training. These findings suggest relatively moderate awareness of e-waste among the participants, with social media as the predominant source of information. However, the lack of formal training or educational intervention on e-waste management highlights a significant gap in structured environmental education efforts targeting this population.

Table 1.

Characteristic of respondents

Age (years)	n	%
18	13	4.4
19	115	38.6
20	92	30.8
21	62	20.8
22	14	4.7
23	2	0.7

Gender		
Male	38	12.7
Female	260	87.3
Ownership of electronic devices		
Yes	298	100
No	0	0
Have you heard or read about e-waste before?		
Yes	182	61.1
No	116	38.9
If you have EVER heard or read about e-waste, where have you read/heard of it?		
Information from social media	139	46.6
Information from friends or family	7	2.3
Information from Teachers/Lecturers	13	4.4
information from mass media (newspapers, magazines, both print and electronic)	20	6.7
Never	117	39.3
Yes, but did not mention	2	0.7
Have you ever participated in counselling or training on e-waste management?		
No	293	98.3
Yes	5	1.7

The bar chart in Figure 1 presents data on the types and quantities of electronic devices possessed by respondents in the study. The chart reveals varying ownership patterns across different device categories among the student population. According to the data, handphones were the most widely owned device, with 294 respondents reporting ownership, indicating near-universal access. This is followed closely by computers or notebooks (275) and electric fans (255), suggesting a high dependence on devices essential for communication, academic work, and comfort.

Overall, the data demonstrate a strong penetration of mobile and digital technologies among students, reinforcing the relevance of targeted e-waste management strategies that prioritize high-ownership categories such as mobile phones and laptops. This pattern of device ownership also suggests potential areas for educational intervention, particularly regarding the environmental implications of the disposal of commonly used electronics.

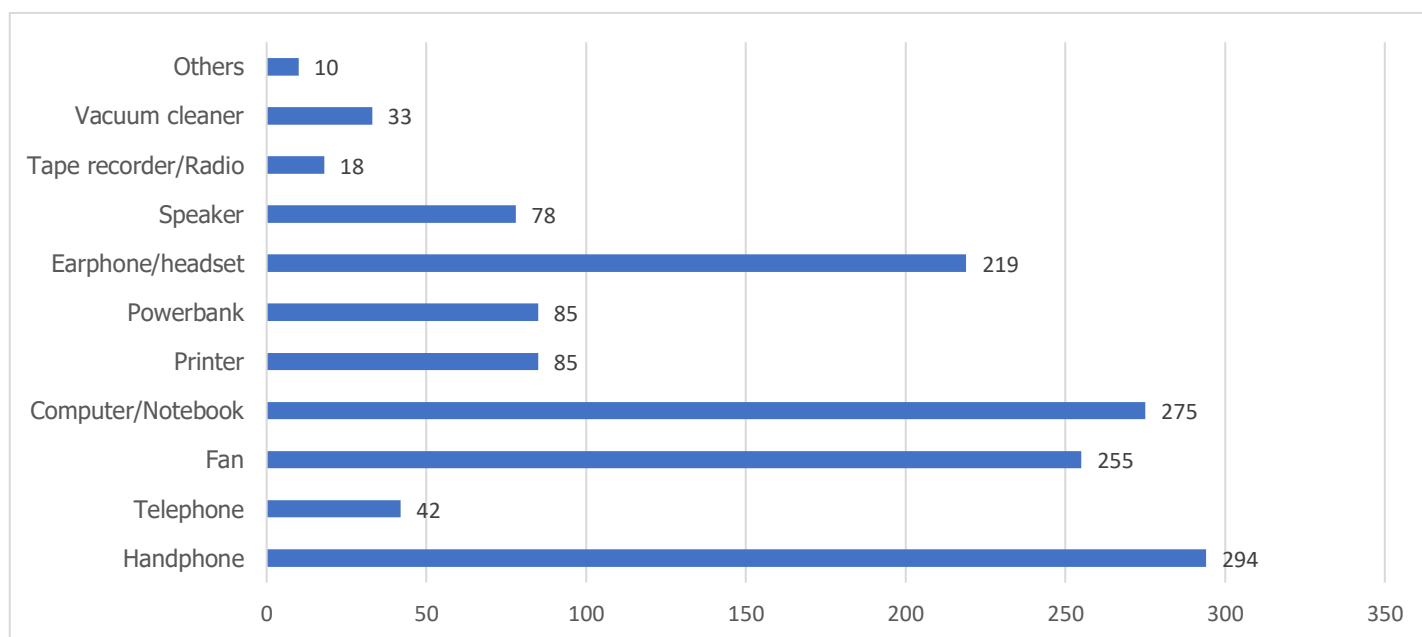


Figure 1
Students' owned electronic devices

Knowledge, attitude, practice, and perception on government regulation

According to Table 2, the research data show that more than half of the students had negative practices (52.7%),

negative attitudes (52.3%), and a poor perception (53.7%) of managing e-waste. However, more than half of the students had good knowledge (63.4%).

Table 2

Frequency distribution of knowledge, attitude, practice, and perception on government regulation on electronic waste management

Variables	n	%
Knowledge		
Good	189	63.4
Less	109	36.6
Attitude		
Positive	142	47.7
Negative	156	52.3
Practice		
Positive	141	47.3
Negative	157	52.7
Perception of Government regulation		
Good	138	46.3
Enough	160	53.7

Table 3

The relationship between attitude, knowledge, perception, and practice on electronic waste management

		PRACTICE		Total	p-value 5%
		Negative	Positive		
ATTITUDE	Negative	128 (73.9%)	45(26.1%)	173	0.000
	Positive	29 (23.2%)	96 (76.8%)	125	
Total		157	141	298	
KNOWLEDGE	Less	63 (57.8%)	46 (42.2%)	109	0.222
	Good	94 (49.7%)	95 (50.3%)	189	
Total		157	141	298	
PERCEPTION	Enough	108 (61.7%)	67 (38.3%)	175	0.000
	Good	49 (39.8%)	74 (60.2%)	123	
Total		157	141	298	

In this research, more than half of the students had a negative attitude toward managing e-waste. The analysis shows a statistically significant relationship between attitude and practice ($p = 0.000$, $p < 0.05$). Among respondents with a negative attitude, 128 (73.9%) demonstrated negative practices, while only 45 (26.1%)

showed positive practices. In contrast, those with a positive attitude predominantly exhibited positive practices (96 individuals or 76.8%), with only 29 (23.2%) engaging in negative practices. These results suggest that a positive attitude significantly improved e-waste management practices.

Compared to other studies examining the relationship between attitudes and practices in e-waste management among students and the community, it was reported that positive attitudes can significantly influence actions in effective waste management. The literature shows that while knowledge is essential, individuals' attitudes often determine their involvement in sustainable action. Meem et al. conducted a study to assess the knowledge, attitudes, and actions (KAP) regarding e-waste management among consumers in Dhaka City, Bangladesh. Their findings show that positive attitudes towards e-waste management correlate with better actions. In particular, respondents who recognized the environmental and health impacts of improper e-waste disposal were more likely to engage in responsible disposal actions. This underscores the importance of fostering positive attitudes through education and awareness campaigns to improve e-waste management actions (Meem et al., 2021). Similarly, Kshtriya's research focused on health science students in Pune, India, highlighting that students with a positive attitude towards e-waste management are more likely to practice proper disposal methods. The study highlights that even with the e-waste law implementation, there is still a knowledge-action gap that can be closed by encouraging students to take a more proactive approach to e-waste (Kshtriya & Anchala, 2023). This shows that educational interventions should not only provide knowledge but also aim to change attitudes towards more sustainable actions.

In a broader context, a study by Babaei et al. on household waste recycling actions shows that attitudes significantly influence recycling behaviour. Their research found that individuals with a positive attitude towards recycling were more likely to engage in practical waste management actions. This is in line with the findings of Meem et al. and Kshtriya, reinforcing the idea that attitudes play an important role in determining aspects of action (Babaei et al., 2015). In addition, a study by Tolera et al. on waste management among slaughterhouse workers in Ethiopia found a statistically significant relationship between positive attitudes and practical waste management activities. The study revealed that workers with good attitudes towards waste management were more involved in appropriate disposal actions, highlighting the critical relationship between attitudes and actions in the context of waste management (Tolera et al., 2022). In addition, research by Kumar and Rahman on biomedical waste management among dental students shows that despite satisfactory levels of knowledge, students' attitudes significantly influence their actions. The study concluded that improving students' attitudes towards waste management can lead to better actions, suggesting that educational programs should focus on attitude modification in addition to knowledge improvement (Kumar & Rahman, 2017). In general, some literature supports that positive attitudes towards *e-waste* and waste management significantly correlate with better actions. Educational programs that aim to cultivate

positive attitudes are crucial to encourage students and the community to manage their e-waste responsibly.

The relationship between knowledge and practice was not statistically significant ($p = 0.222$, $p > 0.05$). While a slightly higher proportion of participants with good knowledge demonstrated positive practices (95 individuals or 50.3%) compared to those with less knowledge (46 individuals or 42.2%), the difference was insufficient to establish a meaningful relationship. This indicates that knowledge alone may not strongly predict e-waste management behaviour. However, several other studies have shown a positive relationship between the level of knowledge about e-waste and actions by individuals and communities. Meem et al. studied knowledge, attitudes, and actions (KAP) in e-waste management among consumers in Dhaka City, Bangladesh. The study results showed that most respondents showed poor knowledge about *e-waste* management, which directly affected their actions. The study emphasizes that increasing knowledge through education and awareness campaigns can lead to improved action in the disposal and recycling of e-waste (Meem et al., 2021). Similarly, Nuwematsiko et al. reported that consumers in Kampala, Uganda, showed inadequate knowledge regarding e-waste management, especially disposal and handling actions. This lack of awareness is associated with inadequate efforts, hence the need for targeted educational initiatives (Nuwematsiko et al., 2021). In addition, Kariwala et al. explored KAP regarding e-waste management among electronic equipment users in Lucknow City, India. Their research demonstrated that only 37% of participants were aware of the adverse health effects of improper e-waste disposal, which was associated with inadequate management strategies. The study concluded that increasing awareness and knowledge about e-waste can significantly improve management actions among users (Kariwala et al., 2023).

Azodo et al. argue that a lack of awareness and information about the dangers of incorrect e-waste management can potentially threaten human health and the environment, so educational intervention is needed (Azodo et al., 2017). In contrast, a study from Dhusia et al. examined the impact of knowledge and cultural factors on e-waste management actions in India. The study showed an insignificant direct relationship between knowledge and action, but found that knowledge of environmental issues can influence e-waste management actions indirectly (Dhusia et al., 2021). So while knowledge is essential, other factors such as cultural attitudes and environmental awareness also play an important role in shaping actions. Furthermore, Razak et al. assessed the KAP on e-waste management among business students at state universities, finding that students have a moderate level of knowledge and actions related to e-waste management. This shows that educational institutions have an important role to play in fostering better understanding and action among future professionals (Razak et al., 2021).

Increased awareness and education are essential to improve the action aspect, which can lead to more

sustainable e-waste management. The interaction of knowledge, cultural factors, and environmental awareness creates a multifaceted approach to address the challenges posed by e-waste.

A significant relationship was found between perception and practice ($p = 0.000$, $p < 0.05$). Respondents with a good perception of government

supervision and regulation tended to engage more in positive practices (74 individuals or 60.2%) than those with only a sufficient perception (67 individuals or 38.3%). This highlights the importance of public trust and confidence in regulatory systems as drivers of proper e-waste handling practices.

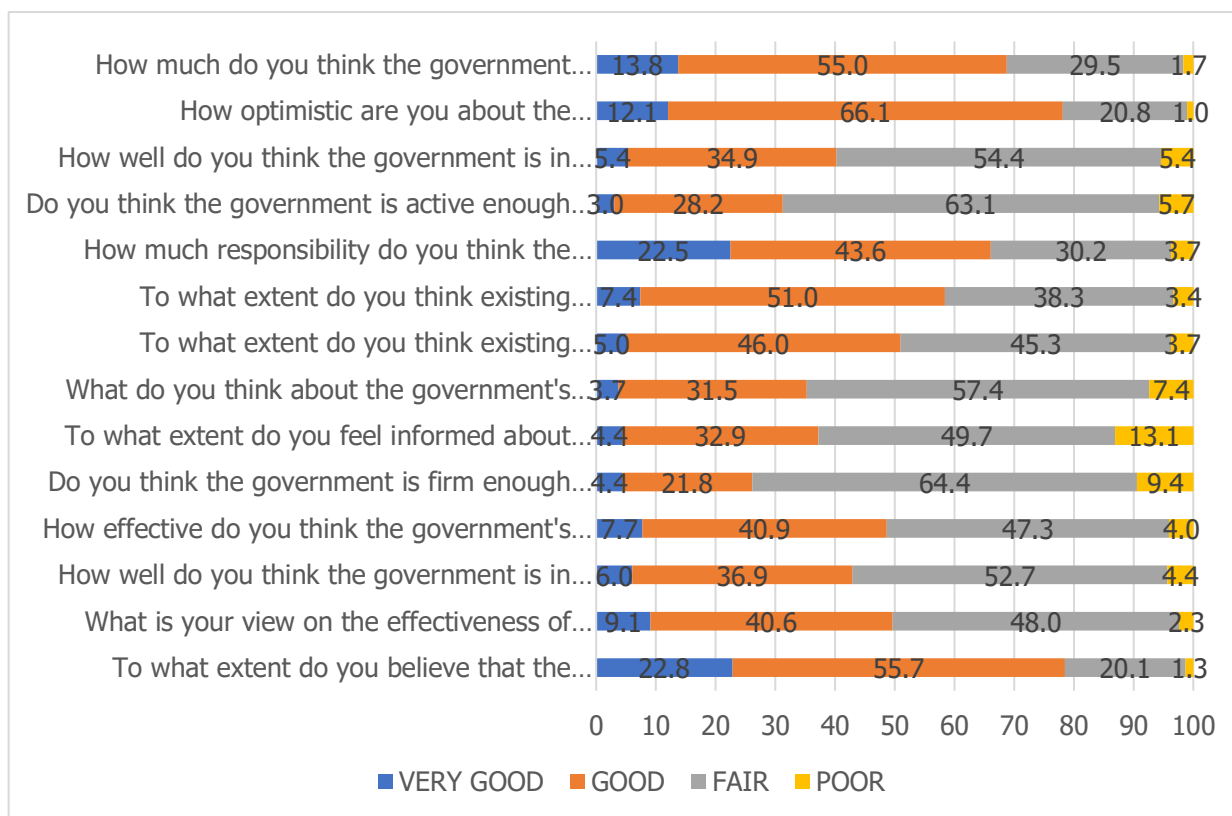


Figure 2. Perception of the government's role in e-waste management

Figure 2 illustrates that the responses are generally concentrated in the fair and reasonable categories, indicating moderate satisfaction with current government actions. For example, many respondents assessed the government's role in facilitating e-waste management (63.1%), public engagement (54.4%), and law enforcement against violations (64.4%) as fair. Similarly, the perceived transparency of government policies (57.4%) and the accessibility of regulatory information (49.7%) are also categorised as fair, indicating perceptions of adequacy rather than effectiveness. While students recognize the government's involvement in e-waste regulation, they also identify weaknesses in policy communication, enforcement, and outreach. These findings highlight the need for improved transparency, more vigorous regulatory enforcement, and enhanced public education to support more effective e-waste management.

Research on the relationship between students' perceptions of government regulations and their practices

regarding *e-waste* management suggests that positive perceptions of government policies can significantly influence responsible waste management behaviours. Several studies have explored this relationship, emphasizing the importance of effective communication and the implementation of supportive policies. Sari et al. conducted a study that examined consumers' intentions to participate in *e-waste* collection programs in Indonesia. The findings reveal that government drivers, including regulations and policies, significantly influence consumers' intentions to engage in *e-waste* management practices. The study highlights that when students and community members find government regulations helpful and supportive, they are more likely to participate in *e-waste collection initiatives* (Sari et al., 2021). This suggests that the effectiveness of government policies is closely linked to public perception, which can increase public engagement in sustainable practices.

Table 4
 Multivariate analysis

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1^a	Attitude	2.212	0.279	62.79	1	0	9.134
	Knowledge	0.302	0.285	1.118	1	0.29	1.352
	Perception	0.834	0.277	9.034	1	0.003	2.302
	Constant	-1.572	0.286	30.17	1	0	0.208
Step 2^a	Attitude	2.218	0.279	63.36	1	0	9.19
	Perception	0.829	0.277	8.971	1	0.003	2.292
	Constant	-1.38	0.215	41.08	1	0	0.252

Multivariate logistic regression assessed the combined influence of knowledge, attitude, and perception on students' e-waste management practices (Table 4). In the initial model (Step 1), three independent variables were included: attitude, knowledge, and perception. The results indicated that attitude ($B = 2.212$, $p < 0.001$) and perception ($B = 0.834$, $p = 0.003$) were significantly associated with proper e-waste management practices. The odds ratio (Exp(B)) for attitude was 9.134, suggesting that students with a positive attitude were approximately nine times more likely to engage in appropriate e-waste management practices than those with a negative attitude. Similarly, students with a good perception of government regulation were 2.3 times more likely (Exp(B) = 2.302) to report good e-waste management practices. In contrast, knowledge did not exhibit a statistically significant association with practice ($B = 0.302$, $p = 0.289$), indicating that knowledge alone may not directly influence behaviour when other factors are accounted for. In the refined model (Step 2), the knowledge variable was removed due to its non-significance. The final model confirmed that attitude ($B = 2.218$, $p < 0.001$, Exp(B) = 9.191) and perception ($B = 0.829$, $p = 0.003$, Exp(B) = 2.292) remained significant predictors of e-waste management behaviour. These findings underscore the importance of fostering positive attitudes and enhancing public trust in regulatory frameworks to encourage environmentally responsible practices among students. Therefore, educational programs aiming to improve e-waste behaviour should emphasize attitudinal and perceptual development rather than solely focusing on knowledge dissemination. Attitude is the most dominant predictor of e-waste management behaviour among students. This suggests that interventions to improve e-waste practices should prioritize shaping positive attitudes over increasing knowledge.

In a broader context, the study by Kazançoğlu et al. highlights the critical role of government support in fostering environmentally responsible behaviors, such as waste reduction and recycling, particularly within

corporate settings. Their findings indicate that the lack of compulsory rules and inadequate governmental support for green projects might considerably hinder the effectiveness of waste management efforts. These insights point to the necessity of establishing clear, enforceable policies that not only regulate producer responsibilities but also influence public attitudes and practices related to electronic waste (Kazançoğlu et al., 2020). Complementing this perspective, Wan et al. emphasize that individuals' perceptions of policy effectiveness play a crucial role in shaping their pro-environmental behaviours. When people perceive government policies as effective and credible, they are more likely to adopt environmentally responsible actions, including proper e-waste disposal and recycling (Wan et al., 2015).

Applied to the university context, these findings suggest that students' internalisation of e-waste management behaviors is likely to be strengthened when they perceive government policies as both legitimate and impactful. Thus, enhancing policy visibility, clarity, and enforcement—while also promoting positive perceptions of such policies—can foster a stronger sense of responsibility among students and encourage more active participation in sustainable e-waste practices. Awodele et al. also highlighted the necessity for awareness of the waste management system among the community to enhance proactive measures. Their findings show that when individuals are informed about government regulations and their implications for waste management, they are more likely to adopt responsible disposal practices. This indicates that effective communication of government policy is crucial for fostering positive perceptions and practices among students and community members (Awodele et al., 2016). Furthermore, research by Elele and Subanda on waste management policies in Indonesia underscored that citizens' perception of government waste management policies has a significant impact on their waste disposal practices. The study concluded that positive perceptions of government efforts in waste management lead to more responsible behaviour among the community, reinforcing the idea that public perception

is an important factor in the success of waste management initiatives (Elele & Subanda, 2020). The literature consistently shows that students' perceptions of government regulations significantly influence their practices regarding e-waste management. Positive perceptions of government policies can increase community engagement and responsible waste management behaviours, highlighting the need for effective communication and a supportive regulatory framework.

Indonesia requires comprehensive and enforceable regulations to implement Extended Producer Responsibility (EPR) for e-waste, ensuring that manufacturers are liable for the complete lifespan of electronic products, including proper management and disposal (Widyarsana et al., 2021). The lack of specific regulations for e-waste management in Indonesia has led to challenges in ensuring sustainable practices and minimizing the environmental impact of electronic waste disposal. One of the cities in Indonesia that has made strides in formal e-waste management is Jakarta, highlighting the importance of localized efforts to address e-waste challenges (Soesanto, 2023). However, the broader national framework for e-waste management in Indonesia still relies on general rules that do not specifically regulate e-waste, such as the Law on Hazardous and Toxic Waste (Akbar & Ardi, 2022). This gap in specific regulations for e-waste management underscores the need for tailored policies and guidelines to address the unique challenges posed by electronic waste. In Indonesia, consumer participation in e-waste collection programs is influenced by government drivers, indicating the importance of introducing regulations for the handling of electronic waste to enhance public engagement and compliance with waste management practices (Sari et al., 2021).

The lack of specific regulations for e-waste in Indonesia has hindered efforts to promote sustainable e-waste management practices and optimize resource recovery from discarded electronic products. The absence of targeted regulations for e-waste has also contributed to challenges in predicting e-waste generation and implementing effective waste management strategies in cities like Bandung (Widyarsana et al., 2021). It is imperative to implement strategies that prioritize infrastructure enhancement, SWOT analysis, and sanction enforcement in order to enhance the sustainability of Indonesia's e-waste management supply chain (Wibowo et al., 2021). The high volume of e-waste in Indonesia necessitates a robust e-waste management infrastructure supported by effective regulations to facilitate the utilization of e-waste resources and minimize environmental impacts. The economic feasibility of establishing e-waste treatment facilities in Indonesia requires a regulatory framework that supports investment in sustainable waste management practices (Andarani & Goto, 2012).

CONCLUSIONS

This research aims to examine the relationship between knowledge, attitudes, perceptions of government involvement, and practices in electronic waste management among university students. The majority of students had good knowledge, more than half demonstrated negative attitudes, and poor practices regarding e-waste management. There was a significant association between attitude and practice, as well as between perception of government regulation and practice. Indonesia faces significant challenges in managing electronic waste effectively due to the absence of specific regulations tailored to e-waste management. The country must develop comprehensive and enforceable regulations that promote Extended Producer Responsibility, enhance consumer participation in e-waste collection programs, and establish sustainable e-waste management practices. By implementing targeted regulations and strategies to address the unique challenges of e-waste management, Indonesia can work towards a more sustainable and environmentally friendly approach to handling electronic waste.

SUGGESTION

To improve e-waste management practices among university students, it is recommended that educational institutions integrate structured environmental education into the curriculum, particularly focusing on the practical aspects of electronic waste handling and disposal. Universities should collaborate with government agencies and environmental organizations (such as Dinas Lingkungan Hidup) to organize regular awareness campaigns, workshops, and training sessions on sustainable e-waste management. Additionally, the government should strengthen and communicate regulations related to e-waste, ensuring students and the broader public understand their role and responsibility in complying with such policies. Establishing accessible e-waste collection points within campuses and promoting student-led initiatives can foster a culture of environmental responsibility and active participation in waste reduction efforts.

REFERENCES

- Abbas, Y., Sarwar, F., Idrees, M., Hussain, I., Jamil, S. U., & Ali, A. (2015). Administrative and Legislative Scrutiny of Existing Computer Waste Management Practices in Pakistan. *American Journal of Environmental Protection, 4(6)*, 279–284. [[Crossref](#)] [[Publisher](#)]
- Akbar, I. A., & Ardi, R. (2022). Development of Integrated Electronic Waste Management System Strategies in Indonesia. In *1st Australian International Conference on Industrial Engineering and Operations Management*. [[Crossref](#)] [[Publisher](#)]
- Alam, M. S., & Bahauddin, K. M. (2015). Electronic Waste in Bangladesh: Evaluating the Situation, Legislation and Policy and Way Forward With Strategy and Approach. *Present Environment and Sustainable*

- Development*, 9(1), 81–101. [[Crossref](#)] [[Publisher](#)]
- Alaskar, K., Akaram, S., Memon, S. A., Desai, V. V., Patil, R. D., & Tamboli, F. A. (2022). Current Status of Electronic Waste in Information Communication Technology (ICT) and Its Environmental Management. *Current World Environment*, 17(3), 836–845. [[Crossref](#)] [[Publisher](#)]
- Andarani, P., & Goto, N. (2012). Preliminary Assessment of Economic Feasibility for Establishing a Households' E-Waste Treating Facility in Serang, Indonesia. *International Journal of Environmental Science and Development*, 3(6), 562–568. [[Crossref](#)] [[Publisher](#)]
- Awodele, O., Adewoye, A. A., & Oparah, A. C. (2016). Assessment of Medical Waste Management in Seven Hospitals in Lagos, Nigeria. *BMC Public Health*, 16(1). [[Crossref](#)] [[Publisher](#)]
- Azodo, A. P., Ogban, P. U., & Okpor, J. (2017). Knowledge and Awareness Implication on E-Waste Management Among Nigerian Collegiate. *Journal of Applied Sciences and Environmental Management*, 21(6), 1035. [[Crossref](#)] [[Publisher](#)]
- Babaei, A. A., Alavi, N., Goudarzi, G., Teymouri, P., Ahmadi, K., & Rafiee, M. (2015). Household Recycling Knowledge, Attitudes and Practices Towards Solid Waste Management. *Resources Conservation and Recycling*, 102, 94–100. [[Crossref](#)] [[Publisher](#)]
- Corwin, J. E. (2019). Between Toxics and Gold: Devaluing Informal Labor in the Global Urban Mine. *Capitalism Nature Socialism*, 31(4), 106–123. [[Crossref](#)] [[Publisher](#)]
- Cruz-Sotelo, S. E., Ojeda-Benítez, S., Jáuregui Sesma, J., Velázquez-Victorica, K. I., Santillán-Soto, N., García-Cueto, O. R., Alcántara Concepción, V., & Alcántara, C. (2017). E-Waste Supply Chain in Mexico. *Challenges and Opportunities for Sustainable Management. Sustainability*, 9(4). [[Crossref](#)] [[Publisher](#)]
- Dhusia, D. K., Gupta, P., Mital, N., & Jain, R. (2021). Analyzing the Impact of Knowledge and Cultural Factors on E-Waste Management Practices in India – An Approach Towards Sustainability. *Administrative Development a Journal of Hima Shimla*, 8(SI-1), 199–214. [[Crossref](#)] [[Publisher](#)]
- Elele, E. C., & Subanda, I. N. (2020). Residents Social Behavior in the Implementation of Denpasar City Waste Management Policy. *Jurnal Ilmiah Ilmu Administrasi Publik*, 10(1), 123. [[Crossref](#)] [[Publisher](#)]
- Ghimire, H., & Ariya, P. A. (2020). E-Wastes: Bridging the Knowledge Gaps in Global Production Budgets, Composition, Recycling and Sustainability Implications. *Sustainable Chemistry*, 1(2), 154–182. [[Crossref](#)] [[Publisher](#)]
- Ghulam, S. T., & Abushammala, H. (2023). Challenges and Opportunities in the Management of Electronic Waste and Its Impact on Human Health and Environment. *Sustainability*, 15(3), 1837. [[Crossref](#)] [[Publisher](#)]
- Goyal, J. K. C. (2023). Awareness of the Electronics Technology Students in Managing Their E-Waste: An Input for Developing an E-Waste Management Policy. *International Journal of Multidisciplinary Applied Business and Education Research*, 4(8), 2702–2717. [[Crossref](#)] [[Publisher](#)]
- Hesham Lotfy Hassan Rabie, S., Saafan, M. G., & Saraya, M. S. (2021). Current Status of the Electronic Waste Problem in Egypt. *Dept. E. Mej Mansoura Engineering Journal*, 46(4), 10–19. [[Crossref](#)] [[Publisher](#)]
- Kariwala, P., Kandpal, S. D., Dixit, S., Singh, A. K., Pathak, A., & Singh, S. (2023). Knowledge, Attitude and Practices Regarding Electronic Waste (E-Waste) Management Among Users of Electronic Equipments Living in Lucknow City. *Indian Journal of Community Health*, 35(1), 38–45. [[Crossref](#)] [[Publisher](#)]
- Kazançoğlu, İ., Sağnak, M., Mangla, S. K., & Kazançoğlu, Y. (2020). Circular Economy and the Policy: A Framework for Improving the Corporate Environmental Management in Supply Chains. *Business Strategy and the Environment*, 30(1), 590–608. [[Crossref](#)] [[Publisher](#)]
- Kshtriya, P., & Anchala, R. (2023). Knowledge, Attitude, Practice, and Generation of Electronic Waste (E-Waste) Among Students of Health Sciences in a Private College in Pune. *Indian Journal of Community Health*, 35(3), 348–353. [[Crossref](#)] [[Publisher](#)]
- Kumar, S., & Rahman, R. (2017). Knowledge, Awareness, and Practices Regarding Biomedical Waste Management Among Undergraduate Dental Students. *Asian Journal of Pharmaceutical and Clinical Research*, 10(8), 341. [[Crossref](#)] [[Publisher](#)]
- Kusch, S. (2017). *Waste Electrical and Electronic Equipment (WEEE): A Closer Look at Photovoltaic Panels*. [[Crossref](#)] [[Publisher](#)]
- Liu, J., He, X. -, Lin, X.-R., Chen, W. ., Zhou, Q., Shu, W. S., & Huang, L.-N. (2015). Ecological Effects of Combined Pollution Associated With E-Waste Recycling on the Composition and Diversity of Soil Microbial Communities. *Environmental Science & Technology*, 49(11), 6438–6447. [[Crossref](#)] [[Publisher](#)]
- Meem, R. A., Majumder, A. K., & Bahauddin, K. M. (2021). Assessment of Knowledge, Attitude and Practice (Kap) of Electronic Waste Management Among Consumers in Dhaka City, Bangladesh. *GSC Advanced Research and Reviews*, 8(2), 126–135. [[Crossref](#)] [[Publisher](#)]
- Mmerek, D., Li, B., Baldwin, A., & Liu, H. (2016). *The Generation, Composition, Collection, Treatment and Disposal System, and Impact of E-Waste*. [[Crossref](#)] [[Publisher](#)]
- Nuwematsiko, R., Oporia, F., Nabirye, J., Halage, A. A., Musoke, D., & Buregyeya, E. (2021). Knowledge, Perceptions, and Practices of Electronic Waste Management Among Consumers in Kampala, Uganda. *Journal of Environmental and Public Health*, 2021(1), 1–11. [[Crossref](#)] [[Publisher](#)]

- Nyakudya, P., Schoeman, T., Madushele, N., & Madyira, D. (2022). Extended Producer Responsibility: A Management Option for E-Waste Management. *5th European International Conference on Industrial Engineering and Operations Management*. [Crossref] [Publisher]
- Paranjape, P., & Yadav, M. D. (2022). Recent Advances in the Approaches to Recover Rare Earths and Precious Metals From E-waste: A Mini-review. *The Canadian Journal of Chemical Engineering, 101*(2), 1043–1054. [Crossref] [Publisher]
- Pérez-Belis, V., Bovea, M. D., & Ibáñez-Forés, V. (2014). An in-Depth Literature Review of the Waste Electrical and Electronic Equipment Context: Trends and Evolution. *Waste Management & Research the Journal for a Sustainable Circular Economy, 33*(1), 3–29. [Crossref] [Publisher]
- Popoola, O., Popoola, A., & Purchase, D. (2019). Levels of Awareness and Concentrations of Heavy Metals in the Blood of Electronic Waste Scavengers in Nigeria. *Journal of Health and Pollution, 9*(21). [Crossref] [Publisher]
- Purchase, D., Abbasi, G., Bisschop, L., Chatterjee, D., Ekberg, C., Ermolin, M. S., Fedotov, P. S., Garelick, H., Isimekhai, K., Kandile, N. G., Lundström, M., Matharu, A. S., Miller, B. W., Pineda, A., Popoola, O., Retegan, T., Ruedel, H., Serpe, A., Sheva, Y., & Wong, M. H. (2020). Global Occurrence. *Chemical Properties, and Ecological Impacts of E-Wastes (IUPAC Technical Report)*. *Pure and Applied Chemistry, 92*(11), 1733–1767. [Crossref] [Publisher]
- Razak, S. S. A., Logaiswari, A., & Indiran, P. (2021). Knowledge, Attitude and Practices on E-Waste Management Among Business Students in a Public University. *International Journal of Academic Research in Business and Social Sciences, 11*(8). [Crossref] [Publisher]
- Sari, D. P., Masrurroh, N. A., & Asih, A. M. S. (2021). Consumer Intention to Participate in E-Waste Collection Programs: A Study of Smartphone Waste in Indonesia. *Sustainability, 13*(5), 2759. [Crossref] [Publisher]
- Soesanto, H. (2023). Design of Sustainable Electronic Waste Management Business Process Transformation Towards Circular Economy Transition in Jakarta, Indonesia. *Iop Conference Series Earth and Environmental Science, 1266*(1), 12038. [Crossref] [Publisher]
- Tolera, S. T., Alemu, F. K., & Mengistu, D. A. (2022). Knowledge, Attitude, and Practice of Abattoir Workers Toward Abattoirs Waste Management in Eastern Ethiopia. *Environmental Health Insights, 16*. [Crossref] [Publisher]
- Wan, C., Shen, G. Q., & Yu, A. T. (2015). Key Determinants of Willingness to Support Policy Measures on Recycling: A Case Study in Hong Kong. *Environmental Science & Policy, 54*, 409–418. [Crossref] [Publisher]
- Wath, S. B., Vaidya, A. N., Dutt, P., & Chakrabarti, T. (2010). A Roadmap for Development of Sustainable E-Waste Management System in India. *The Science of the Total Environment, 409*(1), 19–32. [Crossref] [Publisher]
- Wibowo, N., Piton, J. K., Nurcahyo, R., Gabriel, D. S., Farizal, F., & Madsuha, A. F. (2021). Strategies for Improving the E-Waste Management Supply Chain Sustainability in Indonesia (Jakarta). *Sustainability, 13*(24), 13955. [Crossref] [Publisher]
- Widyarsana, I. M. W., Supramono, D. S., & Fadel, N. (2021). Electronic Waste Generation Prediction in Bandung City, Indonesia. *Environmental and Climate Technologies, 25*(1), 111–120. [Crossref] [Publisher]