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Potentialities of the environmental law and policy for e-waste recycling: a vista for sustainable development

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Abstract

E-waste production contains damaged, obsolete, non-functional, old, or expired goods, which are allocated into two sources: industrial and household production. Disposing e-waste will hurt public well-being. This study was conducted to examine the effects of environmental law and policy on the connections between environmental attitudes, subjective norms, perceived behavioral control, and e-waste recycling. The chosen study location was the southern region of Malaysia, and consisted of selected individual residents. The methodology used was quantitative, and this study used a questionnaire as the primary material; 258 respondents answered the survey. The data investigation method used was moderated regression analysis. This study concludes that environmental attitudes, subjective norms, and perceived behavioral control positively affect e-waste recycling behavior. Interaction investigation in regression shows that environmental laws and regulations can develop the control of environmental attitudes and subjective norms on e-waste recycling behavior. In contrast, environmental laws and regulations do not moderate the correlation between perceived behavioral control and e-waste recycling. Thus, the Malaysian government requires a strong legal and institutional structure for environmental protection and self-control practices to foster sustainable development.

Keywords:
Environmental law and policy;
Environmental attitude;
Subjective norm;
Perceived behavioral control;
E-waste recycling;
Interaction.

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1. Introduction

The Sustainable Development Goals (SDGs) are 17 goals presented by the United Nations (UN). The 17 SDGs involved 169 specific targets covering diverse types of sustainable development, such as eliminating poverty, improving health, and addressing climate change. (Bhaskar & Kumar, 2019). The sustainable development method agreed upon in the SDGs is based on the idea that economic success, environmental safety, and community well-being are interrelated elements that cannot be overcome individually. E-waste culminating in landfills can compromise the environment and human health, affecting the SDG15, which aims to safeguard and rebuild terrestrial ecosystems, forests, mountains, drylands, swamps, and biodiversity.

Electronic waste, also known as e-waste, is often used to portray used electronics nearing the expiration of their functional life and being discarded, donated, or given to recyclers

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(Shahabuddin et al., 2023). The environmental impact of e-waste cannot be ignored as it pressures the environment and its life forms (Yang et al., 2025). E-waste confines contaminated and unsafe materials such as mercury, which can severely threaten human health and the environment. Many plans have been made to address this increasing concern, but none have been entirely successful without a proper strategy (He et al., 2024).

Based on the report unveiled in the Global E-waste Monitor 2024, only 13.8 billion kg of e-waste is recognized as formally composed and cast-off in an environmentally sound method, and 18 billion kg of e-waste is projected to be held in low- and lower-middle-income countries with no established e-waste management infrastructure (Grandhi et al., 2024). Furthermore, 14 billion kg of e-waste is projected to be disposed worldwide. Between 2019 and 2023, the number of nations with e-waste laws grew slightly from 78 to 81. Of these 81 countries, 67 had a legal method of managing e-waste management encompassing provisions supporting the environmental policy principle of extended producer responsibility (EPR) (Grandhi et al., 2024). However, the enforcement of e-waste regulations and guidelines remains a legitimate global task. Rautela and Yadav (2023) reported that approximately 71% of the world's population was protected by e-waste legislation and regulations in 2019. Nevertheless, only 78 of the 193 countries have applied e-waste regulations and statutes.

In 2022, only three countries in the European Union (EU), Bulgaria, Latvia, and Slovakia, achieved the objective of 65 percent e-waste collection (Datsyuk et al., 2023). In Malaysia, the collection percentage was recounted as below the target of 40 percent, notwithstanding the execution of an e-waste management system. The Malaysian national recycling rate in 2022 has increased to 33.17 percent, with the total amount of recyclables reaching 4.626 million tons (Yu et al., 2024). The rate of increase was still small from the recycling rate target set in the 12th Malaysia Plan, which is 40 percent by 2025. Regarding acceptance, the Malaysian public is generally unaware of the necessity of recycling e-waste (Rodzi et al., 2024). As a result, many prefer to retain end-of-life devices in their collections for as long as possible. It is worth noting that some e-waste is disposed of through regular trash cans with other solid waste. Therefore, this study examined the factors affecting e-waste recycling behavior among Malaysians. These include environmental laws and policies, environmental attitudes, subjective norms, and perceived behavioral control. The second is to investigate the interaction effect of environmental law and policy towards the relationships between environmental attitude, subjective norms, perceived behavioral control, and e-waste recycling. In this study, researchers believed that environmental law and policy can undermine or reinforce the interactions between environmental attitudes, subjective norms, perceived behavioral control, and e-waste recycling.

Laws are imperative for environmental management (Bird et al., 2022; Kyriakopoulos, 2021; Mulakkal et al., 2021; Rene et al., 2021). Developing laws and policies safeguards the environment and human well-being (Jiang, 2024). A list of public laws that highlight environmental management towards achieving sustainable development in Malaysia includes (a) the Environmental Quality Act, 1974 (Act 127), (b) Roads, Drains, and Buildings Act, 1974 (Act 133), (c) the Town and Country Planning Act, 1976 (Act 172), and others. All the laws mentioned above are classified as public law because they regulate and govern the link between the Malaysian state and an individual or group of individuals. Two central policies uphold e-waste management: the National Cleanliness Policy and the National Solid Waste Management Policy.

There are no specific laws or policies governing e-waste in Malaysia, especially at the household level (Sanghvi, 2023). The Environmental Quality Act of 1974 (Act 127) delivers legal guidelines and sanctions only to the industry. E-waste recycling is voluntary. In 2025, the Ministry of Natural Resources and Environmental Sustainability planned to create a specific law or policy regarding the management of e-waste at the national level (Bernama, 2025). This move was needed because Malaysia had no policy directing the issue for public reference. This study aims to fill these gaps in literature. First is the prospect that embracing the theory of planned behavior (TPB) has

limitations and cannot yet support research. TPB only recognizes the disposition of attitude, subjectivity, and perceived behavioral control on intention and behavior. Nevertheless, behavioral modifications may not be viable and may be adjusted by other intervening or interacting variables. Limitations exist regarding its narrow focus on observable behavior and the potential neglect of the internal and external factors influencing it. Second, the researchers realized a gap between the evidence from past studies. For example, Vijayan et al. (2023) found an opposite correlation between perceived behavioral control and the intent to recycle electronic waste. Aboelmaged (2021) also showed that subjective norms and behavioral control do not substantially impact e-waste recycling. Neves et al.'s (2024) findings indicate that taxation lowers e-waste exports abortively. Moreover, substantial focus has been placed on assessing e-waste intention instead of real action and behavior, especially in the Malaysian context (e.g., Noor et al., 2023; Shaharudin et al., 2023). Third, there is a knowledge gap when most past studies have heavily investigated the direct association between variables, and research on the impact of law and policy is still contracted.

2. Literature review

The theory of Planned Behavior (TPB) is planned to forecast and justify human actions in a detailed context (Ajzen, 1991). TPB is an extension of the Theory of Reasoned Action (TRA), which owns restrictions by only describing the behavior that is desired (volitional control) (Ajzen, 1991). According to the TRA, the intention to perform absolutely will only occur if the behavior is required, even though many behaviors are not in complete individual control (incomplete volitional control). Although someone has an attitude of positivity and acceptance of others (subjective norm), actual behavior may not develop because of environmental factors. Ajzen (1991) included the perceived behavioral control construct to overcome these weaknesses and verify intention. Ajzen (1991) declared that three factors affect a person's intention (see Figure 1). The first is attitude towards the behavior, where someone has a favorable or unfavorable estimation of the behavior. The second is social factors or subjective norms that imply the social pressure perceived to execute the behavior. Third, perceived behavioral control implies the maneuver or difficulty perceived in performing the behavior and the expectation of various obstacles in displaying behavior. Applying TPB theory, this study suggests the influence of environmental law and policy on the interactions among environmental attitudes, subjective norms, perceived behavioral control, and e-waste recycling.

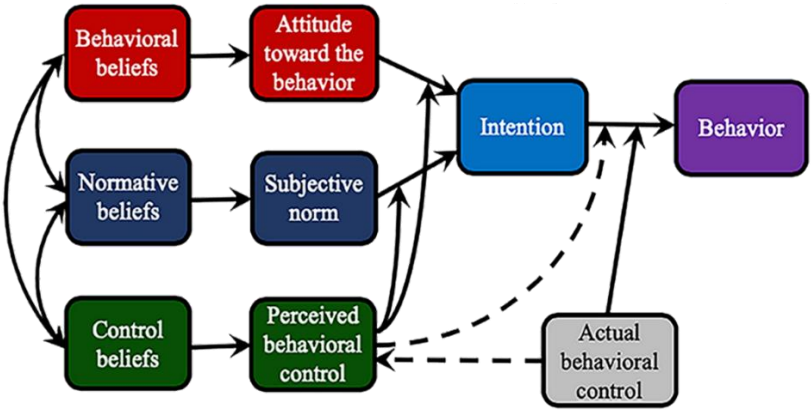

Figure 1: TPB Model (Adapted from Ajzen, 1991)

2.1 Environmental attitude

According to Heberlein (2012), attitude is a belief that is interpreted as an action on a desired object. Attitude is a positive or negative valuation of the response to objects, people, situations, or

other aspects, and it allows us to predict and change the behavior of society. Milfont and Duckitt (2010) separated two models from the description of attitude: (1) attitude as an amalgamation of affective, cognitive, and conation and (2) attitude as a positive or negative assessment of a particular object uttered with a certain intensity. Recycling practices are closely conveyed to a person's attitude towards the environment (Simsar, 2021). Attitudes strongly affect behavior, and judging attitudes in consumer behavior research is important (Corrado et al., 2022). Environmental attitudes are valuable in inducing human behavior towards the environment. Individuals with positive attitudes towards the environment will apply these attitudes daily (Negash et al., 2021). This belief has been supported by a study by Corrado et al. (2022). Moustairas et al. (2022) defined environmental attitudes as the tendency to learn to respond consistently, favoring, or disfavoring the environment. Chao et al. (2023) stated that attitudes would foresee behavior but are restricted to environmental issues and not to more general issues. Therefore, the following hypothesis is proposed:
H1: Environmental attitude significantly predicts e-waste recycling.

2.2 Subjective norm

Subjective norms exist when a person knows a particular social norm and chooses to comply. This induces a person to act in accordance with normative expectations and past experiences (Ajzen, 1991). Subjective norms affect a person if perceived behavioral rules exist in a group. Aboelmaged (2021) found that a person who sees others completing e-waste recycling activities is also more likely to engage in such behaviors. Mohamad et al. (2022) found that subjective norms can influence an individual's commitment to recycling e-waste. Another study by Mohd Noor et al. (2022) analyzed behavioral intentions to recycle household waste and found that subjective norms are one of the core diviners of recycling. Similarly, Vijayan et al. (2023) found that subjective norms are a predictor of recycling behavior motivation in the context of insignificant waste control. However, Noor et al. (2023) found that neighbors who do not manage their waste often inspire neighbors not to. Subjective norms are modeled on two aspects: family norms and social norms of friendship. The norm is considered adequate for interference to increase the intention of pro-environmental behavior, especially descriptive norms rather than injunctive norms. Descriptive norms emphasize what other people do or do not do. Descriptive norms are more effective than injunctive norms, indicating that someone is more likely to see what others are doing from what others say. Based on this reasoning, the following hypothesis is proposed:
H2: Subjective norm predicts e-waste recycling.

2.3 Perceived behavioral control

An individual's self-control over behavior is produced by several properties, including internal and external influences (Ajzen, 1991). Internal influences, such as skills, will, and information, come from within the individual. Simultaneously, external influences come from the environment across individuals. Perception of behavioral control refers to how a person admits that the behavior in which he/she appears is the consequence of control. Ajzen (1991) showed that situational variables imply a person's observation of the ease or strain of presenting a behavior. On the other hand, Puzzo and Prati (2024) termed situational variables as personal situations given behavioral circumstances (e.g., service provision), individual traits (e.g., socio-demographics), and individual wisdom and proficiency in a behavioral manner. Shahabuddin et al. (2023) explored consumer observations of lack of accessibility to validate consumer e-waste recycling intentions. Accessibility is segregated into two categories: availability and capability. Thus, recycling programs have not yet fully recognized this practice. A study by Dutta and Goel (2021) found that deprivation of facilities influenced the assembly between perceived behavioral control and recycling intentions. Jain et al. (2023) studied the influence of availability attributes (e.g., recycling fees, days open, and driving distance) on the collection rate. They learned that the number of items gathered decreased with the recycling fee and improved with the number of days

open. Facilities such as material assembly points, transportation, and recycling bins are among the attributes that should be depicted regularly to convince users to participate in recycling programs (Puzzo & Prati, 2024). Therefore, we propose the following hypothesis:
H3: Perceived behavioral control predicts e-waste recycling.

2.4 Moderating role of environmental law and policy

This study suggests the moderating roles of environmental law and policy. Moderating variables could affect the intensity or path of the relationships between environmental attitudes, subjective norms, perceived behavioral control, and e-waste recycling. The moderating variable gives circumstance to the association between the independent and dependent variables, so the relationship's complexion can be altered depending on the moderating variable's value. For instance, Awan et al. (2025) reveal the significant moderating role of environmental policy strictness in OECD economies, where it can reinforce the relationship between green innovation and green growth. Dong et al. (2023), Zhang and Li (2023), and Zhao et al. (2022) studied the moderating roles of environmental law and policy. Past research, such as Bird et al. (2022), Kyriakopoulos (2021), Mulakkal et al. (2021), and Rene et al. (2021), has established that environmental law and policy are necessary enablers for e-waste recycling and administration. Law, including e-waste administration, plays an elementary role in maintaining order, justice, and equilibrium in a country (Dias et al., 2022; Noor & Nordin, 2023). The magnitude of law covers several aspects of community life, from securing citizens' rights to controlling the social and economic order. In Malaysia, the Environmental Quality Act of 1974 indicates the love of the Malaysian community for the environment. In Malaysia, e-waste is classified as scheduled waste in the First Schedule, Code SW110, in the Environmental Quality (Scheduled Waste) Act 2005 (Ismail & Hanafiah, 2021). This waste is classified as flammable, corrosive, reactive, and poisonous. Because e-waste is classified as organized waste, the responsibility for overseeing e-waste rests with the Department of Environment (DOE) under the Ministry of Natural Resources and Environmental Sustainability. According to the Environmental Quality (Scheduled Waste) Act 2005, e-waste will only be supervised by contractors nominated by the DOE and relinquished to premises designated by the DOE (Noor & Nordin, 2023). However, the enforced regulations only use industry-generated e-waste and not households (Yahya et al., 2022).

Household solid waste is defined in Section 2 of the Solid Waste and Public Cleansing Management Act 2007 (Act 672) (Yahya et al., 2022). Act 672 was lawful in guaranteeing the uniformity of law in organizing and overseeing matters involving solid waste management and public cleaning through Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan (Sanghvi, 2023). Act 672 allowed the Federal Government to direct solid waste and public sanitation from Local Authorities throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan (Shaharudin et al., 2023). On February 21, 2019, the Minister of Housing and the Local Government declared the formation of a National Cleanliness Policy. This policy is a government strategy to make Malaysia a clean country and to institute a society that cultivates clean habits. Cleanliness is a valuable aspect in recognizing a developed country's status. Moreover, the Cabinet accepted the National Solid Waste Management Policy on September 13, 2006, with the goal of creating a comprehensive, united, cost-effective, sustainable, and socially documented solid waste management system and applying solid waste management that bounces urgency to waste reduction through Reduce, Reuse, Recycle (3R), and final disposal. Thus, based on the above analysis, the following hypothesis is proposed:
H4: Environmental law and policy moderate the influence of (a) environmental attitude, (b) subjective norms, and (c) perceived behavioral control on e-waste recycling behavior.

3. Research framework

Figure 1 presents the conceptual model used in this study. We hypothesize that e-waste recycling is determined by environmental attitude, subjective norm and perceive behavioral control. The relationships between the independent and dependent variables are hypothesized to be moderated by environmental law and policy.

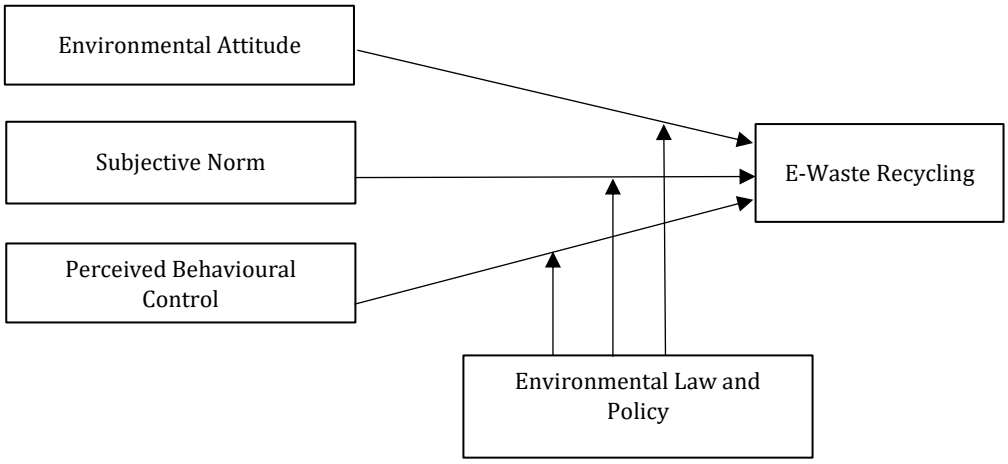

Figure 2: Research model

4. Methods

This study employed a cross-sectional survey design using a quantitative approach. As shown in Figure 3, the study population comprised Malaysian residents in the southern region (i.e., Negeri Sembilan, Melaka, and Johor). Based on previous studies, there is still a lack of studies examining e-waste recycling in the southern region of Malaysia, and most of them have heavily examined the context in Klang Valley or urban areas (e.g., Hamzah et al., 2022; Yahya et al., 2022). This population gap occurs in previous research, which cannot reach the vast population for research data collection. According to open data disclosed by the Department of Statistics Malaysia in 2024, the population for each state in the southern region is as follows: 1) Johor (4,186 million), 2) Melaka (1,047 million), and 3) Negeri Sembilan (1,240 million). Thus, the total population of the southern region is 6.473 million residents.

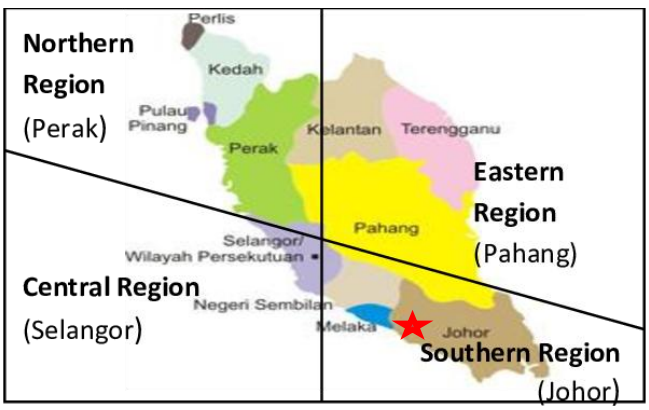

Figure 3: Southern Region, Malaysia

The Krejcie and Morgan (1970) formula is a statistical method used to determine the number of samples required for research. Based on this formula, the sample size needed for this study was 384 respondents who were residents of states in the southern region. This study used quota and convenience sampling. The researchers then allocated 40% of the total sample size to Johor (n=154), followed by 30% to Melaka (n=115) and Negeri Sembilan (n=115). The weightage is assigned based on the number of populations, with Johor having the highest population compared to Melaka and Negeri Sembilan.

The study data were collected using a questionnaire and the items were adjusted from past studies. The questionnaire was tailored to the English version of the questionnaire. This study utilized an online survey approach with the Google Form application. Google Forms are displayed on social media such as Facebook, Instagram, and TikTok. The research items were altered from the studies by Aboelmaged (2021) for evaluating environmental attitude, Rakhmawati et al. (2023) for gauging subjective norms, perceived behavioral control, environmental law and policy, and Darby and Obara (2005) for measuring e-waste recycling. A Likert scale ranging from 1 to 5 was used.

A reliability test was used to assess the level of dependability of a questionnaire designed based on the specific indicators of a variable or construct. The reliability of determining instruments is usually assessed through reliability coefficients, such as Cronbach's alpha, where a value above 0.6 indicates a good reliability level (Hulin et al., 2001). Based on the results shown in Table 1, the variables' instruments were presumed to be reliable. The normality test is a statistical method that reviews whether data distribution in a variable or group follows a normal distribution pattern and measures data preservation. According to Kline (2005), skewness values must descend between -3 and +3, and kurtosis values must fall between -10 and +10. Based on the results shown in Table 1, this study also completed a normality assumption was also made.

Table 1: Measurement items, normality, and reliability results

Variable	Items	Skewness	Kurtosis	Cronbach's Alpha
Environmental Attitude	1. E-waste recycling makes me feel pleased. 2. E-waste recycling impacts society. 3. E-waste recycling is everyone's obligation. 4. E-waste recycling is useful	-0.821	0.635	0.896
Subjective Norm	1. People who are significant to me support waste-sorting behavior. 2. People who are valuable to me think that sorting e-waste is a good activity. 3. People who are vital to me sort them out. 4. People who are crucial to me think that I should sort my e-waste.	-0.181	0.179	0.906
Perceived Behavioral Control	1. For me, sorting is straightforward. 2. I have the resources, time, and chance to sort e-waste. 3. I can sort e-waste if I am willing. 4. The determination to sort e-waste or not rests solely in my hands.	1.011	0.903	0.930
Environmental Law and Policy	1. Environmental monitoring encourages me to sort e-waste. 2. Environmental regulations persuade me to sort waste. 3. Government policies inspire me to sort waste. 4. Government promotions have helped me to understand the significance of e-waste sorting.	-0.286	0.068	0.898
E-Waste Recycling	1. I donated e-waste. 2. I resell e-waste. 3. I store e-waste.	- 0.479	0.476	0.689

Out of the 384 surveys distributed, 258 respondents answered the questionnaire that was administered in person. The response rate of the survey was 67.2%. Response rates of approximately 60% for most studies were considered acceptable. A descriptive analysis was used to depict the demographic characteristics of the selected respondents. In this study, correlation and hierarchical regression tests were used. The correlation test was applied to determine the magnitude of the relationship between environmental attitude, subjective norms, perceived behavioral control, environmental law and policy, and e-waste recycling. Regression tests were conducted to determine the degree to which environmental law and policy moderate the relationships between (a) environmental attitude, (b) subjective norm, (c) perceived behavioral control, and e-waste recycling. The significance level in this test was set at alpha (α) = 0.05, which indicates a 95 percent confidence level.

5. Results

Validity is the magnitude to which an instrument agrees with what it is expected to assess. Principal Component Analysis (PCA) in the Exploratory Factor Analysis (EFA) process was performed, and varimax rotation was used. The Bartlett test results were significant for *p*-values less than 0.05 ($p < 0.05$). Meanwhile, the value for determining sampling adequacy from Kaiser-Meyer-Olkin (KMO) is 0.740, which shows that the data used in this study are assumed according to the EFA process. The factor analysis results for the study variables include five factors (see Table 2). Factor loading reached a set value (>0.50). Thus, the instrument-measured variables were valid.

Table 2: Exploratory Factor Analysis (EFA)

Rotated Component Matrix

	1	2	3	4	5
EA1		0.640			
EA2		0.621			
EA3		0.577			
EA4		0.540			
SN1			0.710		
SN2			0.720		
SN3			0.734		
SN4			0.740		
PBC1				0.800	
PBC2				0.810	
PBC3				0.720	
PBC4				0.712	
ELP1					0.789
ELP2					0.688
ELP3					0.678
ELP4					0.659
EW1	0.611				
EW2	0.620				
EW3	0.578				

5.1 Demographics profile

Based on Table 3, most respondents were female (192 respondents, 74.4%), and the rest were male (66 respondents, 25.6%). Of the respondents, 155 were from the low-income group (60.1%), 87 were from the middle-income group (33.7%), and sixteen respondents are from the high-income group (6.2%). Regarding the level of education, most respondents had obtained undergraduate qualifications, with 179 (69.4%). This was followed by *Sijil Pelajaran Malaysia (SPM)* with 64 people (24.8%), *Sijil Tinggi Pelajaran Malaysia (STPM)* with nine respondents (3.5%), a foundation with four respondents (1.6%), and a secondary school level with two respondents (0.8%).

Table 3: Demographic profile

Profile		Frequency (n)	Percentage (%)
Sex	Female	192	74.4
	Male	66	25.6
Monthly Income	Low Income	155	60.1
	Middle Income	87	33.7
	High Income	16	6.2
Level of Education	Secondary School	2	0.8
	Sijil Pelajaran Malaysia (SPM)	64	24.8
	Sijil Tinggi Pelajaran Malaysia (STPM)	9	3.5
	Foundation	4	1.6
	Undergraduate	179	69.4

5.2 Pearson correlation results

Pearson's correlation helps researchers verify whether variables move together consistently, positively, or negatively. The Pearson correlation analysis results showed significant and positive correlations between the study variables. The results are presented in Table 4.

Table 4: Correlation results

	Mean	**SD**	**1**	**2**	**3**	**4**	**5**
Environmental Attitude	4.164	0.710	1				
Subjective Norm	2.988	0.935	0.447**	1			
Perceived Behavioral Control	2.591	0.849	0.483**	0.416**	1		
Environmental Law and Policy	3.792	0.754	0.561**	0.495**	0.575**	1	
E-Waste Recycling	3.805	0.794	0.416**	0.407**	0.480**	0.510**	1

**Correlation is significant at the 0.01 level (2-tailed)

5.3 Moderated regression analysis

Table 5 shows the regression results, which indicate that the estimated equation is statistically significant at less than 1 percent ($p< 0.01$). This indicates that the results for Models 1, 2, 3, 4, and 5 are significant. Model 1 shows a regression analysis with two variables: environmental attitude and e-waste recycling. The model was significant with R square = 0.100 and Adjusted R square=0.040. The results showed that environmental attitudes predicted e-waste recycling (β=0.312, p<0.01).

In Model 2, two independent and dependent variables were included in the model. After statistical control, the model showed evidence of a direct relationship between the independent and dependent variables. As shown in Table 5, Model 2 improved substantially, with *R* square=0.120 and adjusted *R* square=0.060. The results showed that the control variables, namely, environmental attitude (β=0.279, p<0.01) and subjective norm (β=0.240, p<0.01), were significant at p<0.01.

In Model 3, Model 3 increased significantly with R square = 0.140, Adjusted R square = 0.080. The results showed that the control variables, namely environmental attitude (β=0.230, p<0.01), subjective norm (β=0.210, p<0.01), and perceived behavioral control (β=0.220, p<0.01), were significant at p<0.01. Hence, Hypotheses 1, 2, and 3 were assumed.

In Model 4, all variables were entered, and Model 4 progressed substantially with R square = 0.180 and Adjusted *R* square=0.100. The results show that environmental attitude (β=0.119, p<0.01), subjective norm (β=0.200, p<0.01), perceived behavioral control (β=0.109, p<0.01), and environmental law and policy (β=0.278, p<0.01) were significant at p<0.01. In Model 5, all variables and interaction terms were entered to determine their significance of the interaction

terms. Model 5 improved significantly with *R* square=0.250 and Adjusted *R* square=0.210. The results showed that environmental law and policy significantly moderated the relationship between environmental attitude and e-waste recycling (β =0.250, p<0.01) and between subjective norms and e-waste recycling (β=0.380, p<0.01). Therefore, Hypotheses 4(a) and 4(b) agree.

Table 5: Moderated regression results

Variable	Std Beta Model 1	Std Beta Model 2	Std Beta Model 3	Std Beta Model 4	Std Beta Model 5
Model variables					
Environmental Attitude	0.312**	0.279**	0.230**	0.119**	0.107**
Subjective Norm		0.240**	0.210**	0.200**	0.196**
Perceived Behavioral Control			0.220**	0.109**	0.008
Environmental Law and Policy				0.278**	0.266**
Moderating effect					
Environmental Law and Policy*Environmental Attitude					0.250**
Environmental Law and Policy*Subjective Norm					0.380**
R square	0.100	0.120	0.140	0.180	0.250
Adjusted *R* square	0.040	0.060	0.080	0.100	0.210

**Correlation is significant at the 0.000 level (2-tailed)

6. Discussion

This study examined the influence of environmental laws and policies on the interactions among environmental attitudes, subjective norms, perceived behavioral control, and e-waste recycling. This research confirms that environmental attitudes, subjective norms, and perceived behavioral control indeed impact e-waste recycling behaviors. The interaction investigation in regression shows that environmental law and regulation can strengthen the effect of environmental attitudes and subjective norms on e-waste recycling behavior. This outcome is consistent and supports the moderating role of environmental laws and regulations carried out by Awan et al.' (2025), Dong et al.' (2023), Zhang and Li' (2023), and Zhao et al.' (2022). Thus, the Malaysian government requires a robust legal and institutional framework for environmental protection and self-control practices to foster sustainable development. These results prove that environmental management can be achieved through non-legal methods (i.e., policy) and law. These results are supported by previous studies, such as Bird et al. (2022), Kyriakopoulos (2021), Mulakkal et al. (2021), and Rene et al. (2021). Environmental management through non-legal methods includes the planning, monitoring, implementation of guidelines, and application of codes of practice, education, and research and development (Jain et al., 2023). Environmental administration through law at the national level can be classified into two segments: environmental administration through public law and environmental administration through private law.

Environmental laws and policies can be used to protect the environment and promote sustainable practices (Bird et al., 2022). These laws and policies aim to inhibit pollution, conserve natural resources, and guarantee the health and well-being of humans and ecosystems (Dias et al., 2022; Noor & Nordin, 2023). This is notable because it presents a legal framework for addressing environmental problems and holds individuals, organizations, and industries accountable for their actions (Mulakkal et al., 2021). It helps avoid environmental deprivation, upholds sustainability, and shields the health and future of our planet (Bird et al., 2022; Kyriakopoulos, 2021; Mulakkal et al., 2021; Rene et al., 2021). Penalties for breaking environmental laws can differ depending on the seriousness of the violation and the jurisdiction. These may involve penalties, imprisonment, or both. In addition to legal outcomes, violators may be required to restore the environmental damage and face reputational harm. Blending these regulations,

orders, and methods with the Act is a powerful tool for dealing with environmental problems in this country. In environmental conservation, strict regulations are needed to ensure that the nature we inhabit can be conserved in terms of health (Dias et al., 2022; Noor & Nordin, 2023).

As a practical consequence, government environmental officers play a key role in enforcing environmental laws and policies. They must supervise compliance, investigate violations, and enforce penalties when necessary (Sanghvi, 2023). Recognizing the ins and outs of environmental law allows officers to shield the environment, warrant public health and safety, and uphold sustainable development. Among the factors that can support the development of sound environmental legislation are the government's ability to provide experts and equipment to enforce legislation, the preparedness of the private sector to provide financial allocations to find and deliver the most advanced environmentally friendly technology, and the awareness and continuous concern of society towards the environment. If all legal provisions can be updated occasionally, informed, understood, mobilized, and enforced, half of this environment will be saved (Yahya et al., 2022). Environmental consultants need to guide businesses on compliance with environmental laws and regulations by developing strategies to reduce environmental impacts and ensure that clients comply with applicable laws. Managers of sustainability within companies are also liable to develop and implement sustainability approaches.

Moreover, an efficient campaign must integrate effective messages, e-waste management, and community involvement. Social sectors, such as schools or companies, should be apprehended to accelerate the positive effect. School e-waste recycling and awareness from an early age are key to its long-term accomplishments. Education about the use of e-waste recycling should be injected in schools and at home, while parents and teachers should educate children about the appropriate method for disposal of e-waste (Aboelmaged, 2021; Mohamad et al., 2022). Policies on e-waste disposal and recycling must be articulated because many people still need to dispose of e-waste. The government must re-enact heavier penalties to ensure that such things are not widespread.

Mass media is also valuable in suggesting that the e-waste recycling movement is more effective in the community (Dutta & Goel, 2021). Advertisements about e-waste recycling should be continuously publicized to ensure that the community is always aware of this campaign. The government and local authorities must increase the number of e-waste recycling bins and centers (Puzzo & Prati, 2024). The role of NGOs in determining specific associations or bodies to address the e-waste disposal crisis is also necessary. With cooperation between the government, community, and private sector, recycling can be implemented more widely. Countries such as Japan, Germany, Sweden, and Taiwan are exceptional examples of innovative e-waste management. For instance, the 2020 Olympic Games in Tokyo are examples of the most sustainable sporting event in the history of the event. The organizers began a project to collect electronics from all over Japan and recycle them into more than 5000 medals offered to event winners. Seventy-nine thousand tons of electrical equipment and 6.1 million mobile phones have been successfully gathered to produce medals (Moumeni, 2024).

7. Conclusion

As AI and digital technologies become more extensive, the total e-waste produced likewise increases. This e-waste confines dangerous materials that can damage the environment and human condition if disposed of incorrectly. Several studies have suggested that communities exposed to e-waste may contain heavy metals and persistent organic chemicals. Thus, the public is asked to send e-waste to collection centers voluntarily and not throw it into existing domestic rubbish bins, as this waste is toxic and has the potential to threaten health and damage the environment. This study supports the theory of planned behavior (TPB), which expands the model via the interaction effect of environmental law and policy. Throughout the process of conducting this study, several limitations were identified, and they are vital and obligatory to be

stated here to enable future researchers to conduct this study as well as possible and study from the mistakes that have been made. The first constraint is the limited number of samples. The number of respondents played an important role in this study. If the number of respondents obtained is large, the results of the study could represent the targeted population. Further studies can be carried out to test the relationship between variables and each respondent's background. In addition, the researchers suggested that future study designs should use a qualitative research approach. Thus, combining qualitative and quantitative data through observations and interviews can strengthen the information obtained. The joint method allows the researcher to understand the research questions better and quickly answer them. This method also provides a balanced analysis to address the flaws between quantitative and qualitative approaches.

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