

INVESTIGATING THE PREDICTORS OF INTENTION TO PARTICIPATE IN e-WASTE RECYCLING AMONG UNIVERSITY STUDENTS: A CASE OF UNIVERSITI MALAYSIA TERENGGANU

ELDONNA JOE JOBIT AND OLAWOLE FAWEHINMI*

Faculty of Business, Economics and Social Development, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

*Corresponding author: olawolefawehinmi@umt.edu.my

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Abstract: E-waste is an existential problem for the environment and its inhabitants. This study intends to examine the relationship between Environmental Concern (EC), Perceived Behaviour Control (PBC), and Attitude (ATT) toward the intention to practice e-waste recycling (ERI) among students in Universiti Malaysia Terengganu (UMT). Data was collected from 446 students by using a non-probability sampling technique. Partial Least Squares-Structural Equation Model (PLS-SEM 4.0) was used for the analysis of the structural model. The analysis of data from 446 questionnaires revealed that EC, PBC, and ATT significantly influence students' ERI, with ATT having the strongest influence. This research may aid policymakers in gaining a greater comprehension of students' intention to participate in e-waste recycling. This is very helpful in paving the way for a successful e-waste recycling and management system not only at UMT but also in other states in Malaysia and other countries with similar e-waste issues.

Keywords: E-waste recycling intention, environmental concern, perceived behavioural control, attitude, students.

Introduction

Due to the progress made in Information and Communication Technology (ICT), a growing proportion of people have recently joined the worldwide information society and digital marketplace (Tansel, B., 2017). The fast-paced technological revolution and increasing consumer desire for high-tech goods have led to an unparalleled surge in the consumption of Electrical and Electronic Equipment (EEE) (Islam *et al.*, 2021). This has increased the quantity of global e-waste due to the increased disposal of e-waste. On a global scale, the annual generation of e-waste reached 44.7 million tonnes (Mt) in 2016, compared to 43.8 million metric tonnes (Mt) in 2015, as documented by Baldé *et al.* (2017). Adrian *et al.* (2020) found that global e-waste production escalated to 53.6 Mt in 2019, marking a significant 21% increase in just five years. However, the recycling and collection of e-waste accounted for only 17.4%.

The rising reliance on electronic gadgets makes managing e-waste one of the most critical environmental issues (Dayaday & Galleto, 2022). Baldé *et al.* (2020) highlight that irresponsible e-waste disposal containing mercury, brominated flame retardants, chlorofluorocarbons, and hydrofluorocarbons poses substantial environmental and human health hazards. Moreover, children, adolescents, and expectant mothers are vulnerable to exposure to toxic substances such as lead, mercury, and flame retardants, which can cause adverse birth outcomes, respiratory problems, DNA damage, and an increased risk of chronic diseases. Apart from this, the incorrect handling and disposal of electronic waste can also result in environmental pollution and contamination. Toxic elements like mercury and flame retardants may seep into the atmosphere, water sources, and soil, posing considerable threats to ecosystems and human well-being.

The study conducted by Chamhuri Siwar *et al.* (2015) showed that recycling emerges as a crucial technique in addressing the issue of excessive waste accumulation in landfills. Environmental Education (EE) enhances individuals' awareness of environmental issues and encourages a proactive attitude toward overcoming them.

Furthermore, it promotes individuals to contribute towards global improvement through activities such as the responsible disposal and recycling of electronic waste. According to Yucedag *et al.* (2018), it has been argued that EE has a significant role in promoting favourable attitudes toward ecological problems. Therefore, more people need to take part in the practice of recycling e-waste.

Alternatively, Bhat and Patil (2014) emphasise that consumer awareness is vital in efficiently managing e-waste. It ensures the proper transportation of e-waste to authorised collection centres and recyclers for appropriate disposal, minimising its adverse impacts on the environment and human health. Increased awareness holds the potential to address e-waste problems effectively. Hence, human engagement is required to promote responsible consumption, ensure proper recycling and recovery, increase awareness, and advocate for sound policies and practices.

However, the Malaysian Health Ministry stated that Malaysians still lack awareness of environmental protection (Abas, 2019). Asian nations concurrently produce about half of this massive amount (Mohamad *et al.*, 2022). Malaysia is one of the countries that faces the issue of dumping enormous quantities of e-waste caused by the rising usage of electronic equipment in every industry. According to Rajesh *et al.* (2022), the country generated 364 kilotons of e-waste in the year 2020, which is equivalent to 11.1 kilogrammes per person. In addition, as reported by Malay Mail, in 2021, the Terengganu Department of Environment (DOE) gathered 20.873 Mt of electronic and electric waste (e-waste) (Malay Mail, 2022). The Terengganu DOE collected it to properly dispose

of the e-waste, as they anticipate reducing the air pollution caused by burning e-waste.

In addition, Mohamad *et al.* (2022) discovered that Malaysians continue to possess inadequate awareness of e-waste and its impact on the environment and human health, mainly because they perceive recycling as a voluntary action lacking incentives or benefits.

According to recent studies, students are irresponsible when disposing of e-waste. A study conducted by Siringo *et al.* in 2020 revealed that students in Indonesia were aware of the hazards of e-waste in the environment but still refused to practise proper e-waste recycling behaviour because they underestimated the effects of e-waste. A study conducted by Mohamad Zuhdi *et al.* in 2023 also determined that students in Malaysia have a low tendency to participate in e-waste recycling.

One student is an essential stakeholder in e-waste recycling because they belong to the digital age and perceive electronic devices as essential to their daily lives. Their willingness to engage in e-waste recycling is paramount in tackling this problem. Generation Z (Gen Z), as they are referred to, is a technologically savvy generation whose members explore the globe, establish friends, and learn and play with technology (Anom *et al.*, 2018). People refer to Gen Z as digital natives and are also dependent on technology, according to Giunta (2017). Moreover, young consumers constitute a significant demographic group pivotal in utilising and disposing of electronic goods.

How can we encourage students to recycle e-waste? Research findings suggest that while a sense of duty can positively affect E-waste Recycling Intentions (ERI), the effect is minor across different cultures (Dhir *et al.*, 2021).

In Malaysia, a study has shown that moral obligation and perceived convenience are significant factors influencing ERI (Mohamad *et al.*, 2022). In Japan, it has been found that recycling reasons positively affect attitudes and intentions (Dhir *et al.*, 2021). It has also been discovered that habits and perceived attitudes

predict young adults' ERI. However, subjective norms and behavioural control show no significant influence (Aboelmaged, 2021).

Additionally, free access to disposal, consumer knowledge about products and disposal sites, and access to a recycling facility within a reasonable distance are all important factors in consumer decisions to recycle e-waste (Arain *et al.*, 2020).

Despite extant studies explaining the predictors of ERI, there needs to be more research on the role of Environmental Concern (EC) in predicting ERI among students, especially in Malaysia.

As Faizah Haron (2019) indicated, the obstacles in controlling e-waste overload arise from unregulated waste collectors and insufficient consumer awareness and knowledge. It is crucial to understand students' attitudes, Perceived Behaviour Control (PBC), and ECs related to ERIs.

This study applied the Theory of Planned Behaviour (TPB) to better understand recycling behaviour among university students. According to TPB, the successful accomplishment of behaviour relies on two variables: Behavioural intention and behavioural control (LaMorte, W. W., 2022). Therefore, according to the theory, an individual's intention might help predict their behaviour. This study employs two TPB constructs to assess the extent of ERI, which refers to the willingness of a person to engage in e-waste recycling behaviour (Ajzen, I., 2002).

Firstly, the student's attitude toward e-waste recycling is determined by their evaluation of the positive or negative outcomes of the behaviour. Furthermore, the PBC pertains to an individual's perception of their ability to effectively execute a particular behaviour. The TPB provides a structured theoretical framework to systematically analyse the factors influencing behavioural choices, as Mahmud and Osman (2010) stated. Attitudes reflect a person's evaluation of the intended behaviour as beneficial or detrimental. In comparison,

PBC depicts the individual's view of the intended behaviour as easy or difficult to carry out (Kumar, 2019). When a person positively evaluates e-waste recycling behaviour as beneficial and perceives carrying out such action as easy, it may be associated with their ERI. Hence, this study included attitude and PBC as the independent variables.

Further, ECs refer to people's awareness of environmental issues, their support for solving them, and their willingness to contribute to their resolution (Dunlap & Jones, 2002; Fawehinmi *et al.*, 2022).

In brief, this research seeks to address the following issues:

1. To investigate the influence of Universiti Malaysia Terengganu (UMT) students' Attitudes (ATT) toward e-waste recycling on their intention to participate in e-waste recycling.
2. To study the influence of Perceived Behaviour Control (PBC) of Universiti Malaysia Terengganu (UMT) students on their intention to participate in e-waste recycling.
3. To assess the influence of Universiti Malaysia Terengganu (UMT) students' Environmental Concerns (EC) of e-waste on their intention to participate in e-waste recycling.

This study explores the link between UMT students' ATT, PBC, and EC regarding the negative impact of e-waste and their intention to recycle e-waste.

Theoretical Framework and Hypotheses Development

The TPB by Ajzen (1991) is one of environmental psychology's primary theoretical frameworks. Lee *et al.* (2010) employed the TPB to investigate educators' aspirations to implement technology in the classroom. Other than that, Alam and Sayuti (2010) utilised the TPB as a theoretical basis to extend previous research on the purchasing behaviour of Malaysians toward halal food. Likewise, Kaveh (2018) utilised the TPB to examine the impact of a school-based nutrition education intervention on dietary behaviour among adolescents.

In this study, we extracted two variables from the TPB to explain ERI. The first aspect is the students' ATT concerning e-waste recycling, which pertains to the extent of their evaluation of the behaviour's favourable or unfavourable outcomes. Secondly, the PBC towards e-waste recycling refers to an individual's subjective perception of their ability to perform a specific behaviour successfully.

It is opined that when students have a positive evaluation of e-waste recycling behaviour, they will be willing to partake in such activities. Moreover, when students feel that carrying out e-waste recycling is easy and convenient, they tend to engage in it.

Next, this study adopted the EC variable from the Value Belief Norms Theory (VBN). Previous studies have emphasised the significance of EC as a fundamental aspect of the VBN theory. EC has also been regarded as a form of belief (Stern *et al.*, 1999). The research findings show that EC is valuable to the TPB framework in predicting ERI (Lau & Hashim, 2020). When students are informed about the harmful effects of thoughtlessly disposing of e-waste and the potential damage to the ecosystem, they are more likely to engage in actions that can prevent it, such as recycling e-waste.

By incorporating individual ECs as an additional factor in the extended TPB model, this study demonstrates the significance of addressing and understanding individual ECs when promoting e-waste recycling behaviour, alongside the favourable attitude and PBC toward e-waste recycling.

Students' Attitude in E-waste Recycling (ATT) on Students' E-waste Recycling Intention

Attitude is the degree of assessment concerning the positive or negative result of the behaviour (Dhir *et al.*, 2021). According to research by Hidayana *et al.* (2023), respondents' attitudes have a substantial impact on their intention to recycle e-waste. Favourable attitudes, such as recognising the environmental advantages and viewing recycling as a responsible act, positively impact recycling intentions. Note that participation

intentions can be hampered by negative attitudes, such as inconvenience or lack of trust.

Furthermore, the article by Laequeuddin *et al.* (2022) investigates how respondents' attitudes toward e-waste recycling influence their intention to engage in safe disposal behaviour among consumers of electronic products. The study also reveals that respondents' attitudes significantly impact their intention to recycle e-waste. Favourable attitudes in relation to e-waste recycling, which include acknowledging the environmental importance of proper disposal, considering it a responsible behaviour, and valuing the benefits of recycling, positively impact the intention to participate. In contrast, negative attitudes, such as ignorance or apathy regarding e-waste recycling, can impede the intention to engage in secure disposal behaviour.

According to Gonul Kochan *et al.* (2016), the results suggest that respondents' attitudes toward e-waste recycling play a crucial role in shaping their intentions to participate. The presence of positive attitudes towards e-waste recycling is associated with an increased probability of participating in recycling activities. This indicates that positive perceptions, beliefs, and values regarding the recycling of e-waste play a crucial role in encouraging individuals to actively partake in recycling initiatives. This is supported by Wang *et al.* (2016) in their study that stated that a greater tendency to partake in e-waste recycling activities was exhibited by those with a positive outlook who recognised the significance and advantages of recycling. Therefore, a substantial positive association exists between respondents' attitudes regarding e-waste recycling and their intentions to recycle.

The articles illuminate the impact of attitudes towards e-waste recycling on individuals' intentions to engage in e-waste recycling. Positive attitudes towards recycling, such as recognising the significance of recycling and perceiving its benefits, positively influenced the intention to recycle e-waste among Malaysian residents, according to a Malaysian study. Likewise, the investigation into consumers of electronic products and their practises for safe e-waste

disposal indicated that having positive attitudes toward e-waste recycling was linked to a higher inclination to adopt safe disposal methods. Finally, a study conducted in China found that individuals who held positive attitudes toward e-waste recycling demonstrated a greater likelihood of participating in recycling activities through their intention. Overall, these studies demonstrate a positive link between individuals' attitudes toward e-waste recycling and their intention to engage in recycling activities. Thus, it is hypothesised that:

H1: The attitude (ATT) of students towards e-waste recycling is significantly and positively related to their e-waste recycling intention.

Perceived Behaviour Control (PBC) on Students' E-waste Recycling Intention

The definition of PBC indicates a person's perception of the difficulty or easiness of engaging in responsible behaviour (Ajzen, I., 2002). Alternatively, Mokkhamakkul, T. (2022) conducted a study to explore the correlation between perceived behavioural control and the intention to participate in e-waste recycling using a reverse logistics system in India. PBC has a significant positive effect on the intention to participate in e-waste recycling through the reverse logistics system, according to the findings of this study. Note that individuals who perceived a greater degree of control over their behaviour in relation to the return of e-waste were more likely to indicate a desire to partake in the reverse logistics system. By enhancing individuals' knowledge, improving access to recycling facilities, and fostering positive social influences, stakeholders can promote higher levels of perceived control and increase the likelihood of individuals' intent to recycle e-waste, according to Joshua E. Lou's (2022) study findings.

The investigation conducted in South Africa by Ichikowitz and Hattingh (2020) reveals similar PBC facts. According to their findings, consumers' perceptions of their access to recycling facilities and their knowledge of appropriate recycling procedures significantly

impact their perceptions of their behavioural control. When individuals perceive that recycling facilities are readily accessible and have the knowledge necessary to recycle e-waste properly, they feel more confident in their ability to engage in recycling behaviours.

Consequently, Cheng's (2017) study on waste segregation among households in Putrajaya, Malaysia, reveals that PBC significantly influences individuals' intention to participate in waste recycling by controlling their confidence in their ability to segregate waste correctly. Their belief that they have the necessary resources and opportunities to do so plays a significant role in shaping their intention to recycle. Therefore, if individuals believe they can engage in refuse segregation-at-source behaviour effectively, they are more likely to intend to participate in recycling activities.

Based on the conclusions drawn from these articles, perceived behavioural control significantly influences the intention to recycle electronic waste. According to numerous studies, individuals who believe they have greater influence over their recycling behaviours are more likely to develop stronger intentions to engage in e-waste recycling activities. This perception of control can be influenced by factors such as knowledge and awareness of recycling processes, the accessibility and convenience of recycling facilities, and personal competence in conducting recycling tasks. The research indicates that enhancing individuals' PBC through targeted interventions and boosting the infrastructure for e-waste recycling can effectively increase recycling intention and participation. Consequently, the hypothesis states:

H2: The perceived behaviour control (PBC) of students is significantly and positively related to their e-waste recycling intention.

Students' Environmental Concerns of E-waste (EC) on Students' E-waste Recycling Intention

ECs pertain to individuals' beliefs and attitudes regarding the significance of safeguarding the environment and their inclination to adopt eco-friendly behaviours (Dhir, Malodia, *et al.*, 2021). The systematic review conducted by Gilal *et al.*

(2022) concludes that ECs, such as awareness of the environmental impact of e-waste and a desire to preserve the environment, are significant determinants of consumers' intentions to recycle their electronic waste. People who exhibit a higher level of EC are more inclined to engage in electronic waste recycling. Hence, recognising the environmental impact of e-waste and increasing awareness of its consequences can encourage consumers to recycle and contribute to more sustainable management of electronic waste.

Alternatively, Kianpour *et al.* (2017) indicated that individuals are motivated to take responsible actions and contribute to sustainable practises by EC. Consumers experience a sense of duty to counteract the adverse environmental impacts of e-waste by returning their outdated electronic products for reuse, repair, or recycling.

Sajid *et al.* (2022) discovered in a study that the ECs factor of 338 responses from Indian urban households had significant positive associations with every other factor, including the intention to recycle e-waste. A possible explanation for this finding is that if EC is high, external stimuli, such as a financial incentive, would have little effect on an individual's intention to recycle e-waste (Sajid *et al.*, 2022).

Based on the findings of these articles, it can be concluded that ECs about e-waste substantially impact the intention to partake in e-waste recycling. According to several studies, individuals who possess heightened ECs, including awareness of the adverse environmental effects of e-waste and a sense of responsibility towards sustainable waste management, are more prone to form stronger intentions to actively participate in e-waste recycling activities. Note that EC serves as a propelling force, prompting individuals to actively recycle and contribute to reducing e-waste. These results underscore the importance of promoting environmental awareness and education to foster a sense of responsibility and motivate individuals to prioritise e-waste recycling to ensure environmental sustainability. Hence, it is hypothesised that:

H3: The environmental concern (EC) of students about e-waste is significantly and positively related to their e-waste recycling intention.

Method

Demographics

The survey results indicated that a significant proportion of the participants identified as male (74%), and the remainder of respondents identified as female (26%). The predominant age cohort among the participants was individuals aged 21 to 23 years, accounting for 74.6% of the sample. This was followed by respondents aged 18 to 20, including 15.5% of the participants, and those aged 24 to 26, comprising 7.6% of the sample. A minority of participants belonged to the age brackets of 27 to 29 and 30 to 32, constituting 0.2% each of the overall sample. Additionally, a mere six respondents were aged 33 years or above, accounting for 1.3% of the total.

In relation to the participant's marital status, the majority of respondents indicated being single (97.5%), while a tiny proportion reported being married (2.0%), and a minority disclosed being divorced (0.4%). With regards to the level of educational achievement, a significant proportion of participants possessed a bachelor's degree (89.9%), whereas a lesser fraction was enrolled in diploma programmes (7.2%) or pursuing a master's degree (2.8%). Within the surveyed population, the predominant demographic consisted of first-year students enrolled at UMT, comprising 39.7% of the total respondents. Subsequently, third-year students constituted the second largest group, accounting for 31.8% of the participants. The survey participants consisted of 24.2% second-year undergraduates and 4.3% fourth-year undergraduates. The survey results indicate that the Faculty of Business, Economics, and Social Development (FPEPS) had the largest proportion of respondents, accounting for 41.0%. This was followed by the Faculty of Science and Marine Environment (FSSM) with 18.4% representation and the Faculty of Ocean Engineering Technology and

Informatics (FTKKI) with 17.4% representation. Furthermore, a notable proportion of the participants, specifically 17.3% exhibited certain resemblances with FTKKI, whereas a smaller percentage of 5.8% had affiliations with the Faculty of Maritime Studies (FPM).

Participants and Procedure

The data was collected using the non-probability convenience sampling technique during May and June 2023 through an online survey. The participants were students from five faculties of UMT. The demographic chosen for this study includes diploma, bachelor's degree, and master's students who continue their education at UMT.

This demographic will be surveyed to determine their history, level of attitude toward e-waste recycling, and EC regarding the dangers of e-waste. Consequently, the outcomes of this study may achieve their purpose. The respondents were requested to complete the ATT, PBC, EC, and ERI surveys. Sekaran (2016) states that sample sizes between 30 and 500 is appropriate for most investigations.

Hence, the minimum permissible sample size for a research measure is 375 respondents; however, this research collected 446 respondents. Among the respondents, 74% (330) were female, while 26% (116) were male, as shown in Table 1. Regarding their age, students from 18 to 20 years are 15.5% (69), 21 to 23 years are 74.9% (334), and 24 to 26 years are 9.6% (43), as presented in Table 2.

Questionnaire and Measures

The questionnaire was meticulously designed with an emphasis on items and variables. It is divided into nine sections assessing interest constructs and demographic information. All these variables are operationalised using items derived from previous research. In this study, adapted measures from credible published literature were utilised. The measurement items were assessed using five Likert-type scales. ATT was evaluated based on Oskamp *et al.* (1991), Cheung *et al.* (1999), and Tonglet *et al.* (2004). PBC was measured using a 5-item scale adapted from Tonglet *et al.* (2004), while students' ECs regarding e-waste were gauged using a 5-item scale derived from Lee (2008). Lastly, all the items used to measure ERI were adapted from Kochan *et al.* (2016).

Findings

Measurement Model Testing

The measurement model testing was evaluated using the Partial Least Squares-Structural Equation Model (PLS-SEM 4.0). The model is tested by investigating convergent validity (COV) and discriminant validity (DIV). For the COV, the composite reliability (CR), Cronbach's alpha (CA), average variance extracted (AVE), and factor loadings are examined (Hair & Alamer, 2022). Further, the DIV was determined using the HTMT ratio based on the recommendation of Henseler *et al.* (2015). According to Franke and Sarstedt (2019), there is a severe problem with DIV if the HTMT value is greater than 0.85. As presented in Tables 3 and Table 4, the COV and DIV tests indicate that the data meets all threshold requirements.

Table 1: Gender of respondents

Gender	Frequency	Percentages (%)
Male	116	26.0
Female	330	74.0
Total	446	100.0

Table 2: Age of respondents

Age	Frequency	Percentages (%)
18-20 years old	69	15.5
21-23 years old	334	74.9
24-26 years old	43	9.6
Total	446	100.0

Table 3: Convergent validity

Constructs	Items	Loading	CR	AVE
ATT	ATT1	0.550	0.874	0.539
	ATT2	0.816		
	ATT3	0.750		
	ATT4	0.798		
	ATT6	0.796		
	ATT7	0.661		
	EC	EC1		
EC2		0.836		
EC3		0.780		
EC4		0.820		
ERI	INT1	0.840	0.894	0.737
	INT2	0.905		
	INT3	0.828		
PBC	PBC1	0.788	0.915	0.684
	PBC2	0.784		
	PBC3	0.791		
	PBC4	0.888		
	PBC5	0.876		

ATT = Attitude; EC = Environmental concern; ERI = e-waste recycling intention; PBC = Perceived behavioural control.

Table 4: HTMT

Constructs	ATT	EC	ERI	PBC
ATT				
EC	0.713			
ERI	0.649	0.597		
PBC	0.369	0.344	0.517	

Structural Model Testing

After successfully evaluating the measurement model, the subsequent phase in PLS-SEM assesses the structural model. It evaluates the connection between the variables. The PLS-SEM 4.0 structural model was evaluated using the Bootstrapping method with 5,000 resamples (J. F. Hair *et al.*, 2019), as illustrated in Figure 1.

Hypotheses Assessment

Diamantopoulos and Sigauw (2006) and Hair and Alamer (2022) demonstrated that a Variance Inflation Factor (VIF) indicating collinearity should be less than three. Table 5 indicates that all VIF values were below the cutoff value set by Diamantopoulos and Sigauw (2006), suggesting that collinearity is not a concern for this study.

This study made three hypotheses based on the direct link between independent and dependent variables. The results present that H1 is true ($\beta = 0.333$, $t = 6.329$, $LL = 0.244$, $UL = 0.414$, $p\text{-value} = 0.000$). This is because a positive attitude toward e-waste recycling is directly and significantly linked to ERIs. The results indicated that H2 was true ($\beta = 0.225$, $t = 4.324$, $LL = 0.137$, $UL = 0.311$, $p\text{-value} = 0.000$). This indicates a positive link between ECs and ERIs. The results also supported H3, revealing a significant positive link between PBC and ERIs ($\beta = 0.270$, $t = 6.330$, $LL = 0.200$, $UL = 0.338$, $p\text{-value} = 0.000$).

The size of the effect was also measured. As presented in Table 6, the results indicate that all the suggested relationships have minor effects.

Table 5: Hypotheses testing

	Beta	SE	T-stat	P values	LL	UL	Decision	VIF
ATT -> ERI	0.333	0.053	6.329	0.000	0.244	0.414	Supported	1.540
EC -> ERI	0.225	0.052	4.324	0.000	0.137	0.311	Supported	1.524
PBC -> ERI	0.270	0.043	6.330	0.000	0.200	0.338	Supported	1.141

Acceptance criteria for the R^2 value are usually nearer to 1. Values around 0 indicate a lesser effect of the exogenous variables (Henseler *et al.*, 2009), which were used to test the Coefficient of Determination (R^2). The study discovered that the R^2 value for the ERI was 0.415, indicating that the R^2 acceptance criteria were reached for the three variables. It shows that attitude, EC, and PBC explain 41.5% of the variance in ERI. The numbers can be seen in Table 6.

This investigation examined the accuracy of (Geisser, 1974) Q^2 in predicting future events. An unbiased test was conducted to determine the accuracy and utility of the model’s predictions. According to Fornell and Cha (1994) and J. F. Hair *et al.* (2019), a goal construct is predictively accurate and relevant if its Q^2 value is greater than 0. In accordance with Table 6, the Q^2 values for this study, which are 0.297, indicate that the predictive accuracy and utility of its model are adequate.

Table 6: Coefficient of determination (R^2) and effect size (f^2)

Construct	R^2	Q^2	f^2	Decision
ERI	0.415	0.297		
ATT			0.123 ^a	Small
EC			0.057 ^a	Small
PBC			0.109 ^a	Small

Note: ERI = a.

Using the PLS prediction method, we examined how well the exogenous factors could predict ERI. Consistent with Shmueli *et al.* (2019), the root-mean-squared error values

of the PLS model were compared to those of the Linear Regression (LM) model as the standard. As indicated in Table 7, the PLS model demonstrated lower forecast errors than the LM model for 2 out of the 3 indicators of ERI.

Table 7: PLS predict outcome

Items	PLS (RMSE)	LM (RMSE)	PLS -LM	Q ² predict
ERI1	0.841	0.854	-0.013	0.281
ERI2	0.795	0.804	-0.009	0.363
ERI3	0.974	0.969	0.005	0.232

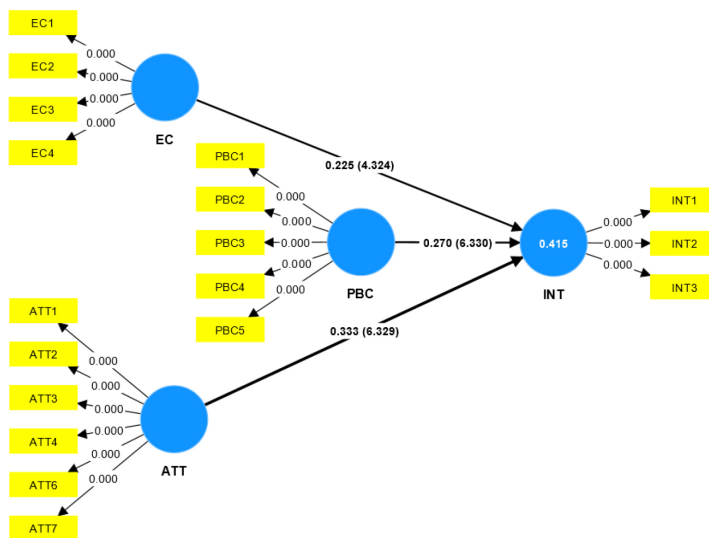


Figure 1: Structural model

Discussion

The primary objective of this study is to explore the connections between EC, PBC, ATT, and UMT students' intention to participate in e-waste recycling (ERI), with ERI being the dependent variable. The research findings indicate that all the independent variables positively and significantly predict ERI, highlighting their considerable influence on students' recycling intentions.

Numerous research studies have shown that ATT, PBC, and EC significantly influence students' intentions to recycle e-waste. Hidayana *et al.* (2023) discovered that respondents' attitudes significantly influence their ERI. Positive attitudes include

recognising environmental benefits and perceiving recycling as responsible behaviour. Both increase recycling intentions, whereas negative attitudes, such as inconvenience and distrust, can hinder participation intentions. Note that positive attitudes, such as recognising the environmental significance of appropriate disposal, perceiving it as responsible behaviour, and appreciating the benefits of recycling, positively influence the intention to participate, according to Laeequddin *et al.* (2022). Negative attitudes, such as ignorance or apathy regarding e-waste recycling, inhibit the intent to engage in secure disposal behaviour. According to Gonul Kochan *et al.* (2016), having positive

attitudes towards e-waste recycling substantially enhances participation intentions. This suggests that favourable perceptions and values related to e-waste recycling are vital in promoting active involvement in recycling efforts. This finding was supported by Z. Wang *et al.* (2016), who observed that individuals with a positive outlook and recognition of the significance of recycling show a greater tendency to participate in e-waste recycling activities, establishing a significant positive link between attitudes and recycling intentions.

Positive attitudes towards e-waste recycling, greater control over one's actions, and greater concern about the negative environmental consequences of e-waste are likely to result in a greater intention to engage in recycling behaviours. Note that the findings support a broad chain of transmission in which ATT, PBC, and EC influence ERI.

Higher PBC positively influenced the intention to participate in the reverse logistics system, indicating that increasing knowledge, access to recycling facilities, and positive social influences can promote greater control and increase participation in ERI, as highlighted by the research of Joshua E. Lou (2022). In South Africa, Ichikowitz and Hattingh (2020) discovered that consumers' perceptions of access to recycling facilities and knowledge of recycling procedures substantially impact their PBC. When individuals perceive recycling facilities as easily accessible and have the necessary knowledge, they are more likely to recycle.

Similarly, Cheng's (2017) study in Putrajaya, Malaysia, revealed that perceived behavioural control significantly influences individuals' intention to partake in waste recycling by influencing their confidence in waste segregation and belief in having the required resources. Overall, these studies suggest that enhancing the perceived behavioural control of individuals through targeted interventions and enhanced recycling infrastructure can effectively increase recycling intention and participation in e-waste recycling.

EC significantly influence the intention to recycle e-waste. Studies by Gilal *et al.* (2022), Kianpour *et al.* (2017), and Sajid *et al.* (2022) demonstrate that higher EC is associated with a stronger intention to participate in e-waste recycling. Note that people with greater awareness of e-waste's environmental impact and a sense of responsibility towards sustainable waste management are more likely to recycle e-waste actively. This indicates the importance of promoting environmental awareness and education to foster sustainable e-waste recycling practices.

Theoretical Implication

Based on the viewpoint of theory, this current study contributes to the researchers who have advocated enacting e-waste recycling to attain environmental objectives. However, limited studies have been conducted on the relationship between attitude, PBC, and EC on university students' intentions to recycle e-waste. This study extends previous research on conceptualising the intention to recycle e-waste through the lens of the TPB theory and VBN.

This study's findings contribute to a previous study that suggested further studies on a specific group of students' intention to recycle e-waste in Malaysia (Shaharudin *et al.*, 2023). Other than that, this study contributes to the study of Dhir *et al.* (2021) by exploring the combined influence of ECs in addition to attitude and PBC to influence the intention to recycle e-waste among UMT students.

This study's findings also confirm the high significance of attitude in the decision-making process for engaging in an activity such as e-waste recycling, as attitude had the greatest impact on the intention to recycle e-waste. PBC was the second most influential factor in the intention to recycle e-waste. TPB continues to be a formidable theory for predicting behaviour. The inclusion of ECs demonstrates the adaptability of TPB to incorporate additional variables in predicting behavioural intention.

Practical Implication

This research has important policy and administration ramifications for colleges and universities. The research aims to inform educational institutions by developing a conceptual model that describes how attitude, PBC, and EC affect students' propensity to recycle e-waste.

Universities that adopt this practice can benefit from the increased focus on e-waste recycling. Colleges and universities' top management should often remind students about the importance of recycling their electronic waste so that they are aware of the consequences of not doing so. In addition, there should be a sufficient number of easily accessible recycling centres spread throughout the campus so students can recycle without much hassle. Last but not least, the university personnel should set an example for the students by recycling their e-waste and making this fact known to them. This would help foster a more positive outlook on the subject among the student body.

Researching e-waste holds immense significance, particularly when investigating young consumers' ATT, PBC, and EC regarding recycling practices. Taking these factors into account is crucial. By utilising the study's findings, policymakers can formulate targeted strategies to encourage and support consumers in their e-waste recycling efforts. Note that effective policies will contribute to resolving the nation's e-waste problem in the long term through recycling initiatives. The policies could include students receiving points for every e-waste recycled.

Conclusions and Future Direction

This research investigates how attitude, perceived behavioural control, and EC impact the intention to engage in e-waste recycling. TPB was evaluated and recommended in this study to discover the primary determinants of ERI among UMT students. This study shed light on UMT students as young consumers regarding

the significance of their intention to be involved in e-waste recycling and to provide a better understanding of the predictors of individual ERI.

According to our findings, ATT, PBC, and EC are crucial factors in forming intentions to participate in e-waste recycling.

Future research can overcome certain limitations identified in the study. Longitudinal studies should be utilised in future studies to observe changes in the target population's characteristics at both group and individual levels. It employs continuous or repeated measurements over extended periods, providing valuable insights into long-term trends and developments. Other than that, conducting additional research on different independent variables, for example, subjective norms, proactive personality, behaviour, and personal norms, could significantly enhance our understanding of ERI. Hence, conducting a similar study in various locations across Asia, America, Africa, Europe, and Oceania is recommended to address this issue globally. Collaborating with researchers from diverse backgrounds and regions could facilitate knowledge sharing and comprehensively resolve the problem.

Other than that, future studies should expand the findings of this work to other universities to gain a more profound knowledge of predictors of students' ERI. This will allow future researchers to examine these variables with larger sample sizes.

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Conflict Interest Statement

All authors declared that they have no conflicts of interest.

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