Mediated Moderation in E-Waste: Intention and Past Habits Shaping Behaviour

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This study uses a mediated moderation framework to examine the factors influencing e-waste disposal behaviour. Pro-environmental attitude, social influence, and perceived innovation attributes shape e-waste disposal intention, which in turn predicts behaviour. Past Habits moderate the intention-behaviour link. The conceptual model is motivated by the Theory of Planned Behaviour, offering insights into how intention drives responsible e-waste actions. Findings indicate that social influence has the strongest impact on intention and behaviour. E-waste disposal intention mediates the effects of the variables on behaviour. Past Habits have a limited moderating role, suggesting they may not strongly affect an educator's intention-behaviour connection.

Keywords: E-waste Disposal, Mediated Moderation, Pro-Environmental Attitude, Social Influence, Perceived Innovation Attributes, E-Waste Disposal Intention, Past Habits, Theory of Planned Behaviour, Sustainable Behaviour

1. Introduction

The importance of researching sustainable e-waste management has significantly increased in recent years, leading to numerous studies examining various facets of e-waste management globally. Electrical and electronic waste popularly known as E-waste, refers to electrical or electronic equipment that is waste, including all components, subassemblies, and consumables that are part of the equipment at the time the equipment becomes waste (United Nations Environment Programme, 2019). In different regions, e-waste is also referred to as WEEE (Waste Electrical and Electronic Equipment). E-waste is a very broad term and covers; temperature exchange equipment (refrigerator, air conditioner, etc.), screens/monitors (laptop, television, etc.), lamps, large equipment (washing machine etc.), small equipment (toaster, electric shaver, etc.), and small IT equipment's (mobile phones, printers etc.) (globalewaste.org, n.d. https://globalewaste.org/). If e-waste is not recycled properly then it will have an adverse impact on the environment as well as human health. As per the information available from The Central Pollution Control Board in India, e-waste generated in the country in FY 2020-21 was 13,46,496.31 tonnes which increased to 16,01,155.36 tonnes in FY 2021-22 (an increase of approximately 19%). Most of the e-waste was generated in Asia (24.9 Metric tonnes), followed by the Americas (13.1 Metric tonnes) and Europe (12 Metric tonnes). About 20 kg of e-waste was produced per person annually in North America, followed by Europe with an e-waste production of 16.2 kg per capita in 2019 but with the highest collection and recycling rate of 42.5% (Forti et al., 2020; Hinchliffe et al., 2020). The per capita generation of e-waste in India is not directly provided by the Ministry of Environment, Forest and Climate Change. However, data on total e-waste generation (FY 21-22) provided by the Central Pollution Control Board can be used to compute per capita e-waste generation which comes to around 1.15 per Kg. E-waste is identified as the fastest-growing waste stream in the world and rapid socio-economic development and technological advancement are the main drivers of this trend (Hossain, Al-Hamadani, Rahman, 2015)

According to the Ministry of Environment, Forest and Climate Change waste from computers, laptops, and, mobile phones constitute a considerable portion of the total e-waste. The Ministry has implemented the E-Waste (Management) Rules, 2016, further revised in November 2022, which instructed manufacturers to ensure proper disposal and recycling of e-waste. Through these rules government introduced the concept of Extended Producer Responsibility (EPR), which mandates the producers of electronic goods to ensure proper collection, recycling, and disposal of e-waste. This responsibility extends to manufacturers, importers, brand owners, and producers, who must establish an effective e-waste collection mechanism (Press Information Bureau, 2023). The Central Pollution Control Board collects data on e-waste generation based on national sales figures and the average lifespan of electrical and electronic equipment. At State level, Pollution Control Boards and Pollution Control Committees are tasked with enforcing e-waste management regulations. By conducting regular inspections and drives to curb informal e-waste processing activities and ensuring that e-waste is handled by authorized recyclers and refurbishers only. The revised rules also emphasize the promotion of a circular economy through sustainable e-waste management practices including scientific recycling and disposal methods, environmental compensation mechanisms, and regular audits to verify compliance. The government has also initiated several programs to promote public awareness about the significance of e-waste management by organizing workshops and campaigns educating stakeholders about safe disposal practices and the benefits of recycling.

The sustainable environment has become a major concern for the world nowadays due to the numerous consequences that await the world in the short or long term if unsustainable consumption practices and disposal processes and methods are not properly managed (Gyawu, Larbi, Addai, 2018). Sustainable e-waste management is a comprehensive approach that pursues to

mitigation of the adverse impact of e-waste on human health and the environment and promotes the efficient utilization of resources through a circular economy, extended producer responsibility, by robustly implementing regulatory framework, through public awareness campaigns. Sustainable e-waste management aims to create a cleaner and more sustainable future for our coming generations. A sustainable environment is achievable by adopting the best e-waste management practices including the enforcement of laws that regulate the collection, recycling, and disposal of e-waste such as E-Waste (Management) Rules in India. Formalizing the recycling infrastructure that employs safe and environmentally sound methods for processing e-waste by licensing and monitoring recyclers to ensure compliance with environmental standards (Ministry of Environment, Forest and Climate Change, 2023) (Borthakur & Singh, 2012) (Kumar & Shah, 2016). The government is also encouraging manufacturers to make innovations in product design that become easier to disassemble, repair, and recycle along with using fewer hazardous materials and more recyclable components. Ministry of Environment, Forest and Climate Change is also collaborating with other countries and international organizations to share best practices and technologies for sustainable e-waste management and ensure that e-waste exported to developing countries is managed responsibly.

This study investigates the psychological factors influencing educators' e-waste disposal behaviour, specifically examining how their disposal intentions and past habits impact sustainable e-waste management practices. Educators comprising teachers, professors, trainers, and other knowledge-disseminating professionals play a pivotal role in shaping attitudes and behaviours, particularly among younger generations and within communities. By exploring the nuanced dynamics of sustainable e-waste management, this research positions educators as key stakeholders whose behaviours can significantly affect e-waste outcomes. Grounded in the Theory of Planned Behaviour, this study examines pro-environmental attitudes, social influences, perceived innovation attributes of electronic devices, e-waste disposal intentions, and disposal behaviours. Additionally, it considers educators' past disposal habits and their effect on current practices. The study conceptualizes disposal intention as a mediating factor predicting e-waste disposal behaviour, with past habits acting as a moderator between intention and behaviour. Notably, there is a research gap concerning educators' specific roles in e-waste management behaviour, making this study one of the first to analyse these factors using a mediated moderation approach. The findings hold valuable implications for governments and educational institutions including students who can leverage this knowledge to foster e-waste recycling. Ultimately, this research aims to guide targeted interventions and policies that advance sustainable e-waste management and address critical environmental challenges.

2. Review of Literature

The Theory of Planned Behaviour (TPB) is employed in this study due to its emphasis on psychological factors influencing behaviour. TPB, developed by (Ajzen, 1985) and rooted in earlier work by (Fishbein & Ajzen, 1977), is a prominent socio-psychological framework for understanding social behaviour. This theory has been used extensively to study various environmental actions, including recycling, energy conservation, alternative transportation, water preservation, ethical investing, and sustainable food choices (Stern, 2000; Staats et al., 2003). TPB is particularly recognized as a robust model for analysing the determinants of recycling behaviour (Tonglet et. al., 2004; Wang et al., 2011).

The core TPB constructs include attitude, subjective norms, and perceived behavioural control. Attitude reflects an individual's positive or negative evaluation of a specific behaviour (De Groot & Steg, 2009). Subjective norms refer to the social expectations and pressures on an individual's decision to engage in or avoid a particular activity. Perceived behavioural control represents an individual's perception of barriers based on past experiences and anticipated challenges. Behavioural intention measures the degree of an individual's readiness to perform a specific action, which ultimately drives actual behaviour. Empirical studies support this theory's utility in predicting behaviour. (Wu et. al., 2017) identified positive associations between behavioural intention and attitude, subjective norms, and perceived behavioural control. Likewise, (Yuan et. al. (2016) found that subjective norms, attitude, and perceived behavioural control significantly influenced participation in household recycling initiatives. Such findings underscore the relevance of TPB in explaining environmentally responsible behaviours.

2.1 Pro-Environmental Attitude

Electronic waste has emerged as a significant environmental challenge due to the rapid technological advancement, climate change and the corresponding increase in electronic device usage. Proper disposal of e-waste has become critical and thus understanding consumers' mind-set favouring the behaviour towards protecting environment is essential. Awareness towards environmental consciousness is the concept in which an individual's conscious of the environmental implications might affect his or her E-waste recycling intention (Wan, Chenug and Shen, 2012). (Amico, Vita and Luisa, 2016; Bittar, 2018; Jain, Singhal and Bhaskar, 2020) explained environmental consciousness as consumers' concerns about environmental issues and their attitudes and intentions toward mitigating these problems. (Waheed et al., 2023) environmental consciousness has a positive moderation effect on the association between e-waste recycling attitudes and intentions and should be increased through training programs to translate e-waste recycling intentions into behaviour. Environmental consciousness is a key factor that can influence the intention to recycle e-waste (Walker, 2013; Wang, 2014; Lin and Niu, 2018; Kautish and Sharma, 2021; Jain, Singhal and Bhaskar, 2020). (Alam, 2023) suggested that emphasizing on science education in the secondary school curriculum could help in achieving sustainable development goals, as it has the potential to enhance the students' environmental consciousness. Recycling attitudes can be shaped by having a positive view of recycling and an individual should believe that waste disposal is a responsible, conscientious, and convenient activity (Greaves, Zibarras and Stride 2013). Educational

institutions can play a key role in promoting environmental consciousness by undertaking research projects aimed at environmental protection and natural resource conservation, as viewed by (Alam, 2023).

2.2 Role of Social Influence in E-Waste Disposal

Social influence is motivated by the variable subjective norm which is a crucial part of Theory of Planned Behaviour (TPB). Beliefs, perceptions, and pressures within one's social group serve as influential factors that can shape behaviour (Kumar, 2019; Ajzen, 1991). Social pressure is a combination of descriptive and injunction norms, representing the social networks and beliefs of nearby communities toward certain actions (Singh et. al., 2018). Social norms are an individual's commitment to fulfilling others expectations, mainly when behaviours involve moral and social responsibility (Wan et. al., 2012), which makes social norms a significant predictor of recycling behaviour (Kochan, 2016). Social norms can be reinforced through regulations that promote e-waste recycling, influencing community attitudes and encouraging residents to participate (Wang et. al., 2018). Individuals are less likely to engage in environment friendly actions, such as recycling if these practices lack visible support within their community, despite strong personal environmental values (Dixit & Badgaiyan, 2020). Recycling behaviour is fostered by social pressures, moral beliefs, and a sense of social responsibility (Tonglet et. al., 2004).

2.3 Perceived Innovation Attributes of Electronic Devices for E-Waste Reduction

To mitigate the problem of e-waste it is important to understand how consumers perceive innovative attributes of electronic devices. (Hilty, 2015) found that energy-efficient devices reduce operational costs and have a lesser impact on environment over their lifespan which contributes to reduced e-waste. Upgradable design increases the useful life of electronic devices which leads to reduction in e-waste generation (Bakker et al., 2014). (Mylan et al., 2016) observed that orientation with consumer environmental values enhances the likelihood of adopting eco-friendly electronic devices. (Gehin et al., 2008) in his research found that modular and standardized designs are important in reducing e-waste by supporting component upgrades rather than making full device replacements. (Zeng et al., 2017) found that reduced design complexity regarding repair and component replacement, can lead to sustained device use. One research suggested that giving electronic devices on lease to consumers will benefit them without having immediate ownership and lead to less frequent disposal (Bocken et al., 2014). It is emphasized that consumers may get more inclined towards adoption of sustainable devices having environmental benefits such as energy savings and recyclability (Girotto et al., 2021). Therefore, the perceived innovation attributes of electronic devices in influencing consumer behaviour towards adopting environment-friendly electronic devices play an important role in e-waste reduction.

2.4 E-Waste Disposal Intention

E-waste disposal intention measures the psychological readiness to engage in responsible e-waste management behaviours. Pro-environmental attitudes, shaped by environmental awareness and perceived benefits, are key predictors of e-waste disposal intention (Zeng et al., 2017). Additionally, subjective norms, reflecting societal expectations and social pressures, significantly contribute to the formation of intentions. Moral obligation and the influence of peers strongly motivate individuals to commit to proper e-waste recycling (Mohamad et al., 2022). Perceived behavioural control, the perception of ease or difficulty in performing the behaviour, also emerges as an important determinant. Studies by Yla-Mella et al. (2018) emphasize that access to recycling infrastructure and knowledge about disposal processes enhance individuals' perceived control, thereby strengthening their intentions.

2.5 E-Waste Disposal Behaviour

E-waste disposal behaviour refers to such actual practices which individuals adopt to manage their electronic waste, such as recycling, donating, or selling used electronics. While intentions are often strong predictors of behaviour, various factors mediate this relationship. As found by Laeequddin et al. (2022) that infrastructural challenges, such as limited accessibility to authorized collection centres, hinder the translation of intention into action. Behavioural studies by Zhang et al. (2019), highlight the intention-behaviour gap, where the individuals with strong intentions fail to act due to external barriers, such as convenience and cost. Further, Gunarathne et al. (2021) observed that routine and habitual practices play a crucial role in determining whether individuals engage in responsible e-waste disposal.

2.6 Past Habits Towards E-Waste Disposal

The past habits of consumers are crucial to be analysed for designing effective e-waste management strategies because their past habits may influence their current e-waste disposal behaviour. (Aboelmaged M., 2020) found that the role of recycling habits and perceived attitudes are crucial in predicting the young adults' e-waste recycling intention. (Yla-Mella et al., 2015) discovered that positive attitudes towards environmental conservation and recycling are strongly predicting consumer's responsible e-waste disposal practices. Behaviour of consumer's e-waste disposal is highly influenced by the convenience of e-waste collection (Chaudhary K. and Vrat P., 2019). Aiming to understand the consumer perception towards e-waste management it was found that majority of them are ignorant of e-waste and related issues (Saritha V., Sunil Kumar K.A. and Srikanth V.N., 2014). Consumers knowledge about e-waste is crucial as it affects their behaviour. (Nuwematsiko et al., 2021) In Kampala, Uganda it was observed that the electronic consumers have a poor knowledge on e-waste management and its ill effects on health and environment. (Joshi S., Sharma M., and Barve A., 2023) says that there should be a comprehensive ecosystem approach for efficient and sustainable e-waste management which should cover environmental factors, human behaviour, social aspects, as well as economic considerations. (Parajuly et al., 2019) identified that consumers are a crucial

component of the e-waste issue as the demand is increasing for electrical and electronic equipment's and that's why the consumer behaviour is a key element to be studied.

2.7 Hypotheses Development

H1: Pro-environmental attitude significantly and positively influences e-waste disposal intention.
H2: Social influence significantly and positively influences e-waste disposal intention.
H3: Perceived innovation attributes significantly and positively influence e-waste disposal intention.
H4: Pro-environmental attitude significantly predicts e-waste disposal behaviour.
H5: Social influence significantly predicts e-waste disposal behaviour.
H6: Perceived innovation attributes significantly predict e-waste disposal behaviour.
H7: E-waste disposal intention mediates the relationship between pro-environmental attitude and e-waste disposal behaviour.
H8: E-waste disposal intention mediates the relationship between social influence and e-waste disposal behaviour.
H9: E-waste disposal intention mediates the relationship between perceived innovation attributes and e-waste disposal behaviour.
H10: Past habits moderate the relationship between e-waste disposal intention and e-waste disposal behaviour, such that the relationship is stronger for individuals with stronger past habits.
H11: Pro-environmental attitude has a significant total positive effect on e-waste disposal behaviour, mediated through e-waste disposal intention.
H12: Social influence has a significant total positive effect on e-waste disposal behaviour, mediated through e-waste disposal intention.
H13: Perceived innovation attributes have a significant total positive effect on e-waste disposal behaviour, mediated through e-waste disposal intention.

2.8 Structural Model

Based on the reviewed literature and motivated by the Theory of Planned Behaviour (TPB), the structural model was developed to examine the impact on e-waste disposal intention, predicting e-waste disposal behaviour. In this model (Figure 1), constructs are influenced by the traditional theory of planned behaviour components. Additionally, the educators' past habit is also considered as a moderator moderating the relationship between e-waste disposal intention and e-waste disposal behaviour.

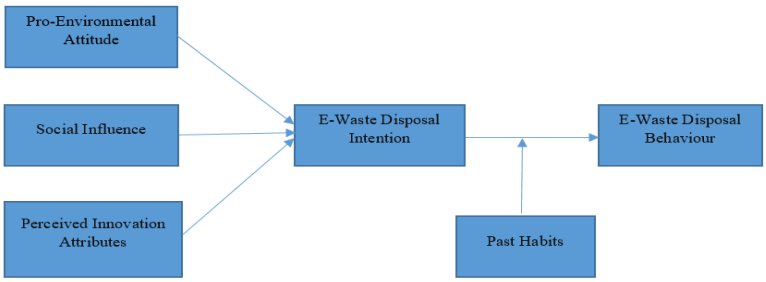

Figure 1 *Structural Model*

3. Methodology

The hypotheses outlined in the previous section were examined by gathering and analysing responses collected through a structured questionnaire survey and utilizing specific measurement procedures.

3.1 Data Collection

The questionnaire was distributed among university and college educators in the Charotar region of Gujarat, India, encompassing various academic fields such as management, commerce, engineering, and science. Educators were intentionally chosen as participants to explore whether those who instruct students on sustainability and environmental issues actively engage in proper e-waste disposal practices in their personal lives. Out of 500 questionnaires distributed, 390 completed responses were deemed usable for analysis.

3.2 Research Instrument and Measurement

This study employed a quantitative approach for data analysis to ensure precise measurement and validation of the variables. A quantitative method is appropriate for examining the influence of multiple variables on intention toward e-waste disposal and for predicting e-waste disposal behaviour by testing specific hypotheses. Data were collected through a questionnaire divided into two sections: Part I collected socio-demographic information about the educators, while Part II included items measuring pro-environmental attitude, social influence, perceived innovation attributes, e-waste disposal intention, e-waste disposal behaviour, and past habits. Responses were gathered using a five-point Likert scale to assess participants' levels of agreement. The constructs were developed after considering the similar variables used in the previous studies by the authors (Ajzen, 1991; Chan et. al., 2014; Rogers, 2003; Botetzagias et. al., 2020; Chen & Tung 2010; Verplanken & Wood, 2006). Past habits also

play a significant role in influencing e-waste disposal behaviours. Mohamad et al. (2022) used the extended Theory of Planned Behaviour and highlighted the role of habitual ease and moral obligation in shaping intentions and behaviour. Laeequddin et al. (2022) explored the impact of subjective norms, awareness, and convenience on safe disposal behaviour, emphasizing routine practices that form the basis of habitual actions. The data were processed and analysed using the Statistical Package for the Social Sciences (SPSS), with additional statistical analysis of the proposed model conducted in Python.

Table 1 *Respondents Demographic Profile*

Demographic Variables	Demographic Variables	Frequency	Percentage
Gender	Male	176	45.1
	Female	214	54.9
Age	22 – 32	217	55.6
	33 – 43	162	41.5
	44 – 54	6	1.5
	55 – 65	5	1.3
Work Experience	Less than 10 years	217	55.6
	10 to 19 years	168	43.1
	20 to 29 years	5	1.3
University	Private	337	86.4
	Government	53	13.6
Education	Post Graduate	296	75.9
	Doctorate	86	22.1
	Post Doctorate	8	2.1
Discipline	Science	10	2.6
	Engineering	76	19.5
	Mathematics	11	2.8
	Commerce	94	24.1
	Management	199	51

4. Results and Analysis

4.1 Reliability Analysis

To evaluate the consistency of the measurement model, reliability assessments were conducted. According to Nunnally (1978), a Cronbach's alpha of 0.7 or higher is deemed acceptable, while values exceeding 0.8 are preferred for more established measures. Hair et al. (2011) also note that composite reliability for each construct should exceed 0.70 to indicate satisfactory reliability. The composite reliability values presented in **Table 2** demonstrate that each variable achieved a commendable level of internal consistency.

Table 2 *Measurement Model Summary*

Construct	Cronbach's Alpha	Composite Reliability
Pro-Environmental Attitude (X1)	0.891	0.8972
Social Influence (X2)	0.895	0.8982
Perceived Innovation Attributes (X3)	0.915	0.9164
E-Waste Disposal Intention (M)	0.939	0.94
E-Waste Disposal Behaviour (Y)	0.866	0.8729
Past Habits (MO)	0.915	0.9154

4.2 Multicollinearity Analysis

Table 3 *VIF Values and Tolerance Level*

Construct	Collinearity Statistics	
	Tolerance	VIF
Pro-Environmental Attitude (X1)	0.307	3.252
Social Influence (X2)	0.202	4.947
Perceived Innovation Attributes (X3)	0.264	3.795
Past Habits (MO)	0.331	3.025

All constructs have VIF values less than 5, which indicates that there is no significant Multicollinearity present in the model. And tolerance of 0.1 or above is generally acceptable suggests that Multicollinearity is not a serious issue (Kutner et. al., 2005; Hair et. al., 2014; Kline 2015; Menard 2015; and Field 2013).

4.3 Residual Analysis

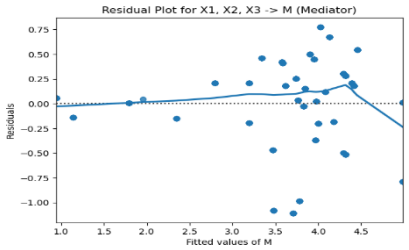

Figure 2

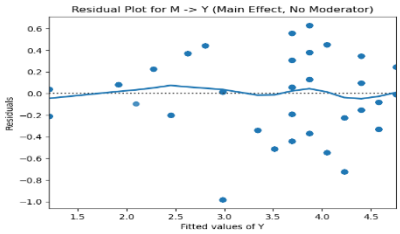

Figure 3

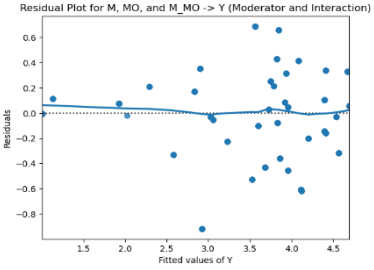

Figure 4

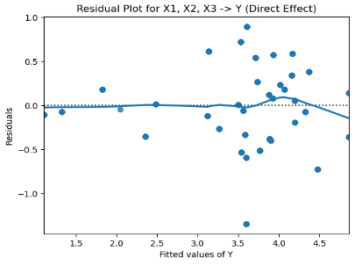

Figure 5

In figure 2 the residuals are somewhat scattered around the horizontal line at zero, and there's no strong pattern of non-linearity. While there is some increase in residual spread at higher fitted values, the low standard errors indicate that the estimates are likely robust. The residuals in figure 3, 4, and 5 are mostly centred around zero indicating that the model captures the linear relationship and supporting the assumption of homoscedasticity.

4.4 Mediated and Moderated OLS Regression Analysis

Table 4 *Summarized Mediated and Moderated OLS Regression Results*

Path	Coefficient (β)	p-value	R^2	Interpretation
(Model 1: M ~ X1 + X2 + X3)			0.802	80.2% of the variance in e-waste disposal intention is explained by X1, X2 and X3
X1 → M (a1)	0.3809	0.00		Pro-environmental attitude significantly and positively influences e-waste disposal intention
X2 → M (a2)	0.4823	0.00		Social influence has a strong positive impact on e-waste disposal intention
X3 → M (a3)	0.1477	0.00		Perceived innovation attributes significantly but moderately affect e-waste disposal intention
(Model 2: Y ~ X1 + X2 + X3)			0.787	78.7% of the variance in e-waste disposal behaviour is explained by X1, X2 and X3
X1 → Y (c1')	0.2309	0.00		Pro-environmental attitude has a significant direct effect on e-waste disposal behaviour
X2 → Y (c2')	0.6926	0.00		Social influence has a substantial direct effect on e-waste disposal behaviour
X3 → Y (c3')	0.0155	0.689		No significant effect of perceived innovation attributes on e-waste disposal behaviour
(Model 3: Y ~ X1 + X2 + X3 + M + MO + M * MO)			0.891	R^2 of 0.891 indicates that 89.1% of the variance in e-waste disposal behaviour is explained
X1 → Y (c1)	-0.0462	0.257		Pro-environmental attitude shows a negative but non-significant effect on e-waste disposal behaviour in the full model with disposal intention as a mediator and past habits as a moderator.
X2 → Y (c2)	0.3684	0.00		Social influence remains a significant positive predictor of e-waste disposal behaviour even when disposal intention and past habits are included.
X3 → Y (c3)	-0.0942	0.00		Perceived innovation attributes shows a significant negative effect on e-waste disposal behaviour indicating its poor inverse relationship with disposal behaviour.
M → Y (with MO, b)	0.7687	0.00		E-waste disposal intention has a strong positive effect on e-waste disposal behaviour, underscoring its critical role in predicting behaviour.
MO → Y	0.0522	0.521		Past habits does not significantly predict e-waste disposal behaviour, indicating that it does not directly affect e-waste disposal behaviour
Moderation Effect (M * MO)	-0.0201	0.270		The interaction term is not significant, suggesting that past habits (MO) do not moderate the relationship between e-waste disposal intention and e-waste disposal behaviour
(Model 4: Y ~ X1 + X2 + X3 + M) (without MO)			0.890	R^2 of 0.890 indicates that 89% of the variance in e-waste disposal behaviour is explained

X1 → Y	-0.0317	0.371		Pro-environmental attitude does not significantly predict e-waste disposal behaviour when moderator (past habits) is not included
X2 → Y	0.3601	0.00		Social influence remains a significant predictor of e-waste disposal behaviour in the absence of the moderator
X3 → Y	-0.0863	0.00		Perceived innovation attributes negatively but weakly predicting e-waste disposal behaviour showing a poor inverse relationship
M → Y (without MO, b)	0.6894	0.00		E-waste disposal intention significantly predict e-waste disposal behaviour
Indirect Effects				
Indirect Effect (a1 * b)	0.2928			Pro-environmental attitude influences e-waste disposal behaviour indirectly via e-waste disposal intention with a moderate positive effect.
Indirect Effect (a2 * b)	0.3708			Social influence impacts e-waste disposal behaviour indirectly via e-waste disposal intention with a larger positive effect.
Indirect Effect (a3 * b)	0.1136			This indirect effect shows a smaller yet positive influence of perceived innovation attributes on e-waste disposal behaviour through e-waste disposal intention.
Total Effects				
Total Effect (c1' + a1 * b)	0.5237			Pro-environmental attitude has a meaningful total positive effect on e-waste disposal behaviour, driven mostly by its indirect influence.
Total Effect (c1' + a2 * b)	1.0633			Social influence has a strong positive impact on e-waste disposal behaviour, with the indirect effect contributing substantially.
Total Effect (c1' + a3 * b)	.1291			For perceived innovation attributes, the total effect on e-waste disposal behaviour is positive but relatively small, indicating that both direct and indirect effects are modest.

4.5 Bootstrap Analysis

Table 5 *Bootstrap Estimates with 99% Confidence Intervals*

Bootstrap Mean Mediation Effect	**Bootstrap Standard Error (Mediation)**	**99% Confidence Interval (Mediation)**
6.5398	0.9755	3.5177, 8.0419
Bootstrap Mean Moderation Effect	**Bootstrap Standard Error (Moderation)**	**99% Confidence Interval (Moderation)**
9.3579	3.7732	1.4971, 17.2167

The mean indirect (mediation) effect is 6.54, suggesting a substantial mediation effect linking the independent and dependent variables. The standard error is 0.98, indicating relatively low sampling variability. The confidence intervals ranging from 3.52 to 8.04 do not include zero, confirming that the mediation effect is statistically significant at the 1% level. The mean moderation effect is 9.36, which implies a notable interaction between the predictor and moderator. The standard error, at 3.77, suggests a moderate degree of variability in this effect across bootstrap samples. The confidence interval for the moderation effect spans from 1.50 to 17.22. However, the non-inclusion of zero suggests a statistically significant moderation effect. Still, the wide confidence interval suggests that the moderation effect has considerable variability within the dataset, indicating a less stable or consistent moderation pattern across different resampled subsets (Crump n.d., Hayes & Scharkow 2013, Preacher & Hayes 2008, Hayes 2017).

4.6 Sobel Test

Table 6 *Sobel Test Results for Indirect Effects*

Independent Variable	**Indirect Effects**	**Sobel Statistic**	**p-value**	**Interpretation**
Pro-environmental attitude	(a1*b): 0.2928	6.3734	0.00	Significant ($p < 0.001$), strong indirect effect
Social Influence	(a2*b): 0.3707	7.5341	0.00	Significant ($p < 0.001$), strong indirect effect
Perceived Innovation Attributes	(a3*b): 0.1135	3.5409	0.00	Significant ($p < 0.001$), moderate indirect effect

Based on the above results all three independent variables; Pro-environmental attitude, Social influence, and Perceived innovation attributes have significant indirect effects on E-waste disposal behaviour, mediated by E-waste disposal intention. The strongest mediation effect comes from Social influence, followed by Pro-environmental attitude, with Perceived innovation attributes having a weaker effect.

5. Research Limitations

Despite the robust findings, this study has several limitations that should be acknowledged. The study's respondents were exclusively educators, which may limit the generalizability of findings to other populations. As data were collected through self-reported surveys, there is a risk of social desirability bias, where participants may have overstated their pro-environmental behaviours or intentions. This study employs a cross-sectional approach, where data were collected at a single point in time. Future research could employ a longitudinal approach to better understand causal relationships and the temporal dynamics of e-waste disposal behaviour. The sample is limited to a specific geographic region or cultural context; the findings may not be widely applicable. The study's focus on psychological constructs such as attitudes, and intentions may overlook other influential

factors such as economic incentives, or environmental infrastructure, which can also play a substantial role in shaping pro-environmental behaviours.

6. Discussion and Conclusion

This study expands our understanding of the factors influencing e-waste disposal behaviour, particularly within the framework of the Theory of Planned Behaviour (TPB). This conceptual model, incorporating pro-environmental attitudes, social influence, perceived innovation attributes, and e-waste disposal intention, provides an inclusive look at how educators make decisions about e-waste disposal.

Social influence emerged as the strongest predictor of e-waste disposal behaviour, both directly and indirectly through e-waste disposal intention. It highlights the critical role of social norms and community expectations in shaping environmentally responsible behaviours, consistent with prior research (Schultz et al., 2007; Bamberg & Moser, 2007). Social pressures from peers and community standards may motivate individuals to adopt environmentally friendly practices in educational institutions. Considering this, policy initiatives and campaigns to increase social endorsement for e-waste disposal could significantly boost participation rates. The study also confirms that pro-environmental attitude significantly influences e-waste disposal behaviour, primarily through its effect on e-waste disposal intention. This finding aligns with TPB and highlights the importance of positive attitudes toward environmental protection as a driving force behind intention (Ajzen, 1991; Steg & Vlek, 2009). Perceived innovation attributes had a smaller influence than other independent variables on e-waste disposal intention. However, it has no significant impact on e-waste disposal behaviour. This aligns with studies indicating that perceived ease of use and benefits of new technology can enhance adoption (Venkatesh et al., 2003).

E-waste disposal intention acts as a crucial mediator in this model, effectively translating attitudes, social influences, and perceived innovation attributes into actual e-waste disposal behaviour. This finding is consistent with TPB, which posits intention as a primary determinant of behaviour (Fishbein & Ajzen, 2010). This study suggests that we should focus on creating strong disposal intentions as an essential pathway to promote responsible e-waste behaviour. Against expectations, past habits did not significantly moderate the intention-behaviour relationship in this study. This may differ from other studies where habitual behaviours play a more substantial role (Verplanken & Orbell, 2003; Gardner, 2015). This finding suggests that for educators, the decision to engage in e-waste disposal behaviour is likely more driven by mindful intentions rather than habitual actions. Although bootstrap results show a significant moderation effect, wider confidence intervals suggest there may be limited evidence of a moderation effect in this dataset.

The insights from this study underscore the importance of social and attitudinal factors in driving e-waste disposal behaviour among educators, reinforcing the applicability of the Theory of Planned Behaviour in predicting pro-environmental actions. Policymakers, educators, and Universities aiming to promote sustainable e-waste management should consider strategies that foster positive environmental attitudes, strengthen social norms supportive of e-waste disposal, and emphasize the practical benefits of innovative disposal methods. Furthermore, while past habits are often central to behaviour change theories, this study suggests that disposal intention rather than habit may be a stronger lever for influencing disposal behaviour in educational contexts. Future research could explore these relationships in diverse professional settings to better understand the role of habitual behaviours and examine whether the observed patterns hold across different demographics and cultural backgrounds.

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