Enhancing User Engagement with Ergonomic E-Waste Recycling Bins in Retail Environments

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ABSTRACT

Electronic waste (e-waste) disposal remains a significant environmental challenge in Malaysia, particularly within urban retail environments. This study aims to understand the factors that influence consumers' intentions to recycle e-waste, focusing on Generation Y. Guided by the Theory of Planned Behaviour (TPB), the research examines how attitudes, perceived behavioural control, subjective norms, influencer credibility, and ergonomic design impact recycling intentions. An online survey will be collected from 200 respondents via purposive sampling, and Partial Least Squares Structural Equation Modelling (PLS-SEM) will be used for analysis. The findings are expected to show that positive attitudes, perceived ease of recycling, strong social norms, and credible influencer attributes significantly increase the intention to recycle e-waste. Ergonomic design features are also anticipated to enhance perceived behavioural control. The study concludes that promoting awareness, improving design, and leveraging social influence can effectively increase e-waste recycling participation. The contribution of this research

lies in providing actionable insights for retailers and policymakers to develop effective strategies that boost recycling efforts and support sustainable waste management in Malaysia.

Keywords: *E-waste recycling, Ergonomic design, Malaysia, Retail environment, Theory planned behaviour*

INTRODUCTION

E-waste is among the rapidly expanding waste streams worldwide. Malaysia is also witnessing a notable increase in e-waste production, largely fueled by technological progress, higher consumption rates of electronic gadgets, and quick product obsolescence (Kumar et al., 2021). Although the country faces clear environmental risks and has implemented regulatory measures like the Environmental Quality Act of 1974, significant obstacles remain in managing e-waste effectively (DOE, 2020). The main challenges include limited public awareness of the importance of recycling e-waste and the scarcity of easily accessible, user-friendly disposal options, which together hamper efforts to promote sustainable waste management practices (Manaf et al., 2019).

While several retail chains and electronics companies, including AEON Malaysia, Harvey Norman, and Panasonic Malaysia, have set up designated e-waste collection points within their stores, the actual participation of consumers remains inconsistent (AEON Malaysia, 2023; Panasonic Malaysia, 2022). The impact of these initiatives is often limited by poor design, lack of visibility, and low perceived ease of access, which reduce consumer willingness to recycle responsibly. To address this gap, the design and ergonomic features of e-waste recycling bins in retail environments must be scrutinised, as attractive, accessible, and well-organised collection points have the potential to motivate higher participation rates.

This research employs the Theory of Planned Behaviour (TPB) as its foundational framework to investigate the psychological factors influencing consumers' intentions to engage in e-waste recycling. TPB suggests that behavioural intentions are shaped by attitudes, social norms, and perceived behavioural control (Ajzen, 1991). The researcher also extended the framework by including the ergonomic element to study the importance of well-designed and user-friendly recycling among the respondent. By understanding these components, this study aims to identify how perceptions and social influences can be harnessed to promote environmentally responsible disposal behaviours within retail settings. The insights gained could guide the design of more effective interventions, ultimately contributing to Malaysia's broader sustainability goals.

LITERATURE REVIEW

E-Waste Recycling in Retail: Importance and Rationale

Retail environments have become strategic venues for promoting sustainable behaviours, including e-waste recycling. Given their high foot traffic and accessibility, retail stores offer a convenient touchpoint for consumers to dispose of electronic waste responsibly. The placement of dedicated e-waste recycling bins within retail outlets facilitates easy access and reduces barriers to recycling, aligning with the concept of "nudge theory," which suggests that environmental design can significantly influence consumer behaviour (Thaler & Sunstein, 2008).

Studies have shown that consumer participation in recycling programmes increases when bins are strategically located in high-traffic areas, visually prominent, and designed to be user-friendly (Muster & Egger, 2020). In Malaysia, several retailers, such as AEON, Harvey Norman, and Panasonic, have already established e-waste collection points, responding to government initiatives and corporate social responsibility goals (AEON Malaysia, 2023). Nevertheless, the effectiveness of these programmes depends greatly on the design, visibility, and ease of use of the collection points. Well-designed e-waste recycling bins can serve as powerful visual cues that motivate consumers to participate actively in recycling, thereby reducing environmental hazards posed by improper disposal of electronic waste.

Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB), proposed by Ajzen (1991), is a widely accepted psychological framework used to predict and understand human behaviour. According to TPB, behavioural intentions are influenced by three key determinants: attitude towards the behaviour, subjective norms, and perceived behavioural control. These factors collectively shape an individual's readiness to perform a specific action, such as recycling e-waste.

HYPOTHESES DEVELOPMENT

Attitude Towards E-Waste Recycling

Attitude remains a fundamental predictor of recycling behaviour, as it reflects personal evaluations of the benefits and drawbacks of recycling (Lin et al., 2021). Recent studies underscore the importance of fostering positive attitudes through awareness campaigns and convenient recycling options, particularly within retail environments where consumer engagement is high (Wang et al., 2022). When consumers believe that e-waste recycling contributes to environmental sustainability and personal benefit, they are more inclined to develop a strong behavioural intention to participate (Cheng et al., 2021). Accessibility, visual cues, and informative signage within retail stores can further enhance consumer attitudes by reducing perceived effort and increasing perceived effectiveness of their actions.

Hypothesis 1: Attitude towards e-waste recycling positively influences consumers' behavioural intention to recycle e-waste within retail environments.

Subjective Norm

Recent works underscore that social influences and normative pressures continue to be significant determinants of pro-environmental behaviours (Rahman et al., 2022). When consumers perceive that important others, such as family, peers, or society at large, endorse e-waste recycling, their motivation to comply increases, thereby strengthening their behavioural intention (Zhu et al., 2023). Retail stores can leverage this by displaying messages that highlight community participation or by involving influential figures, which can effectively shape subjective norms.

Hypothesis 2: Subjective norms positively influence consumers' behavioural intention to recycle e-waste within retail environments.

Perceived Behavioural Control

Perceived behavioural control (PBC) influences the likelihood of translating intentions into actions. Recent research highlights that consumers are more motivated to recycle when they perceive the process as simple and accessible, which is particularly relevant in retail contexts where convenience drives behaviour (Lee et al., 2020). The proliferation of strategically placed, ergonomic recycling bins that are easy to identify and use can significantly enhance PBC, leading to increased recycling intentions. Studies during the COVID-19 pandemic also emphasised that environmentally friendly behaviours are strongly associated with perceived ease and safety (Nguyen et al., 2021).

Hypothesis 3: Perceived behavioural control positively influences consumers' behavioural intention to recycle e-waste within retail environments.

Ergonomic Design of E-Waste Recycling Bins

The physical design and ergonomic features of recycling bins are critical factors influencing user participation. An ergonomic design ensures that recycling stations are accessible, easy to use, and comfortable, thereby reducing perceived effort and increasing the likelihood of behavioural engagement (Chen et al., 2023). Features such as appropriate height, ease of opening, clear signage, and intuitive placement have been shown to positively impact recycling intentions by addressing physical and psychological barriers (Alam et al., 2021).

Recent studies underscore that convenience and comfort in the disposal process significantly influence consumers' willingness to participate in recycling activities (Wang et al., 2022). When consumers encounter well-designed, ergonomic recycling bins, they perceive the process as easier and more accessible, which directly fosters sustainable disposal habits. Conversely, poorly designed, unattractive, or inaccessible collection points can discourage participation, despite overall positive attitudes towards recycling (Liu et al., 2021). In retail environments, where consumers are often in a hurry and mindful of ease, the ergonomic design of e-waste bins plays a pivotal role in transforming intentions into actual recycling behaviour. Thus, the following hypothesis is proposed:

Hypothesis 4: The ergonomic design of e-waste recycling bins positively influences consumers' behavioural intention to recycle within retail environments.

This study adopts the Theory of Planned Behaviour (TPB) as its core framework to understand the determinants of consumers' intentions to recycle e-waste within retail environments. According to TPB, behavioural intention is influenced by three primary factors: attitude towards the behaviour, perceived behavioural control, and subjective norm (Ajzen, 1991). Attitude reflects consumers' overall evaluation of recycling e-waste, perceived behavioural control concerns their perception of ease or difficulty, and subjective norm involves social pressures from others. In addition, ergonomic design is included as an independent variable expected to influence recycling intention directly. Well-designed, user-friendly recycling bins are anticipated to encourage participation by making the recycling process more accessible, intuitive, and convenient.

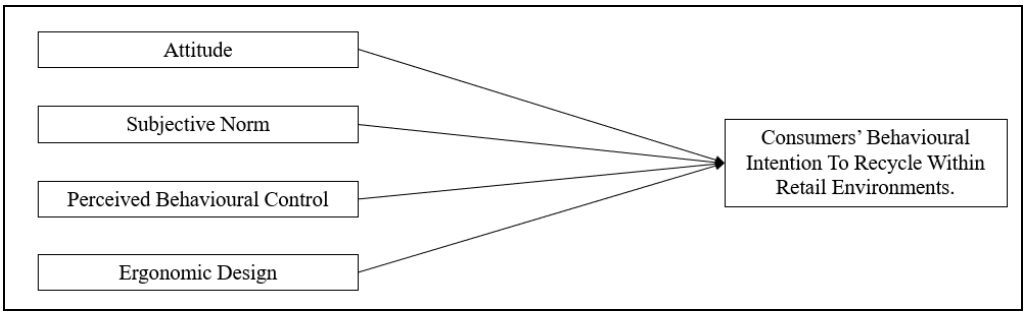

Figure 1. The theoretical framework of this study

METHODOLOGY

This study employs a quantitative research design, utilising an online survey to collect data from participants across urban Malaysia. The focus is on Generation Y individuals, who are selected through purposive sampling. They have higher purchasing power and are more active on digital and social media platforms, making them more accessible and influential regarding social influence and e-waste recycling behaviour (Ng et al., 2022). Participants who have previously engaged in e-waste recycling will be specifically targeted to ensure they have relevant experience and insights. A total of 200 respondents will be recruited via social media, email, and online communities, facilitating efficient data collection across diverse urban settings.

The survey will begin with demographic questions, including age, gender, education level, and duration of residence in urban Malaysia. This will be followed by items measuring the key constructs, such as attitude towards e-waste recycling, perceived behavioural control, subjective norm, influencer attributes, and ergonomic design factors. All items will be adapted from validated scales and rated on a five-point Likert scale from "strongly disagree" to "strongly agree" (Ajzen, 1991; Wang et al., 2020). Ethical considerations will be maintained by ensuring voluntary participation, confidentiality, and anonymity. The collected data will be analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) to assess relationships among variables and test the research hypotheses (Hair et al., 2017). This approach aims to provide a comprehensive understanding of the factors influencing e-waste recycling behaviour in Malaysian urban retail environments.

EXPECTED FINDINGS

This study is anticipated to reveal that key constructs such as attitude, perceived behavioural control, and subjective norm significantly influence consumers' behavioural intentions to participate in e-waste recycling within retail environments. Specifically, it is expected that positive attitudes towards e-waste recycling, higher perceived ease of access and control, and strong social norms will be associated with increased recycling intention (Ajzen, 1991; Wang et al., 2020). Furthermore, the study predicts that influencer attributes, particularly credibility factors like trustworthiness and expertise, will positively impact consumers' attitudes and perceived behavioural control, thereby indirectly influencing recycling intentions (Zhao et al., 2021).

In addition, ergonomic design features of e-waste bins—such as accessibility, ease of use, and visual appeal are expected to directly enhance perceived behavioural control and increase the likelihood

of recycling participation (Chen et al., 2023). It is also anticipated that the influence of these factors will be moderated by consumers' sustainable knowledge, meaning that individuals with higher awareness and understanding of sustainability will demonstrate a stronger relationship between these predictor variables and recycling intentions (Ng et al., 2022). Overall, the findings are expected to provide valuable insights into behavioural determinants of e-waste recycling and actionable guidance for retailers and policymakers to promote sustainable disposal practices effectively.

CONCLUSION

This study seeks to deepen the understanding of the factors influencing e-waste recycling behaviour in Malaysian retail environments by applying the Theory of Planned Behaviour. By examining how attitude, perceived behavioural control, subjective norm, influencer credibility, and ergonomic design impact consumers' intentions, the research aims to provide both theoretical and practical insights. It is expected that positive attitudes, perceived ease of access, social support, and credible endorsements, especially when supported by ergonomic recycling bins, will enhance consumers' willingness to participate in e-waste recycling. Additionally, sustainable knowledge is anticipated to strengthen these relationships, highlighting the importance of awareness in driving pro-environmental behaviours. The findings are poised to inform retailers, policymakers, and environmental practitioners on effective strategies to promote sustainable disposal practices, ultimately contributing to environmental conservation and sustainable development in Malaysia.

LIMITATIONS OF THE STUDY

Despite its contributions, this study has several limitations. First, the use of purposive sampling and online data collection may limit the generalisability of the findings, as responses are confined to Generation Y individuals with internet access and prior e-waste recycling experience. This may exclude other demographic groups or those less digitally engaged, thereby limiting the scope of applicability (Etikan et al., 2016). Second, the reliance on self-reported data could introduce social desirability bias, where respondents may overstate their intentions or attitudes towards recycling (Podsakoff et al., 2003). Third, the cross-sectional design provides a snapshot of perceptions and intentions at a single point in time, which may not accurately reflect actual recycling behaviour over a longer period (Cole & McCathie, 2020). Lastly, while the study considers influence and ergonomic factors, other external variables such as urban infrastructure, government policies, and socioeconomic status are not directly examined but could significantly impact e-waste recycling practices. Future research could extend these findings by exploring these additional factors or adopting longitudinal approaches for more comprehensive insights.

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