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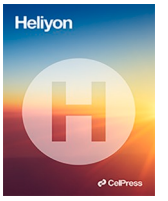

Research article

Impact of information publicity on Korean residents' E-waste recycling intentions: Applying the norm activation model and theory of planned behavior

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ABSTRACT

The escalating annual growth rate of electronic waste, commonly referred to as "e-waste," is currently between 3 % and 5 %, indicating a rapidly increasing solid waste stream. In 2019, South Korea generated 15.8 kg of e-waste per capita. The expansion of South Korea's economy, driven by technological advancement, is a key contributor to this surge in e-waste production. This study examined the impact of information publicity on South Korean residents' e-waste recycling intentions analytically with a quantitative approach. It expanded the norm activation model and theory of planned behavior by incorporating external information elements, including information publicity, in an analysis of 500 responses from the mainland and Jeju Island regarding residents' e-waste recycling intentions and behaviors. The model was validated with partial least squares structural equation modeling via the WarpPLS approach, which is well suited to a model using moderating variables, and the analysis was conducted with WarpPLS 7.0 software. While information publicity did not directly influence residents' intentions to recycle e-waste, it indirectly affected them through two mediating variables: recycling attitudes and moral norms. Additionally, information publicity directly impacted perceived behavioral control. However, perceived behavioral control was not a mediating factor between information publicity and recycling intention. Hence, although people were aware of recycling infrastructure convenience, this awareness did not change their intentions. Current e-waste recycling information and publicity campaigns may be insufficient; the government should improve its publicity events and increase their frequency to encourage effective recycling behavior.

1. Introduction

Some things humans can produce are better if less is produced and more problematic if more is produced, such as waste [1]. Electrical and electronic trash (e-waste) has grown significantly in Korea with the electrical industry's rapid development [2]. E-waste includes all outdated or abandoned electrical and electronic equipment [3].

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Increasing availability and decreasing costs of electronic devices and digital technology have shifted consumer preferences [4]. Mobile phone and internet usage have increased significantly in the last decade [5]. The Digital 2020 report estimated there to be 4.57 billion and 5.15 billion Internet and cellular phone users worldwide, respectively, by July 2020, and approximately 60 % of the world's population uses cellular phones and the Internet [6].

Rapid technological advancements and the industrial revolution have undoubtedly improved our lives, but have also generated significant e-waste [7]. Global e-waste production reached 53.6 million metric tons in 2019, but only 17.4 % was appropriately collected and recycled [8,9]. The remaining 82.6 % was unaccounted for. This trend is expected to continue, with an estimated 74.7 million metric tons of e-waste generated worldwide by 2030 [3].

E-waste includes a variety of equipment, ranging from temperature exchange devices like refrigerators to large appliances such as washing machines and smaller items like toasters and lamps, as well as information technology (IT) and telecommunications equipment like televisions, laptops, and mobile phones [10,11]. Electronic products contain valuable raw materials (e.g., gold, silver, copper, and platinum) and hazardous and toxic additives (e.g., lead, mercury, and cadmium). Hence, recycling them without causing environmental harm is challenging [9].

In South Korea, the formal sector recycled 138 thousand tons of e-waste in 2012. This starkly increased from 155 to 319 thousand tons between 2013 and 2019 [2,12–14].

Social scientists can help tackle economic, social, and environmental issues, such as waste management, environmental conservation, and social conflicts, at the community level. To do so, they must identify factors that can affect people's perceptions of the waste management problem, and informing residents and visitors has high priority. By using these channels, social scientists can facilitate positive changes in a region's economic, social, and environmental conditions [15].

Traditional e-waste management methods like landfilling and incineration are inapplicable in the world's present situation [16]. E-waste disposal for sustainable development and individual contributions to this effort have become increasingly important as e-waste management techniques continue to evolve. It is imperative to comprehend the importance of proper e-waste disposal to achieve prosperity, raise awareness, and encourage individual action toward responsible e-waste management. Awareness of the importance of e-waste disposal can inspire people to evaluate their e-waste management activities and become conscious of their ability to protect the environment.

Little recent research on e-waste issues has addressed the public's disposal habits and awareness [17], and limited knowledge exists on how disseminating information on e-waste management sustainably impacts a particular region or community.

Considering the importance of e-waste recycling informational campaigns [18], it is crucial to examine whether information publicity, specifically for initiatives such as garbage sorting pilot projects, e-waste separation and classification, diverse community campaigns, the provision of free maintenance for electrical and electronic products, promotion of home e-waste recycling, and awareness raising about the hazards of abandoned electrical and electronic products, impacts e-waste recycling and influences residents' behavior. For instance, strategies could involve leveraging crowded places for e-waste recycling publicity, displaying posters in subway or bus stations to create an "e-waste recycling" awareness train, and conducting various forms of media publicity via the Internet, including network recycling channels and a recycling hotline. Therefore, we investigated whether publicizing information significantly affects citizens' inclination to recycle and determined the critical factors influencing their recycling intentions to gain a fresh perspective on e-waste recycling and offer insightful recommendations to the government.

Owing to the increase in non-face-to-face activity due to the COVID-19 pandemic in 2020, the electronics and telecommunications industry market is demonstrating dramatic growth [19].

Considering the value of e-waste recycling informational campaigns, it is crucial to examine whether associated information publicity impacts e-waste recycling besides its effects on residents' behavior, including their intention to recycle e-waste. Furthermore, if publicizing information does significantly affect citizens' inclination to recycle, this study will adduce the most important factors influencing residents' intentions to recycle and provide decision-makers with interesting and informative recommendations based on this new perspective on e-waste recycling.

This study aims to fill a gap in our knowledge of how people deal with e-waste and their knowledge of it by closely examining the reactions of members of the general population, such as residents, to e-waste recycling campaigns. To this end, this study seeks to determine how the provision of information affects the management of e-waste in the community. By concentrating on the general population, we can carefully study the influencing factors of public involvement in e-waste recycling. This can provide good practices for the environment, along with key findings and suggestions for decision-makers. Focusing on the general population can thus afford us a fresh perspective and suggest detailed approaches to improve e-waste recycling in the community.

To provide a solid theoretical foundation for investigating e-waste recycling intentions, this study draws on two schools of thought regarding the nomological structures of the norm activation model (NAM) [20] and the theory of planned behavior (TPB) [21]. Because NAM and TPB have been widely used in research to explore users' views of e-waste recycling and their recycling intent [22–28], they are the most relevant tools for understanding e-waste recycling intention. This study aims to extend both theories by incorporating information publicity and moral norms into the NAM and TPB to produce a more comprehensive model.

According to the literature review, the majority of studies adopting the TPB and NAM to measure recycling intention in the last few years have involved consumers [22,23]. Although researchers have explored people's assessments of recycling conditions regarding attitude, subjective norms, and perceived behavior control, our goal is to expand on these ideas to understand recycling intention using a different paradigm, the integrated NAM-TPB, a more complete model created by extending these theories through the inclusion of information publicity and moral norms.

We aimed to examine and evaluate the influence of various factors promoting participation in e-waste recycling, particularly the mediating role of information publicity. To this end, we measure and analyze the impact of these extended factors and their potential to

encourage people to engage in e-waste recycling activities.

1.1. Literature review

1.1.1. E-waste recycling

Researchers have examined several factors potentially affecting customer intentions regarding e-waste recycling [7,18,24,25]. Research on the influence of customers' behaviors and experiences on their e-waste recycling intentions reveals a positive indirect correlation [26]. Furthermore, the ease of the recycling process influences consumer e-waste disposal behavior [27], suggesting that environmental education can raise awareness of e-waste recycling. Computer knowledge positively mediated the association between social consequences, attitudes, and awareness of laptop disposal practices in Malaysia, which later significantly influenced disposal behaviors [28]. We draw on previous studies to understand how information and publicity impact e-waste recycling in developed countries.

Several e-waste-related studies have been published in South Korea, including on governmental regulations, operational processes, recycling techniques, and their status [2,13,29]. However, studies of consumer behavior and e-waste disposal are sparse. Several studies have investigated de-waste generation, recycling methods, and policies. Jang and Kim [30] surveyed 1090 South Korean customers to determine their rate of generation, methods of systematic recycling, and collection system. Kim, Jang, and Lee [29] employed analytical hierarchy modeling and the Delphi method to identify a list of regulatory priorities in e-waste recycling based on an opinion survey of waste management professionals. Some studies [29–31] have used survey questionnaires to calculate the total annual amount of e-waste generated.

1.1.2. The adoption of integrated NAM-TPB

Schwartz proposed a social psychology model of explanation [32], the NAM, characterized by altruistic purposes or actions in wealthy industrial societies [20,27]. The TPB examines the effects of persistently formed individual attitudes based on concrete beliefs, empirically dependent societal norms, and perceived behavioral controls that limit or accelerate behavioral intentions, positing that behavior is driven by three factors: attitudes, subjective norms, and perceived behavioral control [21]. *Attitudes (ATT)* refer to an individual's beliefs about a behavior and its outcomes [33]. *Subjective norms (SN)* are the perceived social pressure to engage in the behavior, while *perceived behavioral control (PBC)* is the individual's perception of their ability to perform the behavior [34]. Both theories have influenced various studies considering environmental variables such as physical surroundings (e.g., temperature, noise level), social settings (e.g., the presence of others, social norms), and personal beliefs and attitudes (e.g., values, past experiences) and their impacts on behaviors such as energy conservation, recycling behavior, and pro-environmental decision-making [35–37].

Before making decisions, humans frequently monitor and absorb information from others in society [38]. *Subjective norms* in the TPB are the pressure and influence of the referent's opinion, which favorably impact behavioral intentions. According to the NAM, *social norms* are the standards and behaviors of referents that are widely accepted in society [39]. Similar concepts in both theories, such as attitudes, beliefs, and perceived behavioral control, are used to conceptualize these norms and explain how social and subjective norms can influence individual behavior, either through guidance on what is socially acceptable (social norms) or by reflecting an individual's own internal beliefs and values (subjective norms). By using such concepts, researchers can draw comparisons between the NAM and TPB and better understand how social and subjective norms affect behavior [21]. Most recycling research using the TPB has suggested additional variables to increase the *forecasting accuracy* of their research models on recycling behavior; some have also included a moral norm (MN) component [40,41]. The MN standard alludes to people's concerns about their social and ethical responsibilities when performing particular behaviors. In the NAM, a moral norm is conceptualized similarly to a personal norm. Individuals' attitudes have been included in and used to represent MNs [42]. Nevertheless, research shows that MNs increase the variance by 1–10 % when behavioral intentions are described in various contexts [43]. Additional research has acknowledged the statistical significance of MNs in predicting behavioral intentions [40].

Conceptual precision levels increase when measuring MNs from attitudes. In this study, MNs emphasize the presumed moral requirement of recycling, while attitudes emphasize individuals' feelings.

1.1.3. Information publicity

Information publicity (IP) refers to the dissemination of information to the public by government entities, organizations, or individuals to promote transparency, accountability, and public participation in decision-making processes [44–49].

IP is crucial in promoting democratic values and ensuring citizen access to information necessary for informed decisions. It is an essential component of open government and good governance and is increasingly recognized as a fundamental human right [50].

Various factors influence the success of waste recycling, including public policy implementation and consumer participation [22,23]. Public education is crucial to modify residents' customs, behaviors, and habits and encourage them to apply waste sorting [51]. Structured questionnaires commonly evaluate public perceptions and understandings of recycling. Studies reveal that recycling electrical and electronic equipment waste promoted moral standards and informed the public about the benefits of e-waste recycling [52–54]. Active public education and publicity about garbage sorting and recycling increased citizens' inclination to engage in waste disposal [55]. *Social cognitive theory* suggests that outside information influences people's behavior decisions, and the spread of information can affect their psychological aspects [45]. Education and publicity around garbage classification can affect attitudes and behaviors [22,27,56]. However, the impact of garbage classification publicity and education on related behavior varies across regions, and effective policies require a thorough understanding of the influencing mechanisms [57–59].

In this study, information publicity includes all types of information about waste recycling. The information-behavior model

suggests that people's actions can be influenced by the information they have, as a lack of information about specific behaviors may hinder individuals from performing them [60]. Although waste recycling is known to be beneficial for sustainable development, people's awareness of waste and willingness to recycle in their daily lives are often low [56,61], partly due to a lack of information [56, 62]. When residents learn the benefits of waste recycling, the process involved, and how to distinguish recyclable waste, they are more likely to engage in waste recycling activities [56,63,64]. Scholars have also observed a positive relationship between information publicity and residents' intention to participate in household waste separation and recycling activities [64,65].

The TPB and NAM are popular frameworks for understanding individuals' decision-making and behaviors [15,22,56,66–68]. A government IP can influence these models by providing information about the concerned behavior and the associated norms and attitudes [15,22,56]. This literature review explores how government IP affects these models.

Finally, government IP can impact perceived behavioral control [56]. One study found that a campaign encouraging safe alcohol use increased perceived behavioral control for limiting alcohol consumption [69]. Thus, government IP can impact perceived behavioral control and influence behavior through the TPB.

The NAM posits that behavior is driven by MNs or perceived social responsibility [20]. Government IP can impact NAM through the salience of these MNs [70]. For instance, a campaign encouraging energy conservation increased the salience of environmental values, thus increasing energy-saving behaviors [71]. Another campaign encouraging recycling increased the salience of environmental values, thus increasing recycling behaviors [22,56].

Therefore, government IP can potentially impact both models [15,22,56]. These findings suggest that government IP can be a powerful tool for promoting positive behavior change.

A previous study presented the *heuristic model of persuasion*, suggesting that people use mental shortcuts, or heuristics, to process information and make decisions [72]. According to this model, people are more likely to be motivated to act on information if they perceive it to be relevant to their goals. The study also suggested that the time an individual takes to act on information varies depending on several factors, including motivational level, the issue's complexity, and their available cognitive resources [73]. Thus, we formulated the research model and hypotheses based on these viewpoints and theoretical analysis.

1.2. Research model and hypothesis development

The research model for this study is presented in Fig. 1. As few studies have examined the influence of information publicity on e-waste recycling intention [22,23,56], we accordingly address this issue with the integrated NAM-TPB. In this model, altruistic actions follow societal and personal norms when individuals are aware of responsibility and consequences. Moral norms, those integral to one's character, play a vital role in evaluating the morality of specific acts [74]. This study confirms the significance of moral norms in the modified NAM. The TPB examines how individual attitudes, societal norms, and perceived behavioral controls influence behavioral intentions [21]. According to the TPB, perceived behavioral control has a limited impact on residents' intentions [75,76]. In this study, ease of access to recycling infrastructure is considered under the heading of perceived behavioral control [53]. Drawing upon NAM and TPB, hypotheses were developed to investigate how information publicity mediates the intention to recycle e-waste. The researchers expect that this study will guide survey item selection through consideration of the diverse factors influencing human

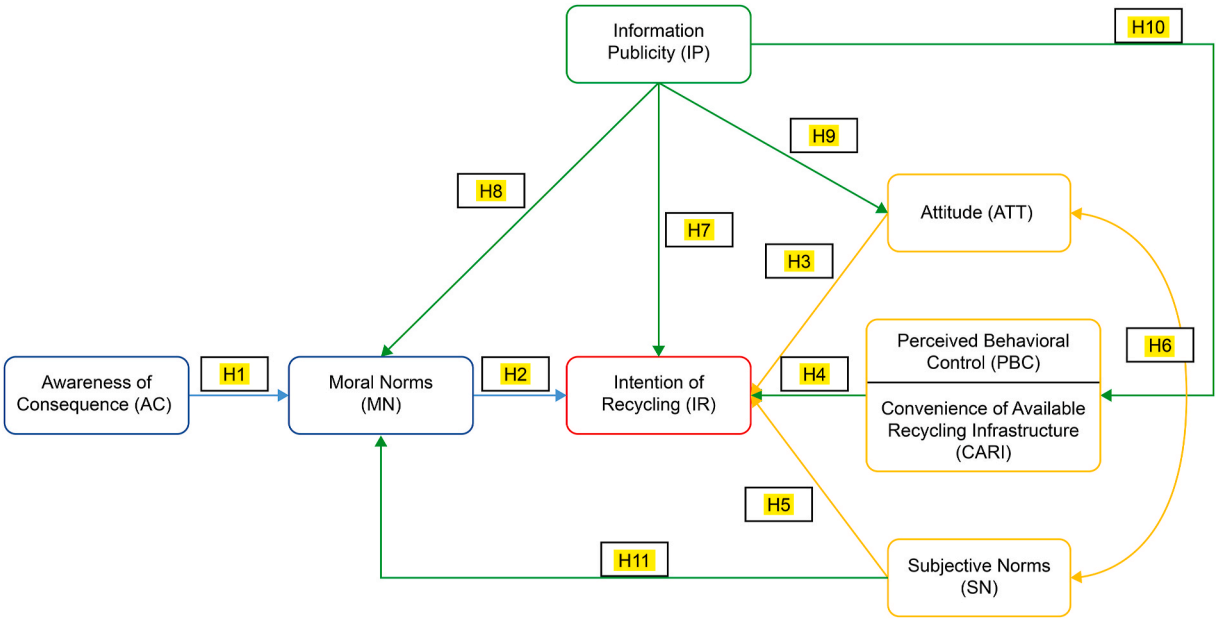

Fig. 1. Research design.

behavioral intentions. The hypotheses introduced align with the research framework of this study. The study's hypotheses and the theoretical framework are reported below.

1.2.1. The NAM can significantly impact residents' behavioral intentions

Awareness of consequence. The main principle of the NAM is that an individual's behavioral intentions can be influenced by the activation of their personal norms. In other words, when personal norms are activated, they can affect an individual's decision-making process and influence the likelihood of certain behaviors [20]. In our research model, MN stimulation was employed to influence people's behavioral intentions toward e-waste recycling. The study found that the use of MN stimulation had a significant impact on participants' intentions. Research shows that moral standards and awareness of consequences (AC) in the NAM can affect people's behavioral intentions toward recycling e-waste [77]. Studies investigating environmental behavior and awareness indicated that the NAM could indeed actively hold [15,22,23,78,79]. Hence, we formulated the first hypothesis using this research framework.

MN. In the *model of altruistic conduct*, an individual's behavior is prescribed by society and their personal norms of awareness of responsibility, with consequences activated by moral norms [20]. Within a moral framework, MNs are similar to awareness of responsibility and fundamental to an individual's sense of morality; notably, they are mostly expressed in moral evaluations and expressions related to social conscience regarding particular acts [74]. An individual's reason for acting in a specific manner is directly impacted by their moral views regarding the conduct. Research has demonstrated that MNs play an essential role in the modified NAM [40]. Hence, it is reasonable to include MNs in the model. Empirical studies of environmental awareness and recycling intentions have shown that the NAM can be activated by providing information about the benefits of recycling, increasing access to recycling facilities, and promoting environmental education initiatives [22,56,68,78]. Therefore, the following hypotheses were developed.

H1. Based on the NAM theory AC stimulates the MN

H2. MN significantly impacts residents' behavioral intentions toward e-waste recycling.

1.2.2. The TPB can significantly impact residents' behavioral intentions

Most researchers studying e-waste recycling [24,26,27,77,80] have used the TPB framework to build and improve models. The TPB was used in a study examining the factors influencing residents' behavioral intentions toward e-waste recycling, showing that attitudes toward recycling, subjective norms, and perceived behavioral control had varying degrees of relevance [81]. We tested the second hypothesis by expanding the theory.

Several studies have reported mixed results regarding the impact of perceived behavior control on recycling behavior [75,76]. Ramayah, Lee, and Lim [53] suggested a new way of measuring recycling behavior and introduced two additional variables under perceived behavior control: convenience of the available recycling infrastructure and cost of recycling.

The availability of convenient recycling infrastructure is a key factor influencing recycling behavior. Consumers may be discouraged from recycling if facilities are not easily accessible or travel distances are too long [51]. Similarly, recycling costs, such as time, space, and ease of performing the task, may also shape recycling behavior. Hence, the present study included the convenience of the available recycling infrastructure as a factor under perceived behavioral control, Therefore, the following hypotheses were developed.

Recycling attitudes (ATT), subjective norms (SN), and perceived behavioral control (PBC) based on the TPB significantly impact residents' e-waste recycling intentions.

H3. ATT significantly impacts residents' behavioral intentions toward e-waste recycling.

H4. PBC significantly impacts residents' behavioral intentions toward e-waste recycling.

H5. SN significantly impacts residents' behavioral intentions toward e-waste recycling.

Subjective norms and attitudes. Researchers have scarcely focused on how subjective norms interact with other TPB factors to affect recycling intentions. It was recently demonstrated that recycling intentions were significantly influenced by the combination of subjective norms and practical attitudes toward recycling (i.e., the benefit of recycling [82,83]). Additionally, strong subjective norms significantly increased the intention of people with a weak recycling attitude to engage in recycling behaviors. Similarly, Wang et al. [78] examined the impact of subjective norms on residents' attitudes toward recycling. Building on this research, we tested a similar relationship and proposed a hypothesis as follows.

H6. SN significantly impacts e-waste recycling attitudes based on TPB.

1.2.3. IP can significantly impact residents' behavioral intentions

IP involves the government or other organizations disseminating pertinent information to the public via policies and media [68]. A person's behavior is influenced by the information they possess [84]; a lack of relevant information can hinder their behavior, as postulated by the *information behavior model* [68]. Investigating whether IP encourages the transformation of intention into activity is imperative. Examples of IP include encouraging multiple community programs to raise awareness of the hazards of waste, utilizing the maximum advantage of locations with high pedestrian traffic to spread false information about the waste generated, and using the Internet to encourage considerable media publicity [79]. Residents will be willing to participate in waste disposal through various IP methods [85].

However, information may become distorted or altered during communication; therefore, the quality and type of information are

equally important. Correspondingly, people are more likely to use the information to engage in particular actions and to be willing to categorize waste responsibly if they believe the information is relevant, trustworthy, correct, valuable, and acceptable [79,86].

Several studies [22,23,59] have provided evidence that information dissemination significantly impacts residents' behavioral intentions toward recycling e-waste or engaging in pro-environmental behaviors.

Furthermore, this study explored the mediating role of attitudes, perceived behavioral control, and MNs in the relationship between IP and behavioral intentions. Therefore, the following hypotheses are proposed.

H7. IP significantly influences residents' behavioral intentions toward e-waste recycling.

H8. *MNs mediate the relationship between IP and residents' behavioral intentions toward e-waste recycling.*

H9. Recycling attitudes mediate the relationship between IP and residents' behavioral intentions toward e-waste recycling.

H10. Perceived behavioral control mediates the relationship between IP and residents' behavioral intentions toward e-waste recycling.

1.2.4. Subjective norms can significantly impact MNs

This study investigated the correlation between subjective and personal norms. Pro-social waste recycling behaviors are likely to align with and be strongly associated with moral standards and individual or social obligations. The connection between moral and subjective norms in our research thus suggests that social influence or expectations might motivate people to act in a particular manner or follow certain values or principles in the future. Several studies have verified different significance levels of the relationship [87,88].

Table 1
Demographic characteristics.

Categories		*n*	Percentages (%)
Gender	Male	250	50.0
	Female	250	50.0
Age	20s	100	20.0
	30s	100	20.0
	40s	100	20.0
	50s	100	20.0
	60s and older	100	20.0
Education	Middle school	5	1.0
	High school	86	17.2
	University	368	73.6
	Graduate	41	8.2
Occupation	General office worker	244	48.8
	Self-employed	37	7.4
	Professional	34	6.8
	Government official	10	2.0
	Student	35	7.0
	Housewife	64	12.8
	Agriculture	5	1.0
	Retired	27	5.4
	Others	44	8.8
Region	Seoul	144	28.8
	Busan	37	7.4
	Daegu	23	4.6
	Incheon	36	7.2
	Gwangju	9	1.8
	Daejeon	15	3.0
	Ulsan	13	2.6
	Gyeonggi	135	27.0
	Gangwon	10	2.0
	Chungbuk	8	1.6
	Chungnam	9	1.8
	Jeonbuk	9	1.8
	Jeonam	6	1.2
	Gyeongbuk	18	3.6
	Gyeongnam	25	5.0
	Jeju	1	0.2
	Sejong	2	0.4
Income (Won/month)	Less than 1 million	71	14.2
	1.0–1.99 million	62	12.4
	2.0–2.99 million	115	23.0
	3.0–3.99 million	110	22.0
	4.0–4.99 million	47	9.4
	More than 5 million	95	19.0
	Total	500	100.0

Based on Klöckner's study [89] of personal environmental awareness and behavior, we propose in H11 that subjective norms can significantly impact personal norms as follows.

H11. In our integrated NAM-TPB model, subjective norms significantly impact MNs.

Fig. 1 demonstrates the study's model based on the hypotheses. We performed a path analysis using a structural equation model to verify the model's hypotheses. The NAM's basic tenet is that motivated MNs can affect a person's environmental behavior. Therefore, this research methodology stimulated the MNs based on the NAM theory to impact residents' behavioral intentions about e-waste recycling.

2. Materials and methods

2.1. Method: measurements and questionnaire design

The study had two main stages of statistical analysis: (1) frequency analysis and basic reliability and factor analysis, and (2) partial least squares (PLS) structural equation modeling (SEM). In the first stage, we used IBM SPSS version 24.0 for data analysis to identify the participants' demographic characteristics and conduct basic reliability and factor analysis. The *reliability analysis* evaluates the consistency of responses to a set of items, while *factor analysis* identifies underlying dimensions or factors that can explain the relationships between the observed variables.

In the second stage, we used WarpPLS 7.0 to analyze the data using the PLS method for SEM, a statistical technique that analyzes the relationships between latent variables. We applied PLS to identify the influential relationships between the latent variables and analyze the path effects for hypothesis testing. *Path analysis* is a statistical method used to evaluate the relationships between variables in a model.

2.2. Sampling (data collection and samples)

In this study, researchers designed the survey questionnaire (Appendix 1), and then collaborated with a recognized survey company to collect data from potential respondents. We secured consent from all online survey participants in line with ethical guidelines from the Jeju National University Institutional Review Board and Korea's Personal Information Protection Act. Our data collection was contactless, adhering to these principles and without clinical trials. The survey company played a vital role in ensuring that the survey was distributed effectively, and that data were collected in a reliable and valid manner. They provided guidance on survey distribution methods and advice on minimizing bias and maximizing response rate. The survey was conducted over 14 days, targeting samples from 17 metropolitan cities and provinces on mainland Korea as well as Jeju Island.

Corresponding precisely to the balanced sex ratio of the Korean population, 250 of the 500 responders were female and 250 were male. The survey sample was selected using a geographically representative sampling method in which the number of respondents from a given city in the study sample was proportional to their proportion of the overall population:

Table 1 presents detailed data on the sample characteristics.

2.3. Data analysis

According to Hair, Ringle, and Sarstedt [90], PLS-SEM can be used to minimize the residual variances of endogenous factors to improve the model's prediction accuracy. Endogenous factors are variables within the model that are influenced by other variables within the same model.

Second, PLS-SLM can incorporate formative and reflective constructs within the model. Formative constructs are variables determined by their indicators, while reflective constructs determine their indicators. PLS-SEM allows the inclusion of both types of constructs in the same model, providing a more comprehensive understanding of the relationships between variables than do other methods that do not consider both formative and reflective constructs simultaneously.

Finally, PLS-SEM was used to interpret complicated models with small or large sample sizes. It can provide accurate results even when the assumptions of traditional statistical methods, such as ordinary least squares, are not met. PLS-SEM is particularly useful when dealing with small sample sizes or models that have a high degree of complexity [90].

3. Results

3.1. Validity and reliability

We tested our hypotheses with PLS-SEM, performed using WarpPLS 7.0. The analysis included evaluations of the reliability and validity of the latent variables in the measurement model and assessing the structural model to test the research hypotheses, following Hair et al.'s procedure [91]. Concerning the reflective measurement model, it is necessary to assess both reliability and validity. WrapPLS established discriminant validity through a thorough examination of full collinearity variance inflation factors (VIFs), loading values, and Heterotrait–Monotrait (HTMT) ratios. Convergent validity was verified using average variance extracted (AVE), while internal consistency was assessed through composite reliability (CR) and Cronbach's alpha [92]. The detailed findings are presented in Table 3 for HTMT, and Table 2 shows the loading values, full collinearity VIFs, AVE, CR, and Cronbach's alpha values.

This comprehensive analysis helps ensure both the internal consistency and the dependability of the study's measurements. To ensure that a construct measures a particular facet of the phenomenon being studied, discriminant validity evaluates whether it differs from other constructs in the study. Discriminant validity is essential, as it strengthens the conviction that each construct is unique and guarantees that various notions in a study are not being confused or viewed as equivalent.

To demonstrate that many measurements of the same construct assess the same underlying notion or are converging, convergent validity evaluates the degree of correlation between the measures. When a construct has high convergent validity, it means that the various measures used to evaluate it agree with one another, which increases trust in the coherence of the notion and the measurement's dependability [93–95]. The loadings are the basis for calculating the average variance extraction value. This section was checked first to ensure that each variable accurately defined the concept of the factor; if the loadings were low, the composite reliability (CR) and average variance extracted (AVE) indices were examined for convergent validity. All items represented the same latent construct according to CR, which indicated internal consistency. As the CR value should be 0.7 or more, we excluded items with loadings less than 0.7, namely: ATT 3, SN 2, 5, and 6, MN 6, AC 1, and CARI 3. All items' AVE values were less than 0.5. Internal consistency was indicated by the fact that all of the constructs' Cronbach's alpha values exceeded the threshold of 0.7 [96].

Specifically, the data in Table 2 show that the internal consistency reliability was 0.727–0.833 for each factor based on Cronbach's alpha value; the CR was also high at 0.575–0.929. This indicated appropriate validity and reliability.

Kock and Lynn (2012) [97] introduced a comprehensive approach known as the full collinearity test to simultaneously assess both vertical and lateral collinearity in a model [98]. This method, facilitated by the WarpPLS software, automatically generates variance inflation factors (VIFs) for all latent variables within the model. A VIF exceeding 3.3 indicates a strong likelihood of pathological collinearity, as it signals that the model might be affected by common method bias [99]. Consequently, if all VIFs obtained from the full collinearity test are 3.3 or lower, it implies that the model is free of common method bias.

WarpPLS is a powerful data analysis tool, considering that it includes composite-based PLS-SEM techniques as well as factor-based PLS-SEM methods. WarpPLS provides descriptive statistics for all latent variables in the model, allowing users to test for multivariate normality. As shown in Table 4, the skewness and excess kurtosis statistics for most latent variables, except ATT, are near zero, implying that the data are sufficiently close to normally distributed [100].

Fig. 2 illustrates the analysis results for the research hypotheses, along with the path coefficients, p-value, and numerical value (R^2). The R^2 indicated outside the circle is the variance of the endogenous variables (causal factors) and the sum of their influences on the mediators.

Table 2
Validity and reliability.

Latent variables	Indicator	Discriminant Validity		Convergent Validity	Internal Consistency	
		VIF	Loading Value	AVE	Cronbach's Alpha	Composite Reliability
AC	AC2	1.985	0.844	0.659	0.727	0.659
	AC3		0.831			
	AC4		0.818			
	AC5		0.752			
MN	MN1	2.221	0.736	0.570	0.811	0.570
	MN2		0.799			
	MN3		0.756			
	MN4		0.778			
	MN5		0.703			
ATT	ATT1	2.316	0.755	0.587	0.765	0.850
	ATT2		0.800			
	ATT4		0.726			
	ATT5		0.782			
SN	SN1	1.802	0.833	0.702	0.788	0.876
	SN2		0.840			
	SN3		0.840			
CARI	CARI1	2.120	0.734	0.518	0.814	0.866
	CARI2		0.719			
	CARI4		0.685			
	CARI5		0.696			
	CARI6		0.722			
	CARI7		0.760			
IP	IP1	2.220	0.816	0.688	0.773	0.869
	IP2		0.832			
	IP3		0.840			
IR	IR1	1.417	0.846	0.857	0.833	0.923
	IR2		0.845			

AC = awareness of consequence, MN = moral norms, ATT = attitude, SN = subjective norm, CARI = convenience of the available recycling infrastructure, IP = information publicity, IR = intention of recycling.

Table 3
Heterotrait–Monotrait Ratio (Discriminant validity).

	ATT	SN	CARI	AC	IR	IP	MN
ATT							
SN	0.693						
CARI	0.607	0.644					
AC	0.84	0.53	0.4				
IR	0.535	0.501	0.433	0.534			
IP	0.671	0.674	0.849	0.581	0.462		
MN	0.747	0.703	0.645	0.725	0.563	0.719	

AC = awareness of consequence, MN = moral norms, ATT = attitude, SN = subjective norm, CARI = convenience of the available recycling infrastructure, IP = information publicity, IR = intention of recycling.

Table 4
Multivariate normality.

Latent variables	AC	MN	ATT	SN	CARI	IP	IR
Skewness	−0.968	−0.329	−0.951	−0.413	−0.276	−0.606	−0.498
Excess kurtosis	1.127	−0.015	1.648	0.323	0.007	0.930	0.026

AC = awareness of consequence, MN = moral norms, ATT = attitude, SN = subjective norm, CARI = convenience of the available recycling infrastructure, IP = information publicity, IR = intention of recycling.

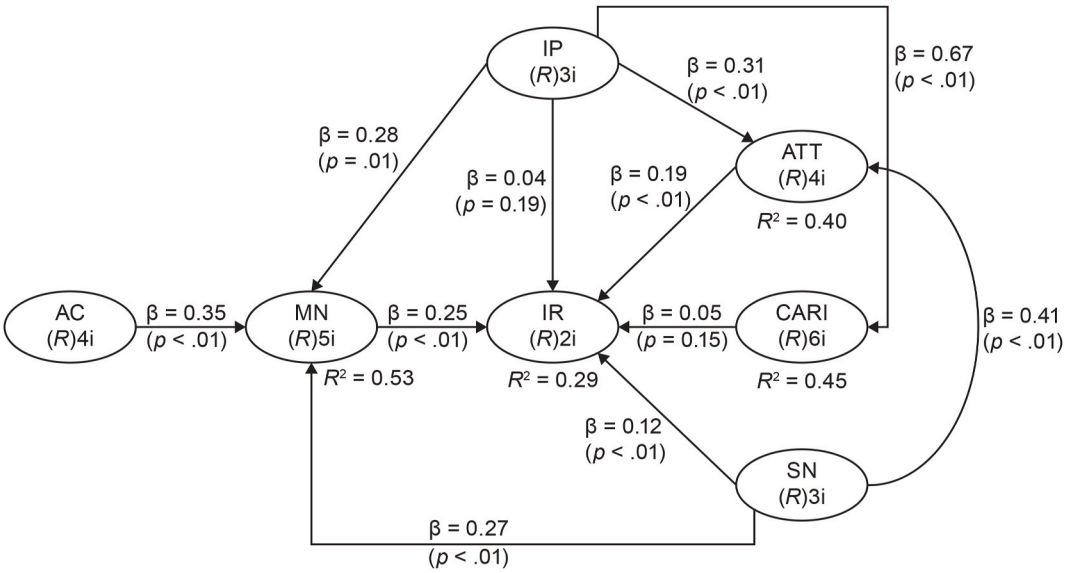

Fig. 2. Results of hypothesis testing.

3.2. Hypothesis testing

Table 5 shows the hypothesis testing results for the effect size, path coefficient, *p*-value, and the direct effects of the entire paths in order of magnitude based on the path effects. The paths with the highest coefficients are IP to the ease of access to available recycling infrastructure (IP→CARI), subjective norms to attitudes (SN→ATT), and AC to MNs: These paths were found to have the greatest effects. Results indicated that H1, H2, H3, H5, H6, H8, H9, H10, and H11 passed the test, but H4 and H7 did not.

WrapPLS calculates the effect sizes in each latent variable block as the absolute values of the individual contributions of the relevant predictor latent variables to the R^2 coefficients of the criterion latent variable. The effect sizes determine whether the effects suggested by the path coefficients are small, medium, or large, interpreted with the conventional threshold values of 0.02, 0.15, and 0.35 [101]. Values less than 0.02 indicate effects that are considerably weak to be considered of practical importance, even if their respective *p*-values are statistically significant; this can happen with large sample sizes [102].

According to the SEM test results shown in Fig. 2, moral standards grounded in the NAM are stimulated by the knowledge of the results and considerably impact residents' inclinations to recycle. Residents' recycling intentions are significantly influenced by their recycling attitudes and subjective norms, all of which are based on the TPB, but not significantly affected by the accessibility of recycling infrastructure under the TPB's perceived behavioral control.

Table 5
Results of hypotheses testing.

Path	Hypothesis	Path coefficient	Effect size	*p*-values	Results
AC → MN	H1	0.348	0.207	0.001	Supported
MN → IR	H2	0.248	0.120	0.001	Supported
ATT → IR	H3	0.190	0.088	0.001	Supported
CARI → IR	H4	0.047	0.017	0.146	Not supported
SN → IR	H5	0.123	0.050	0.003	Supported
SN→ ATT	H6	0.407	0.232	0.001	Supported
IP → IR	H7	0.039	0.014	0.197	Not supported
IP → MN	H8	0.287	0.164	0.001	Supported
IP → ATT	H9	0.311	0.164	0.001	Supported
IP → CARI	H10	0.674	0.454	0.001	Supported
SN → MN	H11	0.273	0.156	0.001	Supported

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.
AC = awareness of consequence, MN = moral norms, ATT = attitude, SN = subjective norm, CARI = convenience of the available recycling infrastructure, IP = information publicity, IR = intention of recycling.

The mediating factors, moral standards, and recycling attitudes influenced citizens' recycling intentions, while IP was not directly affected by those intentions. Additionally, MN and attitude were greatly influenced by subjective norms.

The hypothesis testing found the routes of IP and perceived behavior control affecting recycling intentions not to be significant. Hence, we decided to exclude these variables from analysis and rerun the SEM, as it is a common practice in statistical analysis to remove variables from a model that are not significant or do not contribute to the overall understanding of the relationship between the concerned variables; doing so can simplify the model and ease its interpretation [103,104]. We used WarpPLS 7.0 to re-examine the model. Fig. 3 illustrates the results of the modified model.

3.3. Discussion and implications

This study applied the integrated NAM-TPB model to investigate the impact of information publicity on people's e-waste recycling, which is consistent with the findings of other studies regarding helpfulness and environmental friendliness [28]. It also discovered a positive and significant relationship between residents' awareness of consequences and moral norms, as well as a positive and significant relationship between the two and recycling intention [27].

The current information and publicity regarding e-waste recycling do not directly motivate residents to recycle their e-waste, as our findings suggest. This corroborates Wang et al. [78], who found that information and publicity could indirectly impact people's intentions to recycle e-waste through three mediating variables: personal norms, recycling attitude, and perceived behavior control.

We found that information dissemination significantly affected moral standards at a high significance level. MNs primarily assessed residents' moral awareness of recycling [34], and IP had a significant impact on it. Constructively guiding moral awareness could shape residents' e-waste recycling intentions in a better way than simply relying on informational dissemination. Thus, IP significantly

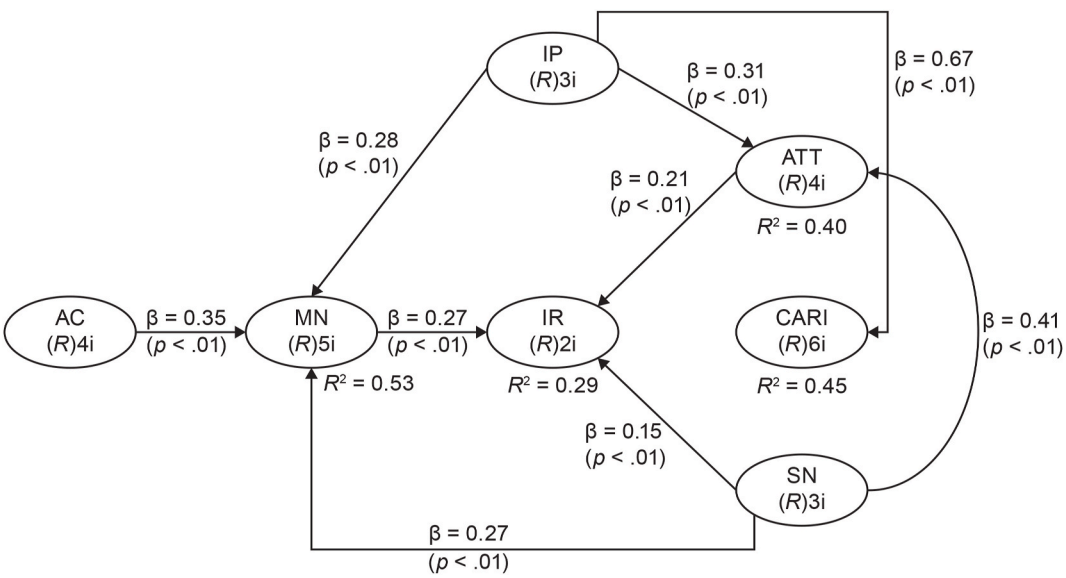

Fig. 3. Modified model.

affected recycling attitudes. As residents became more informed about the negative consequences of discarding or storing e-waste at home and the resulting environmental damage, their attitudes toward recycling changed [105]. By regularly treating this waste, residents' moral subconscious was stimulated, developing positive attitudes toward recycling. This established a favorable environment for e-waste recycling, creating a positive cycle [105,106].

According to our study, informational campaigns do not directly impact residents' intentions to recycle e-waste. However, IP about recycling e-waste was found to be effective. The effectiveness of IP in e-waste recycling lies in its significant impact on moral norms, as indicated by a standardized regression coefficient of 0.287. The variable measuring residents' recycling awareness from a moral perspective demonstrates a substantial influence of IP. By positively influencing moral consciousness, IP fosters residents' intention for e-waste recycling. Furthermore, IP significantly influences recycling attitudes and subjective norms [28]. Nevertheless, we conclude that the current publicity efforts are inadequate and do not motivate people to recycle. Therefore, it is necessary to devise effective strategies that can motivate residents to recycle their e-waste. Encouraging people to recycle electronic waste through IP involves a few key issues. First, information must be publicized regarding the benefits of e-waste recycling for the environment. Offering rewards or prizes for recycling can also motivate people. Sharing success stories from the community can make everyone feel part of something positive. Making sure that recycling spots are easy to find is important as well. Teaming up with local groups and using social media for fun activities or reminders helps maintain people's interest. The government's promotion of recycling strengthens the message, and showing how recycling helps each person by keeping the environment healthy and saving resources makes the message personal. By doing these things through IP, we hope that more people will feel excited to join in and recycle their electronic waste [107,108].

Our findings demonstrate that AC might activate moral standards based on the NAM hypothesis [22]. Residents would take greater responsibility for their living environment when aware of the numerous negative effects of not recycling e-waste, feel a sense of duty, and follow their moral standards effectively [77].

According to the TPB, a resident's attitude toward recycling affects their recycling intention [24–26]. Therefore, it is crucial to evaluate residents' recycling attitudes and actively influence them to improve their understanding of environmental preservation and promote recycling. This can ultimately lead to increased recycling intentions and behavior [25]. The recycling intentions of locals are significantly influenced by subjective norms [83,84]. Therefore, the applicable e-waste recycling regulations and rules and the attitudes of the local populace decide, to an extent, how enthusiastically they engage in recycling. Residents' desires to recycle e-waste will significantly increase if social norm-related activities are conducted. Our results also support the major impact of subjective norms on recycling attitudes. Hence, the environment for recycling in general or the legislation and standards governing e-waste might impact the locals' attitudes toward recycling. MNs are affected by subjective norms, implying that the applicable legislation governing e-waste recycling and public opinion will greatly impact local citizens' moral awareness of recycling [87,88]. Therefore, we believe that subjective norms have a greater impact on e-waste recycling than previously anticipated [24]. It is crucial to strengthen the current laws and rules.

Experience and ease of recycling are key indicators of perceived behavioral control. Ease of access to available recycling infrastructure was thus included under perceived behavior control in this study [53]. The findings indicate that the convenience of recycling does not have a significant impact on people's recycling intention [51]; that is, residents' willingness to participate in recycling is not affected by the ease of access to available recycling infrastructure. Hence, while residents are aware of the convenience of recycling infrastructure, it is insufficient to change their recycling intentions [35]. According to the TPB, perceived behavioral control has a negligible impact on residents' behavioral intentions [75,76]. We recommend that the government increase efforts to disseminate information on e-waste recycling frequently and widely, emphasizing its benefits and giving details on recycling routes. We also suggest enhancing the e-waste recycling infrastructure and integrating it with Internet technologies to increase the convenience of recycling for residents by including features such as mobile applications for scheduling pickups, real-time information on nearby recycling centers, and digital platforms for interactive and informative campaigns. This approach recognizes that mere awareness of the existence of recycling infrastructure might not be sufficient to drive behavioral change. Instead, by incorporating technology, we recommend measures to provide residents with tools and resources that make recycling more convenient, engaging, and aligned with their daily routines. In essence, it is a strategy to transform the way people interact with and perceive recycling in order to bridge the gap between awareness and active participation [109]. We anticipate that residents' awareness and willingness to recycle e-waste will thereby increase, positively impacting public health and the environment.

4. Conclusions

This study aimed to determine the factors shaping e-waste recycling and the influence of the dissemination of pertinent information on South Korean residents' intentions regarding e-waste recycling. Employing a novel research model amalgamating the TPB and the NAM, our findings indicate that information publicity (IP) did not directly impact citizens' willingness to recycle e-waste but rather indirectly influenced it through the mediating factors of moral standards and recycling attitudes. Notably, subjective norms within the TPB emerged as significant determinants of residents' recycling intentions and attitudes.

The research addresses a major gap in our understanding of how information publicity affects residents' behavior and intentions concerning e-waste recycling in South Korea. Before this study, the specific pathways through which information publicity shapes recycling intentions, especially within the context of electronic waste in South Korea, remained inadequately explored. While existing research has examined various factors influencing recycling behavior, this study offers a more comprehensive understanding of the nuanced effects of information dissemination on residents' intentions.

This study contributes to research by filling a critical research gap and providing a nuanced comprehension of the intricate mechanisms influencing the impact of information publicity on e-waste recycling intentions. It also contributes to policy by offering

practical recommendations tailored to enhance recycling initiatives in the unique context of South Korea.

4.1. Limitations and future research

This research identified several areas for improvement in the precision and effectiveness of e-waste recycling. However, some limitations must be acknowledged.

This study did not compare the differences in recycling perceptions and habits across genders and age groups. It is recommended that future research include these moderating variables to understand how different groups perceive and engage in e-waste recycling.

Additionally, the significance of ascribing responsibility, specifically the NAM element, was not thoroughly examined. Future research should investigate how this element interacts with the recycling paradigm to identify any divergent views on its function.

The residential condition shows a clear picture of residents' recycling habits. Compared to homeowners, renters are more likely to participate in e-waste recycling, possibly because homeowners have more space to store old electronic devices. If most homes in the residential neighborhood are rentals or have smaller lots, larger recovery areas may be necessary. To improve precision in support of e-waste recycling, future research should include a moderating variable, such as residential conditions [110].

As the government's role was considered important in the relationship between recycling intention and behavior, future research may examine the effectiveness of e-waste operational guidelines to encourage stakeholders, particularly manufacturers, distributors, and retailers of consumer goods, to develop centralized recycling centers or take-back programs to enable people to significantly increase the rate of recycling. Social media influencers can also play a major role in promoting awareness of e-waste recycling.

Finally, it should be noted that the COVID-19 pandemic has substantially affected e-waste segregation and recycling policies. Analyzing the data and comparing outcomes before and during the pandemic is important to identify spatial heterogeneity and local management insights. Future research should seek to determine how the suggested solution framework can be adapted to handle the challenges of the pandemic.

To enhance the accuracy and efficacy of e-waste recycling programs, future research should explore the impact of moderating variables such as gender, age, and residential status. Additionally, the study recommends investigating the effects of government policies and social media influencers on e-waste recycling. The impact of the COVID-19 pandemic should also be considered and analyzed to identify insights for better e-waste management practices.

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Data availability statement

The data that support the findings of this study are available from the corresponding author [Mincheol Kim], upon reasonable request.

CRediT authorship contribution statement

Walimuni Arachchilage Chathuri Sugandika Muthukumari: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Jinhyun Ahn:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Investigation, Funding acquisition. **Mincheol Kim:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e34319.

References

[1] K. Parajuly, C. Fitzpatrick, O. Muldoon, R. Kuehr, Behavioral change for the circular economy: a review with focus on electronic waste management in the EU, Resour. Conserv. Recycl. 6 (2020) 100035.
[2] J. Park, S.D. Kim, S.O. Choi, Demonstrating the effects of behavioral control beliefs on the actual WEEE discharge routes: a case study in South Korea, Resour. Conserv. Recycl. 163 (2020) 105088.
[3] V. Forti, C.P. Balde, R. Kuehr, G. Bel, The Global E-Waste Monitor 2020: Quantities, Flows and the Circular Economy Potential, United Nations University/ United Nations Institute for Training and Research, International Telecommunication Union, and International Solid Waste Association, Bonn, 2020.
[4] V. Sima, I.G. Gheorghe, J. Subić, D. Nancu, Influences of the industry 4.0 revolution on the human capital development and consumer behavior: a systematic review, Sustainability 12 (2020) 4035.
[5] J. Wallace, B. Selmaoui, Effect of mobile phone radiofrequency signal on the alpha rhythm of human waking EEG: a review, Environ. Res. 175 (2019) 274–286.
[6] M.A. Hidayatullah, L.H. Pasaribu, The effect of effectiveness of digital campaign budget, selection of digital campaign platform, and increasing brand awareness on purchase intention of optik melawai products, Enrichment: J. Manag. 12 (2021) 792–800.
[7] A.A. Ananno, M.H. Masud, P. Dabnichki, M. Mahjabeen, S.A. Chowdhury, Survey and analysis of consumers' behaviour for electronic waste management in Bangladesh, J. Environ. Manag. 282 (2021) 111943.
[8] R. Kaye, M. Rosen-Zvi, R. Ron, Digitally-enabled remote care for cancer patients: here to stay, Semin. Oncol. Nurs. 36 (2020) 151091.
[9] R. Rajesh, D. Kanakadhurga, N. Prabaharan, Electronic waste: a critical assessment on the unimaginable growing pollutant, legislations and environmental impacts, Environment Challenges 7 (2022) 100507.
[10] C.P. Baldé, R. Kuehr, K. Blumenthal, S. Fondeur Gill, M. Kern, P. Micheli, E. Magpantay, J. Huisman, E-waste Statistics: Guidelines on Classification, Reporting and Indicators, United Nations University, Bonn, 2015. IAS-SCYCLE.
[11] Z. Yu, C. Gao, C. Yang, L. Zhang, Insight into quantities, flows, and recycling technology of E-waste in China for resource sustainable society, J. Clean. Prod. 393 (2023) 136222.
[12] C.P. Baldé, V. Forti, V. Gray, R. Kuehr, P. Stegmann, The Global E-Waste Monitor 2017: Quantities, Flows and Resources, United Nations University, International Telecommunication Union, and International Solid Waste Association, Bonn, 2017.
[13] J. Park, C. Ahn, K. Lee, W. Choi, H.T. Song, S.O. Choi, S.W. Han, Analysis on public perception, user-satisfaction, and publicity for WEEE collecting system in South Korea: a case study for door-to-door service, Resour. Conserv. Recycl. 144 (2019) 90–99.
[14] W.-S. Yang, J.-K. Park, S.-W. Park, Y.-C. Seo, Past, present and future of waste management in Korea, J. Mater. Cycles Waste Manag. 17 (2015) 207–217.
[15] I. Mahmud, S. S. Sultana, A. Rahman, T. Ramayah, T. Cheng Ling, E-waste recycling intention paradigm of small and medium electronics store managers in Bangladesh: an S–O–R perspective, Waste Manag. Res. 38 (2020) 1438–1449.
[16] K. Li, Z. Xu, A review of current progress of supercritical fluid technologies for E-waste treatment, J. Clean. Prod. 227 (2019) 794–809.
[17] M.T. Islam, N. Huda, A. Baumber, R. Shumon, A. Zaman, F. Ali, R. Hossain, V. Sahajwalla, A global review of consumer behavior towards E-waste and implications for the circular economy, J. Clean. Prod. 316 (2021) 128297.
[18] R. Yadav, D.K. Panda, S. Kumar, Understanding the individuals' motivators and barriers of E-waste recycling: a mixed-method approach, J. Environ. Manag. 324 (2022) 116303.
[19] V. Murthy, S. Ramakrishna, A review on global E-waste management: urban mining towards a sustainable future and circular economy, Sustainability 14 (2) (2022) 647.
[20] S.H. Schwartz, Normative influences on altruism, Adv. Exp. Soc. Psychol. 10 (1977) 221–279.
[21] I. Ajzen, The theory of planned behavior, Organ. Behav. Hum. Decis. Process. 50 (1991) 179–211.
[22] S. Wang, J. Wang, S. Zhao, S. Yang, Information publicity and resident's waste separation behavior: an empirical study based on the norm activation model, Waste Manag. 87 (2019) 33–42.
[23] Z. Wang, D. Guo, X. Wang, B. Zhang, B. Wang, How does information publicity influence residents' behaviour intentions around E-waste recycling? Resour. Conserv. Recycl. 133 (2018) 1–9.
[24] N.S. Mohamad, A.C. Thoo, H.T. Huam, The determinants of consumers' E-waste recycling behavior through the lens of extended theory of planned behavior, Sustainability 14 (2022) 9031.
[25] M. Sajid, K. Zakkariya, H. Joy, Determinants of E-waste recycling intention in India: the influence of environmental concern, attitude and economic incentives, Colombo Business Journal 13 (2022) 119–140.
[26] H. Thi Thu Nguyen, R.-J. Hung, C.-H. Lee, H. Thi Thu Nguyen, Determinants of residents' E-waste recycling behavioral intention: a case study from Vietnam, Sustainability 11 (2018) 164.
[27] X.G. Liu, Z.H. Wang, W. Li, G.M. Li, Y.Y. Zhang, Mechanisms of public education influencing waste classification willingness of urban residents, Resour. Conserv. Recycl. 149 (2019) 381–390.
[28] K. Jayaraman, S. Vejayon, S. Raman, I. Mostafiz, The proposed E-waste management model from the conviction of individual laptop disposal practices: an empirical study in Malaysia, J. Clean. Prod. 208 (2019) 688–696.
[29] M. Kim, Y.C. Jang, S. Lee, Application of delphi-AHP methods to select the priorities of WEEE for recycling in a waste management decision-making tool, J. Environ. Manag. 128 (2013) 941–948.
[30] Y.-C. Jang, M. Kim, Management of used and end-of-life mobile phones in Korea: a review, Resour. Conserv. Recycl. 55 (2010) 11–19.
[31] V. Pérez-Belis, M. Bovea, A. Gómez, Waste electric and electronic toys: management practices and characterisation, Resour. Conserv. Recycl. 77 (2013) 1–12.
[32] S.H. Schwartz, Normative explanations of helping behavior: a critique, proposal, and empirical test, J. Exp. Soc. Psychol. 9 (1973) 349–364.
[33] L.J. Burak, M. Rosenthal, K. Richardson, Examining attitudes, beliefs, and intentions regarding the use of exercise as punishment in physical education and sport: an application of the theory of reasoned action, J. Appl. Soc. Psychol. 43 (2013) 1436–1445.
[34] W. Rachbini, The relationship of attitude, subjective norm, perceived behavioral control on halal food purchasing behavior in jakarta, IOSR J. Bus. Manag. 20 (2018) 28–37.
[35] S. Barr, Factors influencing environmental attitudes and behaviors: a UK case study of household waste management, Environ. Behav. 39 (2007) 435–473.
[36] B. Gatersleben, N. Murtagh, W. Abrahamse, Values, identity and pro-environmental behaviour, Contemporary Social Science 9 (2014) 374–392.
[37] J. Thøgersen, T. Crompton, Simple and painless? The limitations of spillover in environmental campaigning, J. Consum. Pol. 32 (2009) 141–163.
[38] P.O.D. Valle, E. Rebelo, E. Reis, J. Menezes, Combining behavioral theories to predict recycling involvement, Environ. Behav. 37 (2005) 364–396.
[39] J.R. Hopper, J.M. Nielsen, Recycling as altruistic behavior: normative and behavioral strategies to expand participation in a community recycling program, Environ. Behav. 23 (1991) 195–220.
[40] M.-F. Chen, P.-J. Tung, The moderating effect of perceived lack of facilities on consumers' recycling intentions, Environ. Behav. 42 (2010) 824–844.
[41] M. Tonglet, P.S. Phillips, A.D. Read, Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from brixworth, UK, Resour. Conserv. Recycl. 41 (2004) 191–214.
[42] F.G. Kaiser, A moral extension of the theory of planned behavior: norms and anticipated feelings of regret in conservationism, Pers. Indiv. Differ. 41 (2006) 71–81.
[43] P. Harland, H. Staats, H.A. Wilke, Explaining proenvironmental intention and behavior by personal norms and the theory of planned behavior 1, J. Appl. Soc. Psychol. 29 (1999) 2505–2528.
[44] D. Ahmadi, A. Rachmiatie, Public participation model for public information disclosure, J. Komunikasi Malays. J. Commun. 35 (2019) 305–321.
[45] A. Bandura, The explanatory and predictive scope of self-efficacy theory, J. Soc. Clin. Psychol. 4 (1986) 359–373.
[46] B.S. Noveck, Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful, Brookings Institution Press, Washington, DC, 2009.

[47] S. Picazo-Vela, I. Gutiérrez-Martínez, L.F. Luna-Reyes, Understanding risks, benefits, and strategic alternatives of social media applications in the public sector, Govern. Inf. Q. 29 (2012) 504–511.
[48] N. Rameli, Information broadcasting concerning publicity and public participation in development plan, Turkish Journal of Computer and Mathematics Education 12 (2021) 715–722.
[49] H. Si, Y. Su, G. Wu, W. Li, L. Cheng, Can government regulation, carbon-emission reduction certification and information publicity promote carpooling behavior? Transport. Res. Transport Environ. 109 (2022) 103384.
[50] D. McQuail, McQuail's Mass Communication Theory, Sage Publications, Thousand Oaks, CA, 2010.
[51] S. McDonald, R. Ball, Public participation in plastics recycling schemes, Resour. Conserv. Recycl. 22 (1998) 123–141.
[52] N. Milovantseva, J.-D. Saphores, E-waste bans and US households' preferences for disposing of their E-waste, J. Environ. Manag. 124 (2013) 8–16.
[53] T. Ramayah, J.W.C. Lee, S. Lim, Sustaining the environment through recycling: an empirical study, J. Environ. Manag. 102 (2012) 141–147.
[54] C. Thomas, V. Sharp, Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: a review of social norms and recycling, Resour. Conserv. Recycl. 79 (2013) 11–20.
[55] D. Grazhdani, Assessing the variables affecting on the rate of solid waste generation and recycling: an empirical analysis in prespa park, Waste Manag. 48 (2016) 3–13.
[56] Z. Wang, D. Guo, X. Wang, B. Zhang, B. Wang, How does information publicity influence residents' behaviour intentions around E-waste recycling? Resour. Conserv. Recycl. 133 (2018) 1–9.
[57] K. Stoeva, S. Alriksson, Influence of recycling programmes on waste separation behaviour, Waste Manag. 68 (2017) 732–741.
[58] P. Vicente, E. Reis, Factors influencing households' participation in recycling, Waste Manag. Res. 26 (2008) 140–146.
[59] L. Xu, M. Ling, Y. Lu, M. Shen, Understanding household waste separation behaviour: testing the roles of moral, past experience, and perceived policy effectiveness within the theory of planned behaviour, Sustainability 9 (2017) 625.
[60] K.E. Pettigrew, R. Fidel, H. Bruce, Conceptual frameworks in information behavior, Annu. Rev. Inf. Sci. Technol. 35 (2001) 43–78.
[61] A. Chalak, C. Abou-Daher, J. Chaaban, M.G. Abiad, The global economic and regulatory determinants of household food waste generation: a cross-country analysis, Waste Manag. 48 (2016) 418–422.
[62] K. Refsgaard, K. Magnussen, Household behaviour and attitudes with respect to recycling food waste: experiences from focus groups, J. Environ. Manag. 90 (2) (2009) 760–771.
[63] D. Mickaël, The comparative effectiveness of persuasion, commitment and leader block strategies in motivating sorting, Waste Manag. 34 (4) (2014) 730–737.
[64] A. Bernstad, Household food waste separation behavior and the importance of convenience, Waste Manag. 34 (7) (2014) 1317–1323.
[65] I.D. Williams, C. Taylor, Maximising household waste recycling at civic amenity sites in lancashire, England, Waste Manag. 24 (9) (2004) 861–874.
[66] S. Asadi, M. Nilashi, M. Safaei, R. Abdullah, F. Saeed, E. Yadegaridehkordi, S. Samad, Investigating factors influencing decision-makers' intention to adopt green IT in Malaysian manufacturing industry, Resour. Conserv. Recycl. 148 (2019) 36–54.
[67] J.R.N. Lopes, R. de Araújo Kalid, J.L.M. Rodríguez, S. Ávila Filho, A new model for assessing industrial worker behavior regarding energy saving considering the theory of planned behavior, norm activation model and human reliability, Resour. Conserv. Recycl. 145 (2019) 268–278.
[68] H. Si, L. Shen, W. Liu, G. Wu, Uncovering people's mask-saving intentions and behaviors in the post-COVID-19 period: evidence from China, Sustain. Cities Soc. 65 (2021) 102626.
[69] J. Previte, R. Russell-Bennett, J. Parkinson, Shaping safe drinking cultures: evoking positive emotion to promote moderate-drinking behaviour, Int. J. Consum. Stud. 39 (2015) 12–24.
[70] C.D. Duong, Using a Unified Model of TPB, NAM and SOBC to Understand Students' Energy-Saving Behaviors: Moderation Role of Group-Level Factors and Media Publicity, International Journal of Energy Sector Management, 2023, https://doi.org/10.1108/IJESM-09-2022-0017.
[71] J.I. De Groot, L. Steg, M. Dicke, Transportation trends from a moral perspective: value orientations, norms and reducing car use, New Transportation Research Progress 16 (2008) 2–26.
[72] R.E. Petty, J.T. Cacioppo, The elaboration likelihood model of persuasion, in: R.E. Petty, J.T. Cacioppo (Eds.), Communication and Persuasion: Central and Peripheral Routes to Attitude Change, Springer, New York, NY, 1986, pp. 1–24.
[73] S. Chaiken, The heuristic model of persuasion, in: M.P. Zanna, J.M. Olson, C.P. Herman (Eds.), Social Influence: the Ontario Symposium, vol. 5, Lawrence Erlbaum Associates, Hillsdale, NJ, 1987, pp. 3–39.
[74] L. Beck, I. I. Ajzen, Predicting dishonest actions using the theory of planned behavior, J. Res. Pers. 25 (1991) 285–301.
[75] J. Boldero, The prediction of household recycling of newspapers: the role of attitudes, intentions, and situational factors 1, J. Appl. Soc. Psychol. 25 (1995) 440–462.
[76] J. Davies, G.R. Foxall, J. Pallister, Beyond the intention–behaviour mythology: an integrated model of recycling, Market. Theor. 2 (2002) 29–113.
[77] C. Wan, G.Q. Shen, A. Yu, The role of perceived effectiveness of policy measures in predicting recycling behaviour in Hong Kong, Resour. Conserv. Recycl. 83 (2014) 141–151.
[78] B. Wang, X. Wang, D. Guo, B. Zhang, Z. Wang, Analysis of factors influencing residents' habitual energy-saving behaviour based on NAM and TPB models: egoism or altruism? Energy Pol. 116 (2018) 68–77.
[79] L. Zhang, Q. Hu, S. Zhang, W. Zhang, Understanding Chinese residents' waste classification from a perspective of intention–behavior gap, Sustainability 12 (2020) 4135.
[80] F. Echegaray, F.V. Hansstein, Assessing the intention-behavior gap in electronic waste recycling: the case of Brazil, J. Clean. Prod. 142 (2017) 180–190.
[81] Z.H. Wang, D.X. Guo, X.M. Wang, Determinants of residents' E-waste recycling behaviour intentions: evidence from China, J. Clean. Prod. 137 (2016) 850–860.
[82] A.H. Huffman, B.R. Van Der Werff, J.B. Henning, K. Watrous-Rodriguez, When do recycling attitudes predict recycling? An investigation of self-reported versus observed behavior, J. Environ. Psychol. 38 (2014) 262–270.
[83] C. Wan, G.Q. Shen, S. Choi, Experiential and instrumental attitudes: interaction effect of attitude and subjective norm on recycling intention, J. Environ. Psychol. 50 (2017) 69–79.
[84] K.E. Pettigrew, R. Fidel, H. Bruce, Conceptual frameworks in information behavior, Annu. Rev. Inf. Sci. Technol. 35 (2001) 43–78.
[85] I.D. Williams, C. Taylor, Maximising household waste recycling at civic amenity sites in lancashire, England, Waste Manag. 24 (2004) 861–874.
[86] Y.Y. Mun, J.J. Yoon, J.M. Davis, T. Lee, Untangling the antecedents of initial trust in web-based health information: the roles of argument quality, source expertise, and user perceptions of information quality and risk, Decis. Support Syst. 55 (2013) 284–295.
[87] S. Bamberg, G. Moser, Twenty years after hines, hungerford, and tomera: a new meta-analysis of psycho-social determinants of pro-environmental behaviour, J. Environ. Psychol. 27 (2007) 14–25.
[88] N. Lopez-Mosquera, T. Garcia, R. Barrena, An extension of the theory of planned behavior to predict willingness to pay for the conservation of an urban park, J. Environ. Manag. 135 (2014) 91–99.
[89] C.A. Klöckner, A comprehensive model of the psychology of environmental behaviour—a meta-analysis, Global Environ. Change 23 (5) (2013) 1028–1038.
[90] J.F. Hair, C.M. Ringle, M. Sarstedt, PLS-SEM: indeed a silver bullet, J. Market. Theor. Pract. 19 (2011) 139–152.
[91] J.F. Hair Jr., L.M. Matthews, R.L. Matthews, M. Sarstedt, PLS-SEM or CB-SEM: updated guidelines on which method to use, International Journal of Multivariate Data Analysis 1 (2) (2017) 107–123.
[92] N. Kock, Common method bias in PLS-SEM: a full collinearity assessment approach, Int. J. e-Collaboration 11 (4) (2015) 1–10.
[93] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, J. Market. Res. 18 (1981) 39–50.
[94] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, Multivariate Data Analysis, seventh ed., Prentice Hall, 2010.
[95] J. Henseler, C.M. Ringle, M. Sarstedt, A new criterion for assessing discriminant validity in variance-based structural equation modeling, J. Acad. Market. Sci. 43 (1) (2015) 115–135.
[96] J.F. Hair, J.J. Risher, M. Sarstedt, C.M. Ringle, When to use and how to report the results of PLS-SEM, Eur. Bus. Rev. 31 (2019) 2–24.

[97] N. Kock, G. Lynn, Lateral collinearity and misleading results in variance-based SEM: an illustration and recommendations, J. Assoc. Inf. Syst. Online 13 (7) (2012) 2.
[98] N. Kock, L. Gaskins, The mediating role of voice and accountability in the relationship between internet diffusion and government corruption in Latin America and sub-Saharan Africa, Inf. Technol. Dev. 20 (1) (2014) 23–43.
[99] N. Kock, Common method bias in PLS-SEM: a full collinearity assessment approach, Int. J. e-Collaboration 11 (4) (2015) 1–10.
[100] K.Q. Ma, W. Zhang, Assessing univariate and multivariate normality in PLS-SEM, Data Analysis Perspectives Journal 4 (1) (2023) 1–7.
[101] J. Cohen, Statistical Power Analysis for the Behavioral Sciences, Academic Press, 2013.
[102] N. Kock, Advanced mediating effects tests, multi-group analyses, and measurement model assessments in PLS-based SEM, Int. J. e-Collaboration 10 (1) (2014) 1–13.
[103] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, Multivariate Data Analysis, eighth ed., Cengage Learning, 2018.
[104] B.G. Tabachnick, L.S. Fidell, Using Multivariate Statistics, seventh ed., Pearson, 2019.
[105] M.F. Chen, Factors influencing the recycling of waste electrical and electronic equipment in Taiwan: a case study of households, Waste Manag. Res. 34 (7) (2016) 624–631.
[106] R. Gifford, Environmental psychology matters, Annu. Rev. Psychol. 65 (2014) 541–579.
[107] P.W. Schultz, Strategies for promoting proenvironmental behavior: lots of tools but few instructions, Eur. Psychol. 19 (2) (2014) 107–117.
[108] L. Steg, C. Vlek, Encouraging pro-environmental behaviour: an integrative review and research agenda, J. Environ. Psychol. 29 (3) (2009) 309–317.
[109] S. Oluwadipe, H. Garelick, S. McCarthy, D. Purchase, A critical review of household recycling barriers in the United Kingdom, Waste Manag. Res. 40 (7) (2022) 905–918.
[110] Z. Wang, B. Zhang, J. Yin, X. Zhang, Willingness and behavior towards e-waste recycling for residents in Beijing city, China, J. Clean. Prod. 19 (9–10) (2011) 977–984.