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Examining E-Waste Recycling Behaviour Among Malaysian Public in Negeri Sembilan

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Abstract

E-waste refers to electrical and electronic equipment that is damaged, non-functional, or outdated, including items such as washing machines, refrigerators, televisions, computers, air conditioners, and mobile phones. These materials often contain hazardous substances, including lead, cadmium, mercury, and arsenic. Improper disposal of e-waste, such as in landfills, rivers, or through incineration, releases toxic chemicals that pose significant risks to both the environment and human health. This study investigates the influence of attitude, e-waste sorting knowledge, facility support, and subjective norms on e-waste recycling practices among residents of Negeri Sembilan, Malaysia. Data were collected from 100 respondents using a convenience sampling method and a Google Form questionnaire. Descriptive analysis revealed that most respondents demonstrated moderate levels of e-waste recycling behavior and perceived facility support to be at a medium level, while their attitudes, knowledge, and subjective norms were high. Pearson correlation analysis indicated a significant positive relationship between e-waste sorting knowledge and subjective norms with e-waste recycling behavior. The findings provide valuable insights for stakeholders to enhance and promote effective recycling practices. Educating the public on e-waste management is crucial to fostering environmental responsibility and ensuring the sustainable management of resources.

Keywords*: Attitude, E-waste sorting knowledge, Facility support, Subjective norm, E-waste recycling*

INTRODUCTION

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Electronic waste, or e-waste, is the fastest-growing waste compared to other waste. This is because people in the millennium era depend too much on electronic equipment to make their daily work easier (Noor et al., 2023b). As a result of the increasing demand for electronic equipment, the electronics manufacturing industry has become the fastest-growing industry compared to other industries (Rautela et al., 2021). In the Malaysian context, progress has provided a new situation where waste generation has increased over time (Ismail & Hanafiah, 2021). Developments in the electronics industry have caused electronic equipment to increasingly flood the market until this dumping makes the price of electronic equipment increasingly cheap and affordable for most people, and some even own more than one electronic device

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(Shittu et al., 2021). The ability to own electronic equipment by most individuals is not a problem, but the issue of e-waste piles can become an issue when the equipment can no longer be used or has reached the end of its life, thus requiring proper management (Rautela et al., 2021).

In Malaysia, e-waste is generally defined as electrical and electronic goods whose function is no longer needed and is categorized as scheduled waste in the First Schedule under Code SW110 (DOE, 2024). Improperly disposing of electrical goods will cause negative implications for the environment and humans (Shittu et al., 2021). For example, a mobile phone thrown into a trash can that ends up in a landfill will release Polynuclear Aromatic Hydrocarbon (PAHs), a type of chemical that is produced when exposed to high temperatures, and these chemicals will cause air pollution (Ahirwar & Tripathi, 2021). The large amount of electrical and electronic goods will cause health effects, wildlife, and environmental pollution (Murthy & Ramakrishna, 2022). Given the high content of hazardous substances in these goods, this will undoubtedly be a problem for a country to overcome. According to a United Nations (UN) report, 20 to 50 million tons of e-waste are disposed of each year, and five percent of total municipal waste is e-waste (Forti et al., 2020).

There are two primary sources of e-waste: industry and households (Ahirwar & Tripathi, 2021). In the past, e-waste was generated mainly by industry because electronic equipment was once widely used for production efficiency purposes. However, the overall increase in e-waste is mainly generated by households (Attia et al., 2021). Based on existing legislation, only e-waste from industry needs to be managed by parties appointed by the Department of Environment (DOE). For e-waste from residential areas, there is no specific legislation that requires households to dispose of such waste (Shad et al., 2020). Therefore, all types of e-waste should be managed systematically, not only e-waste from industry but also from residential areas. The legislation or regulations on e-waste management in residential areas are not only an issue for Malaysia, but it has been found that not all countries in the world have managed to provide a similar treatment framework for e-waste from these two sources (Shaharudin et al., 2023).

Malaysia only provides one act to manage e-waste (industry), namely the Environmental Quality (Scheduled Waste) Act 2005. E-waste is listed as a scheduled waste in the First Schedule under Code SW110. However, this legislation only manages e-waste produced by industry rather than households (Shad et al., 2020). The weak e-waste management will negatively affect the environment and humans because e-waste contains six dangerous heavy metals such as lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl. Unsystematic and ineffective e-waste management can also contribute to solid waste management problems (Patil & Ramakrishna, 2020). According to a study by Rodzi et al. (2024),

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local councils or governments also need help collecting and treating e-waste due to cost, geographical distance, and limited preprocessors. Most local councils are interested in handling used electronics, but most respond to minimizing or diverting waste from landfills. Moreover, the lack of facilities is also one of the issues in e-waste management in Malaysia (Yusof et al., 2023). Educating the community about recycling practices is a step to ensure that e-waste management can be implemented properly. Due to a lack of education, the community needs to take the practice of recycling e-waste seriously (Yusof et al., 2023). This early education can help the community to act more decisively in dealing with the problem of e-waste management, which is one of the most significant issues in every country. The problem of e-waste management is also caused by the individual's attitude (Rajesh et al., 2022). Therefore, creating sustainable e-waste management at the household level is essential. This study focuses on Malaysian public e-waste recycling behavior in Negeri Sembilan, Malaysia. The results of the study can provide information and subsequently help the Negeri Sembilan state government and the federal government to plan better future policies, regulations, or legislation.

LITERATURE REVIEW

Theory of Planned Behavior (TPB)

The theory of planned behavior by Ajzen (1991) is an extension of the Theory of Reasoned Action (TRA). It is a conceptual basis that emerged as the primary framework for understanding, predicting, and changing human social behavior. The theory of planned behavior is very similar to TRA, except that it adds a new construct: perceived behavioral control, which refers to the perception of control over the performance of a given behavior. Perceived behavioral control is influenced by the effects of two beliefs, namely, control beliefs and perceived facilitation. Control beliefs include assumed skills, resources, and opportunities, while perceived achievement is from a given set of outcomes. Ajzen (1991) stated that intentions to perform various types of behavior can be predicted from attitudes toward the behavior, subjective norms, and perceived behavioral control. These intentions and perceptions of behavioral control contribute to considerable variation in actual behavior. Attitudes, subjective norms, and behavioral control are related to behavioral beliefs, normative beliefs, and important control over behavior. Figure 1 shows the basic model of the factors determining human behavior in TPB. In the theoretical framework, an additional element, namely perceived behavioral control, has been included in the original theory of TRA. According to TPB, the element of perceived behavioral control can be a determinant of intention, and at the same time, it can also be a direct determinant of certain practices. A more systematic analysis can discuss the direct relationship between this perceived behavioral control and practice. For this study, how individuals change their behavior to conduct e-waste recycling

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might be influenced by attitudes, e-waste sorting knowledge, facility support, and subjective norms as highlighted in the TPB.

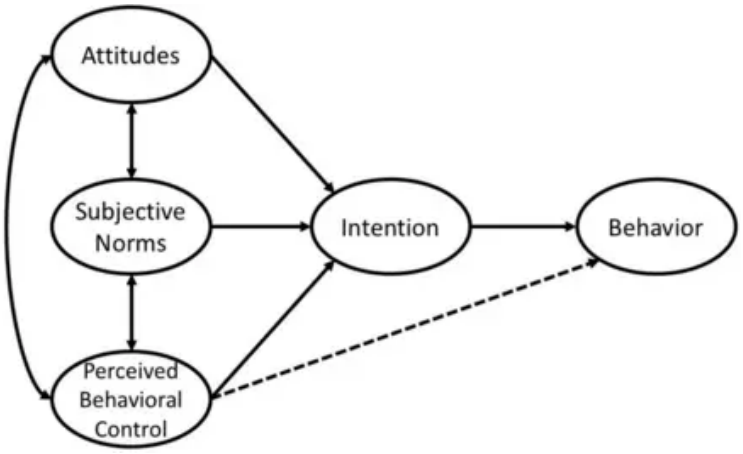

Figure 1: Model

The Relationships between Attitude, E-Waste Sorting Knowledge, Facility Support, Subjective Norm, and E-Waste Recycling Behavior

According to Aboelmaged (2021), many situational or condition factors influence environmentally responsible behavior. Situational factors refer to obstacles, social pressure, and opportunities to choose different actions to prevent or encourage someone to act. There are various views and studies conducted regarding behavior aimed at understanding the desire or need of humans to recycle. Madkhali et al. (2023) stated that e-waste recycling practices are closely related to a person's environmental attitude. In general, attitudes represent positive or negative emotions towards something that influence behavioral habits (Aboelmaged, 2021). Based on previous studies, researchers believe that attitudes can motivate the increase of appropriate behavior to improve a person's personality traits (Noor & Nordin, 2023; Yadav et al., 2022). For example, people who feel comfortable with 3R activities will be willing to apply them daily. According to Mohamad Saleh et al. (2022), attitudes contribute to the effectiveness of waste reduction, separation, collection, and recycling programs. Attitudes are human characteristics that organize thoughts, feelings, or beliefs about objects, subjects, or concepts that motivate a person to respond (Ajzen, 1991). Dhir et al. (2021) stated that preserving natural resources requires prevention and reduction of waste production and relevant policy adjustments that can only be achieved with changes in public attitudes.

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The second factor that could influence e-waste recycling behavior is knowledge. Knowledge is defined as awareness and interpreted as community understanding (Hamzah et al., 2020). Knowledge is all forms of activity that are processed against a specific condition or situation by using tools, ways, methods, and procedures. Then, it will produce new knowledge for humans themselves. A knowledgeable person is a person who has knowledge, understanding, and basis and has the limitations of knowledge according to the way he/she seeks the knowledge he/she possesses (Hamzah et al., 2020). Community understanding consists of various aspects, such as facts, information, and abilities that may be obtained through experience or education (Dhir et al., 2021). Yahya et al. (2022) stated that confusion about the 3R process is associated with a lack of knowledge. In general, individuals prefer to avoid doing something when they have limited information to guide their actions, and this is where confusion arises (Singhal et al., 2021). Whereas, Kamaluddin et al. (2023), found that community awareness regarding the adverse effects of improper e-waste disposal is low, and there needs to be more knowledge about e-waste management. This situation shows why some people do not recycle e-waste because they need sufficient knowledge about 3R (Noor et al., 2024).

Many studies have discovered that facility support promotes e-waste recycling (Dutta & Goel, 2021). Malaysia will strengthen the management of e-waste through the Extended Producer Responsibility (EPR), involving producers, importers, consumers, and registered collection centers under the Department of Environment. In Malaysia, 200 registered e-waste collection centers have been introduced nationwide to make it easier for the public to send and dispose of e-waste in an environmentally sound or environmentally friendly manner. The public can download the MyEwaste application or visit the website for more information about nearby collection centers registered with the Department of Environment. As of 30 March 2022, there are 63 licensed Take-Back Facilities in Malaysia. These E-Waste Collection Centers function as a place to receive or collect e-waste from the public before the e-waste is sent to a licensed take-back facility (Pariatamby & Bhatti, 2020). It aims to make it easier for the public to dispose of the e-waste produced (Ahirwar & Tripathi, 2021). However, only one percent of e-waste has been successfully collected. The government will add collection centers strategically to facilitate consumers and avoid dealing with illegal premises. E-waste collection, transportation, treatment, storage, recovery, and disposal must be established at the national and regional levels for environmentally friendly e-waste management (Liu et al., 2023).

The fourth potential determinant of e-waste recycling is subjective norms. Subjective norms are the acceptance and focus on external influences such as peers and colleagues that majorly impact individual behavior (Ajzen, 1991). Subjective norms are also intended to promote social sharing and the implementation of certain attitudes from people who are essential to the individual about what can and cannot be done in a particular situation (Yadav et al., 2022). Interaction and strong ties between multi-racial

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and multi-religious communities are significant in a social structure (Dhir et al., 2021). Social influence can occur from interpersonal influences such as family, neighbors, or friends or external influences such as mass media and newspapers. If social expectations encourage someone to engage in a behavior such as e-waste recycling, the person tends to do it. Aboelmaged (2021) found that friends, family members, and employees are significant components of subjective norms influencing e-waste recycling behavior. Studies show that subjective norms influence respondents to carry out e-waste recycling because someone close to them encourages them to carry out the activities (Fan et al., 2022). Based on the discussion, the following hypotheses are posited:

H1: Attitude significantly influences e-waste recycling behavior among the Malaysian public in Negeri Sembilan, Malaysia

H2: E-waste sorting knowledge significantly influences e-waste recycling behavior among the Malaysian public in Negeri Sembilan, Malaysia

H3: Facility support significantly influences e-waste recycling behavior among the Malaysian public in Negeri Sembilan, Malaysia

H4: Subjective norms significantly influence e-waste recycling behavior among the Malaysian public in Negeri Sembilan, Malaysia

Figure 1 below shows the conceptual model which underpin in the study.

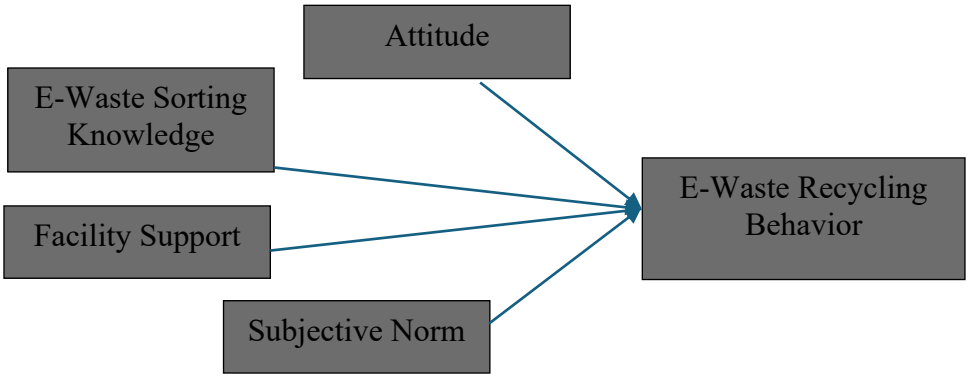

Figure 2: Research Model

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METHODOLOGY

This section describes the data collection process, including the sampling frame and survey procedure. The population of this study includes the Malaysian public in Negeri Sembilan. The sample size is calculated based on Roscoe's (1975) rule of thumb (Roscoe, 1975).

A total of 100 respondents have been selected in this study, by using a convenience sampling method. The respondents consist of various demographic characteristics such as age, gender, race, religion, education level, and others. This study used a survey research method based on a questionnaire instrument. The researchers formed questions based on past studies such as Rakhmawati, et.al (2023). This study questionnaire consists of five parts: Part A, Part B, Part C, Part D, Part E, and Part F. Part A consists of the demographic profile of the respondents, and Part B until F consists of the measurement items for independent variables and dependent variables. Respondents were also asked to answer the questionnaire based on a five-point Likert Scale for Part B until F with a range of 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, and 5= Strongly Agree. The study data was analyzed using descriptive and inferential statistics. Descriptive analysis is used to describe the background of the respondents and the level of each variable in the form of measures of central tendency. Descriptive analysis is also used to see the level of each independent and dependent variable, which consists of low (1.00 to 2.33), medium (2.34 to 3.66), and high (3.67 to 5.00) levels. On the other hand, inferential analysis is used to summarize data by measuring the relationship between variables. In this study, the analysis used is the Pearson correlation test. The Pearson correlation test is used to see the extent of the relationship between the independent variables towards e-waste recycling practices. The decision about the hypothesis is based on the level of significance where $p<0.05$, the alternative hypothesis is accepted. If $p>0.05$, there is not enough evidence to accept the hypothesis.

FINDINGS

Respondent Background

Table 1 shows the background information of the respondents. The study's results found that 72 female respondents (72%) and 28 male respondents (28%) were involved in this study. As for age, 73 of the respondents are from the age of 21-25 years old (73%) and the rest is 18-20 years old which is 27 respondents (27%). 53% of the respondents are in the low-income group, followed by the middle-income 43% and the least are coming from high income group, which is 7%.

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Table 1: *Respondent Background*

No	Profile		Frequency (n)	Percentage (%)
1	Gender	Female	72	72
		Male	28	28
2	Age	18-20 years old	27	27
		21-25 years old	73	73
3	Monthly Income	Low Income	53	53
		Middle Income	40	40
		High Income	7	7

Reliability and Normality Test

As shown in Table 2, the variables used are acceptable and reliable and can be used in the following study (Hair et al., 2010). For Skewness and Kurtosis, the variables used are normally distributed (Kline, 2005). Cronbach's Alpha is sought to determine the reliability of data. The higher Cronbach's Alpha value, the better the items used. The Cronbach's Alpha test value of 0.60 and above is considered high for Social Sciences (Hair et al., 2010).

Table 2: *Normality & Reliability Results*

Variable	Mean	SD	Skewness	Kurtosis	Cronbach's Alpha
E-Waste Recycling Behaviour	3.0450	0.99264	-0.214	-0.035	0.677
Attitude	4.2775	0.67129	-1.075	1.253	0.839
E-Waste Sorting Knowledge	3.7025	0.94126	-0.364	-0.223	0.922
Facility Support	3.4000	1.06600	-0.432	-0.573	0.917
Subjective Norm	3.7925	0.83262	-0.689	1.164	0.900

Descriptive Assessment

Descriptive analysis is used to see the level of each independent and dependent variable, which consists of low (1.00 to 2.33), medium (2.34 to 3.66), and high (3.67 to 5.00) levels based on (Loeb, 2017).

E-Waste Recycling Behaviour

Table 3 shows the findings on the e-waste recycling behaviour. Based on the result, we can find that the level of respondent behaviour to donate e-waste is at a medium level (mean: 3.090, SD: 1.181), while the level of respondent behaviour to resell e-waste is at a medium level (mean: 3.000, SD: 1.100) and for the third level of respondent behaviour to store e-waste at a high level (mean:3.720, SD:1.035). Besides,

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overall mean for the dependent variable is also at medium level (mean: 3.045, SD: 0.9926). This indicates that there is a positive influence on e-waste recycling behaviour.

Table 3: *Descriptive Statistics for E-Waste Recycling Behavior*

Items	Mean	SD	Min	Max	Interpretation
1.I donate e-waste	3.090	1.181	1	5	Medium
2.I resell e-waste	3.000	1.100	1	5	Medium
3.I store e-waste	3.720	1.035	1	5	High
4.**E-Waste Recycling Behaviour**	3.0450	0.99264			Medium

Table 4 below shows the level of respondent attitude toward e-waste. The result stated that recycling makes them feel delighted is at a high level (mean: 4.080, SD:0.824), respondent attitude to e-waste recycling makes them contribute to society is also at high level (mean:4.310, SD: 0.734), respondent attitude to e-waste recycling make them is everyone's responsibility is at high level (mean: 4.350, SD:0.868) and respondent attitude to e-waste recycling is beneficial is at high level (mean: 4.370, SD: 0.836). Lastly, the overall mean value for attitude is at high level (mean: 4.2775, SD: 0.6712). Overall, it indicates a positive influence on attitudes towards e-waste recycling behaviour.

Table 4: *Descriptive Statistics for Attitude*

Items	Mean	SD	Min	Max	Interpretation
1.E-waste recycling makes me feel delighted.	4.080	0.824	1	5	High
2.E-waste recycling contributes to society.	4.310	0.734	2	5	High
3.E-waste recycling is everyone's responsibility	4.350	0.868	1	5	High
4.E-waste recycling is beneficial.	4.370	0.836	1	5	High
Attitude influence on e-waste recycling behaviour	4.2775	0.67129	1	5	High

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Based on Table 5 shows the respondents' e-waste sorting knowledge. Findings indicate that respondent know the types or categories of waste is at a high level (mean:3.760, SD:0.975). The respondent knowledge on how to sort waste was also at high level (mean: 3.840, SD: 0.981). Next, respondent know where to send their e-waste is at a medium level (mean: 3.650, SD: 1.140). Lastly, e-waste recycling behaviour to familiarity with waste sorting guideline is at medium level (mean: 3.560, SD:1.076). Besides, the overall mean for e-waste sorting knowledge is at high value (mean: 3.7025, SD: 0.9412). This indicates that there is a positive influence on e-waste recycling behaviour to e-waste sorting knowledge.

Table 5: *Descriptive Statistics for E-Waste Sorting Knowledge*

Items	Mean	SD	Min	Max	Interpretation
1. I know the types/categories of waste.	3.760	0.975	1	5	High
2. I know how to sort waste.	3.840	0.981	1	5	High
3. I know where to send my waste.	3.650	1.140	1	5	Medium
4. I am familiar with waste-sorting guidelines.	3.560	1.076	1	5	Medium
E-Waste Sorting Knowledge	3.7025	0.94126	1	5	High

Table 6 shows the influence of facility support on e-waste recycling behaviour. The table below shows that the facility supports to there is adequate bins to sort waste at a medium level (mean: 3.490, SD: 1.243). For the facility support to respondents, the area has an adequate facility to collect sorted waste is also at a medium level (mean: 3.270, SD:1.262). Next, the facility support on the sorted waste collection in the respondent area is appropriately managed at medium level (mean:3.410, SD:1.120). Lastly, there are sufficient resources for the facility support to collect sorted waste in the respondent area at a medium level where the mean is 3.430 and the standard deviation is 1.1.30. For the overall mean, it shows that the mean is at medium level (mean: 3.400, SD: 1.0660).

Table 6: *Descriptive Statistics for Facility Support*

Items	Mean	SD	Min	Max	Interpretation
1. In my area, there are adequate bins to sort waste	3.490	1.243	1	5	Medium

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2. My area has an adequate facility to collect sorted waste.	3.270	1.262	1	5	Medium
3. I know where to send my waste.	3.410	1.120	1	5	Medium
4. I am familiar with waste-sorting guidelines.	3.430	1.130	1	5	Medium
E-Waste Sorting Knowledge	3.400	1.0660	1	5	Medium

Table 7 shows the influence of subjective norm on e-waste recycling behaviour. The table below shows that the subjective norm to respondents want to spend their time to sort waste at a high level (mean: 3.680, SD: 0.930). For the subjective norm to important people to respondent think that sorting waste is a good activity also at a high level (mean: 3.900, SD:0.915). Next, the subjective norm on respondent think that it is vital for them to sort e-waste at high level (mean:3.770, SD:0.9830). Lastly, people who are vital to respondent think that they should sort their waste at a high level where the mean is 3.820 and the standard deviation is 0.967. For the overall mean, it shows that the mean is at medium level (mean: 3.400, SD: 1.0660). Lastly, the overall mean for subjective norm shows a mean at a high level (mean: 3.7925, SD: 0.83262). Overall, it positively influences subjective norm towards e-waste recycling behavior.

Table 7: *Descriptive Statistics for Subjective Norm*

Items	**Mean**	**SD**	**Min**	**Max**	**Interpretation**
1. I want to spend my time sorting waste.	3.680	0.930	1	5	High
2. People who are important to me think that sorting waste is a good activity.	3.900	0.915	1	5	High
3. People vital to me sort them.	3.770	0.983	1	5	High
4. People who are vital to me think that I should sort my waste.	3.820	0.967	1	5	High
Subjective norm influence on e-waste recycling behaviour	3.7925	0.83262	1	5	High

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Pearson Correlation Analysis

Based on Table 8, the finding shows that there is a positive correlation between waste sorting knowledge and e-waste recycling behaviour (r=0.246, p=0.014, p<0.05). Then, subjective norm to e-waste recycling behaviour (r=0.273, p=0.006, p<0.05) also shows a positive correlation. Thus, it shows that the hypothesis for waste sorting knowledge (H2) and the subjective norm (H4) is accepted. On other hand, there is insignificant relationships between attitude (r=0.023, p=0.822, p>0.05) and facility support (r=0.189, p=0.059, p>0.05) on e-waste recycling behaviour. Thus, H1 and H3 were rejected.

Table 8: *Correlations*

		E-waste recycling
Attitude	Pearson Correlation	0.023
	Sig. (2-tailed)	0.822
	N	100
Waste sorting knowledge	Pearson Correlation	0.246*
	Sig. (2-tailed)	0.014
	N	100
Facility support	Pearson Correlation	0.189
	Sig. (2-tailed)	0.059
	N	100
Subjective norm	Pearson Correlation	0.273**
	Sig. (2-tailed)	0.006
	N	100

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The findings of the study showed that most respondents had a medium level of e-waste recycling behavior, and respondents believed the facility support provided was at a medium level. The results proved that recycling culture among Malaysians is still at a low level and is only practiced at a minimal level. Hamzah et al. (2020) believe the community needs more exposure or explanation to increase knowledge and improve attitudes and recycling practices. Moreover, attitude, knowledge, and subjective norms are high. In addition, the Pearson correlation coefficient showed that only e-waste sorting knowledge and subjective norms had a significant and positive relationship with e-waste recycling practices. The findings proved that e-waste recycling practices can be practiced through planned environmental awareness activities (Kamaluddin et al.,

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2023). Exposure to environmental awareness and education should be carried out continuously through mass media and electronic media with adequate delivery power so that the message to be conveyed is understood and is easy to understand (Pariatamby & Bhatti, 2020). Besides, subjective norms will motivate a person to conduct e-waste recycling by fulfilling normative expectations and past experiences (Aboelmaged, 2021). Dhir et al. (2021) found that a person who sees others doing e-waste recycling activities will also be more likely to engage in that behavior. Similarly, Yadav et al. (2022) also found that neighbors who do not manage their e-waste often encourage neighbors to refrain from managing their e-waste. Therefore, this study is expected to contribute to filling the research gap in previous studies by analysing the critical determinants of e-waste recycling practices.

As a practical implication, there should be a promotion of e-waste segregation at the source and improve e-waste collection systems by providing recycling infrastructure, facilities, or appropriate incentives to promote e-waste recycling (Noor et al., 2024). The amount of waste will continue to increase unless there is an initiative to prevent and reduce waste generation. Using goods well can help extend their useful life, and it is an effort to reduce electronic waste. This is also a way to avoid waiting to buy electronic goods. Before deciding to buy a new one, the users need to try first to repair electronic items when they are broken. This is intended to maximize the use of goods, especially if the electronic goods only need a little touch from the owner (Ahirwar & Tripathi, 2021).

In addition to being sold, electronic items that are no longer usable can be given for free to people who need them more than just lying useless on a storage shelf or even thrown away (Noor et al., 2023a). Electronic goods are not needed and are only used a few times. For that reason, consider renting instead of buying new ones to prevent electronic items from sitting idle unused. Currently, manufacturers are more aware of the importance of producing electronic goods that support environmental sustainability, which the consumers can buy. Electronic devices labeled Energy Star or certified by the Electronic Product Environmental Assessment Tool (EPEAT) are one form of sustainable measures applied worldwide. Electronic devices that support sustainability are concerned with all aspects and the life cycle of electronic products, including product design, production process, energy consumption, recycling, and the company's responsibility for the environment and social aspects.

Recycling is an important step that can be taken. Governments and private organizations should provide appropriate facilities for collecting recyclable materials

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(Pariatamby & Bhatti, 2020). This includes providing recycling bins in public places and setting up special collection facilities for items. For example, Maxis has announced significant progress in promoting responsible e-waste disposal habits among Malaysians after the launch of its e-waste recycling campaign. The campaign began with a convenient collection service for residential and commercial premises in the Klang Valley, Johor Bahru, and Penang and has now been expanded with a free drop-off postal delivery service for all users in Peninsular Malaysia. Managed by Maxis' campaign partner, Electronic Recycling Through Heroes (ERTH), an e-waste collection center registered with the Department of Environment of Malaysia, is the latest service that further simplifies the recycling of e-waste and encourages users to adopt eco-friendly habits.

Unclear regulations and guidelines on household e-waste management are among the aspects that have caused Malaysia to face still the issue of unsustainable e-waste management (Pariatamby & Bhatti, 2020). Therefore, a more systematic regulation or management guideline should be established as a proposal for sustainable e-waste management in the long term (Ahirwar & Tripathi, 2021). Unsustainable waste management should be addressed as soon as possible to avoid more serious negative environmental and human implications. Moreover, education is critical to increasing e-waste recycling rates. Educational programs should be introduced in schools and through public campaigns to provide information on the methods and importance of e-waste recycling. Communities should be given facilities to recycle without hassle (Singhal et al., 2021). The process of collecting and distributing recyclable materials should be simple and practical. Collaboration between various parties, including the government, the private sector, and local communities, is essential. Initiatives such as e-waste recycling challenges and incentive programs can encourage more people to participate (Ahirwar & Tripathi, 2021). This program should be implemented sustainably, using innovative strategies to engage and inform the public about proper e-waste management (Pariatamby & Bhatti, 2020). More, information on e-waste collection centers in the city should also be easily accessible to the public to facilitate the disposal process (Dutta & Goel, 2021; Noor et al., 2024). Individuals can set a good example by practicing e-waste recycling daily. By showing a positive attitude towards recycling, other communities will be inspired to do the same (Aboelmaged, 2021).

CONCLUSION

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Overall, recycling is a process that is gaining attention in environmental conservation efforts. With the increasing population and rapid development, the problem of e-waste management and pollution is becoming increasingly acute. Community involvement in environmental protection is currently a desirable aspect. Their role in e-waste recycling activities is crucial because it can save costs and time in e-waste management. Since the findings showed that most respondents had a medium level of e-waste recycling behavior, and respondents believed the facility support provided was at a medium level. Moreover, attitude, knowledge, and subjective norms are high. Findings from a Pearson correlation coefficient showed that e-waste sorting knowledge and subjective norm had a significant and positive relationship with e-waste recycling, yet the other variables remain silent. The results of this study contribute to the implications for various parties and can also help promote and encourage recycling practices in society effectively. It is hoped that future studies can examine the behavior towards e-waste management and that the sample can be expanded to other states in Malaysia.

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Author contributions

Nur Batrisyia Nordin developed the presented concept and oversaw the data collection. Nurul Hidayana Mohd Noor and Mahazril 'Aini Yaacob verified the analytical method. Nur Batrisyia Nordin led the manuscript writing. All authors discussed the results and contributed to the final manuscript.

Conflict of interest

The authors agree that this research was undertaken without any self-benefits or commercial or financial conflicts, and they state that they have no conflicts of interest with the funders.

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