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Article

Assessing Public Attitudes Towards E-Waste Recycling: Case Study of Kuala Lumpur, Malaysia

Amirah Sariyati Mohd Yahya[1,*], Tengku Adeline Adura Tengku Hamzah[1] & Mohamad Syahrul Nizam Ibrahim[2]

[1]Department of Geography, Faculty of Arts and Social Sciences, Universiti Malaya, 50603, Kuala Lumpur, Malaysia
[2]Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, 88400, Kota Kinabalu, Sabah, Malaysia

[*]Corresponding Author: amirahsariyati@gmail.com

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Abstract: E-waste refers to those electrical and electronic appliances that are still in use, then degraded and ready to be disposed of by consumers. Malaysia is not excluded from facing this global environmental issue. Hence, this cross-sectional study was conducted among 936 respondents in the residential area (door-to-door) as well as public spaces such as shopping malls and recreational areas to determine the attitude of the public in Kuala Lumpur towards the E-waste recycling activity. Using this cross-sectional approach, the respondents are chosen by ensuring they fit the inclusion criteria – 18 years old and above, Malaysian, living in Kuala Lumpur, and willing to participate. It is considered a large sample size where a larger sample size provides more power. Based on the findings, the study underlined a significant p-value between gender and occupation with the level of attitude towards E-waste recycling as reported at 0.005 and 0.008, respectively. It was also identified that female respondents and those working in the private sector are among the respondents with a good attitude. According to the results, respondents with other demographic backgrounds require room for improvement to ensure the public can manage this environmental issue at every level. These findings offer information on the current attitude towards E-waste recycling among the general population in Kuala Lumpur. Where it will facilitate the national goal of sustainable waste management, aligning with the Twelfth Malaysia Plan (2021-2025), Sustainable Development Goals (SDG) 2030, and Net Zero by 2050.

Keywords: Attitude; E-waste; environmental issue; Kuala Lumpur; public

Introduction

Electrical and electronic waste, known as E-waste, can be defined as various forms of electrical and electronic appliances that already served it, eventually broke, or are no longer wanted, which are generated from various sources such as residential areas. The E-waste generation is impeded by insufficient awareness and information regarding waste management and recycling practices, resulting in customers replacing appliances without contemplating sustainable alternatives. Besides issues on the growing informal recycling centre, the absence of a proper recycling system and lack of enforcement to restrict the informal recycling activity further contributed to the issue of E-waste management. The E-waste will eventually be dumped in the municipal landfill or even in foreign lands, as this usually happens when developed countries send it to developing countries. Growing numbers of E-waste contaminate the environment and human health. The risk of exposure includes air, water, groundwater, and food chain pollution, which environmental impact will affect human

health such as allergies and cancer(Asante et al., 2019; Arain et al., 2020; Kochan et al., 2016; Ravindra & Mor, 2019).

The number of electrical and electronic appliances reported has increased over the years across the globe due to the demand from consumers, including middle- and lower-income countries. In this era of technology, consumers' lifestyles are changing, contributing to the non-stop production of electrical and electronic appliances to feed consumers' demands. There are various examples of electrical and electronic appliances: computers, Liquid Crystal Display (LCD) displays, mobile phones, notebooks, refrigerators, and Television (TV). For example, in 2014, about 41.8 million Tons of E-waste were produced around the globe. This situation is alarming as, for TV, about 14.5 million consumers across the globe no longer want it. The lifespan of electrical and electronic appliances has decreased over the years as reference, the lifespan of a new computer decreased from 4.5 years in 1992 to only 2 years in 2005. Mobile phones have increased rapidly in recent years, for each mobile phone battery amount of cadmium able to pollute 600,000 litres of water (Asante et al., 2019; Arain et al., 2020; Kochan et al., 2016; Rautela et al., 2021, Ravindra & Mor 2019).

Attitude is characterized as the collective sentiment or cognition of a community about an individual, object, or matter, as it can be either positive or negative (Babaei et al., 2015; Petty & Cacioppo, 1981). Societal attitudes are not readily altered, as they are contingent upon how knowledge and information are conveyed (Desa et al., 2011). Attitude influences behaviour. Hence, it is also intertwined with the person's values, beliefs, emotions, and knowledge and contributes to modifying their existing behaviours (Darby & Obara, 2005; Pelto, 1994 in Launiala, 2009; Sivathanu, 2016). This study establishes the current situation in Kuala Lumpur as this will increase the available information and provide empirical data, filling the gap since the previous studies regarding E-waste in Kuala Lumpur discussed – environmental awareness and performance (Afroz et al., 2012); public knowledge, awareness and willingness to pay (Afroz et al., 2013); perception and behaviour (Akhtar et al., 2014). The primary objective of this study is to determine the level of attitude toward E-waste recycling and understanding among different demographic backgrounds of the public in Kuala Lumpur.

Literature Review

Attitudes in an environmental context focusing on environmental activities and issues underline a positive relationship between environmental attitudes and pro-environmental behaviour. However, it is crucial to discover the exact attitude of an individual towards something rather than considering the attitude in a general view. A positive attitude works as an aid to measure the intention of the public in practicing sustainable waste management, which considers its impact on an individual's behavior. Motivation towards a positive attitude toward waste management includes acknowledging the convenience of source segregation collection system, believing in the advantage of sustainable waste management, and the monetary incentives when conducting the activity. In addition, an individual observation may influence their attitude (Asshidin et al., 2016; Badrum et al., 2020; Fang et al., 2017; Gebremedhin et al., 2016, Gusti 2016; Koo et al., 2015; Mamady, 2016; Parizeau et al., 2015; Rasool & Ogunbode, 2015).

The issue of E-waste can be overcome by implementing sustainable E-waste management that involves cooperation from the government, Non-Governmental Organizations (NGOs), stakeholders, recyclers, and the public. For examples, E-waste collection or take-back programs, recovery, and recycling activities, to increase the successful rate of E-waste recovery. Urban mining and formal recycling are considered sustainable and sound E-waste management. The listed steps will eventually become sources of income business opportunities, able to reduce the amount of waste on the municipal landfill, reduce usage of virgin materials via recovery of E-waste, secure all valuable components, and, most importantly, work to reduce environmental pollution. E-waste recycling is important because every one million laptops can save energy equivalent to the electricity used by 3500 houses in the United States annually. At the same time, recycling one million mobile phones able to recover 33 pounds of palladium, 35 thousand pounds of copper, 75 pounds of gold, and 772 pounds of silver (Asante et al., 2019; Arain et al., 2020; Kochan et al., 2016; Rautela et al., 2021; Ravindra & Mor, 2019).

In terms of regional differences, E-waste management in Southeast Asian countries, including Malaysia, is still in the early stages as E-waste is a new type of waste in the waste stream. Nguyen (n.a),

Secretariat of the Pacific Regional Environment Programme (2020), highlighted that each Southeast Asian country defines E-waste in several ways. E-waste encompasses any electrical and electronic equipment from workplaces, residences, and commercial activity that is no longer functional and has been abandoned, thereby qualifying as scrap materials. Countries such as Brunei, Myanmar, and Singapore defined E-waste according to the Basel Convention (code A1180). As for Timor-Leste, E-waste is categorized as recoverable waste since no specific legislation has been highlighted, and E-waste is managed by an Australian company named PDTOL. Meanwhile, Vietnam lacks specific E-waste management regulations, treating all E-waste as hazardous waste under the hazardous waste legal framework. Thailand uses the existing National Waste from Electrical and Electronic Equipment (WEEE) Strategy (2014-2021) as a guideline for managing their E-waste. It is currently developing appropriate legislation to handle it. Compared to Malaysia, E-waste is regulated under First Schedule Environmental Quality (Scheduled Wastes) Regulations 2005 (code SW 110), Environmental Quality Act 1974 (EQA 1974). It focuses on managing industrial E-waste but can still be a guideline on how to manage household E-waste. Malaysia's Department of Environment (DOE) is drafting the Environment Quality (Household Scheduled Waste) Regulation 202x, focusing on household E-waste.

Methodology

1. Study Area

Kuala Lumpur is Malaysia's capital city, it is classified into eight main zones, namely, Mukim Ampang, Mukim Batu, Mukim Cheras, Mukim Hulu Klang, Mukim Kuala Lumpur, Mukim Petaling, and Mukim Setapak, with a total size of 243 km². The total population of Kuala Lumpur is about 1,790,000 people with different demographic backgrounds. Kuala Lumpur is among the fastest developing area in Asia with various economic activities and is also considered one of the top urban destinations in South East Asia (Amir et al., 2015; Ibrahim & Samah, 2011; Mohit et al., 2010; Portal Rasmi Pejabat Pengarah Tanah dan Galian Wilayah Persekutuan, 2017; Portal Rasmi Jabatan Perangkaan Malaysia, 2019). Figure 1 shows the map of Kuala Lumpur.

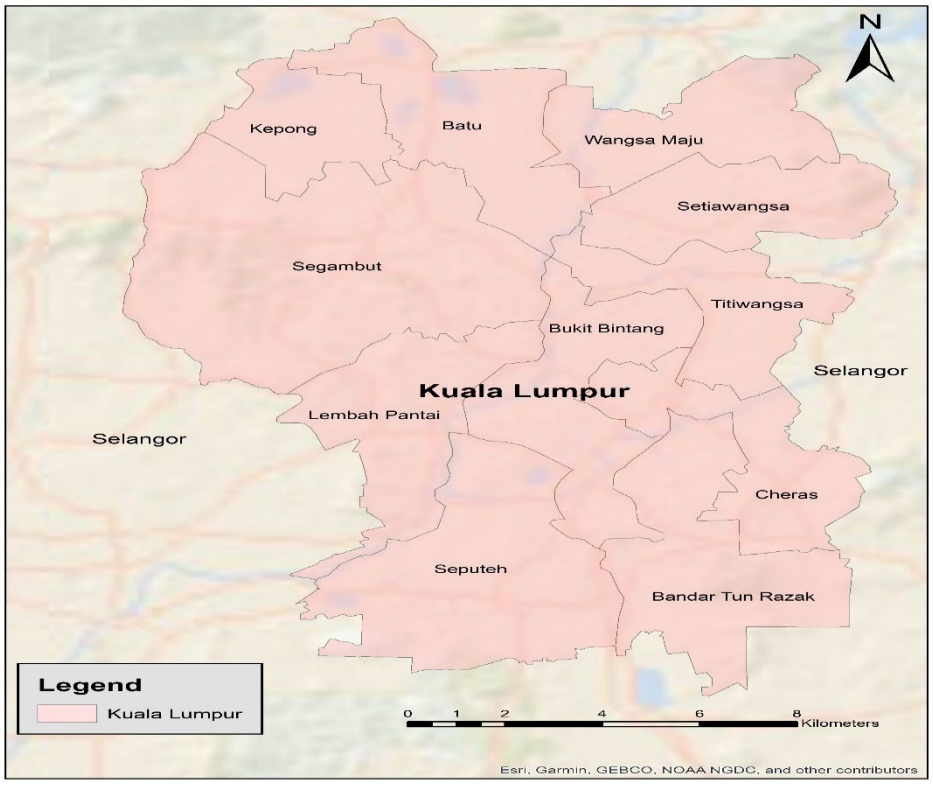

Figure 1. Map of Kuala Lumpur
Source: Authors (2021)

2. Sampling and Conducting Survey

This cross-sectional study surveyed 936 people in Kuala Lumpur. The participants are selected in accordance with the inclusion and exclusion criteria of the cross-sectional study. This is highlighted by Setia (2016), who stated that the inclusion criteria for this study are 18 years old and above, Malaysian, living in Kuala Lumpur, and willing to participate in this questionnaire survey. Furthermore, Deakin University (2024) asserts that an increased sample size enhances statistical power. However, a minimum of 60 respondents is recommended for a cross-sectional study, thereby making it contingent upon the specific research questions of the study. This study is similar to previous E-waste studies by Akhtar et al. (2014), Kalana (2010), and Sivathanu (2016) in that it focuses on people aged 18 and up from various demographic backgrounds. According to Kalana (2010), the categorization of the public aged 18 or older is based on income. At this range of age, the general public usually generates their income and can purchase any electrical or electronic appliances on their own. This study aimed to determine demographic variables influencing people's attitudes toward E-waste recycling. Data was collected in person at a shopping mall, recreational area, or other public location because this method is more convincing and produces reliable results (Babaei et al., 2015; Huang et al., 2006; Vidanaarachchi et al., 2006; Zhuang et al., 2008).

3. Instrument

The questionnaires comprised four questions for the demographic variables and seven items in the attitude section to determine the current attitude toward E-waste recycling among the public in Kuala Lumpur. The questionnaire survey's pre-test was carried out to ensure it was readable and flowed well. Additionally, the questions were taken from previous studies that had already been published and subjected to peer review. Questions on the Attitude toward E-waste recycling were adopted from Almasi et al. (2019), Sivathanu (2016), Stoeva and Alriksson (2017), and Tiep et al. (2015). Then, they were adjusted based on the research objective. The attitude questions were fully measured using the nominal scale (Yes or No).

4. Data Collection and Data Analysis

This cross-sectional data collection approach is used in residential and public places such as shopping malls and recreational parks. This is to increase the number of respondents and the diversity of demographic backgrounds among respondents. Since it uses a cross-sectional study, the most important aspect is the inclusion criteria of respondents. After collecting data through a questionnaire survey, the data was cleaned by removing any incomplete questionnaires, resulting in both budget and paper waste. The incompleteness of the questionnaires occurred during the data collection process at the bus and train stations. The respondents had to hurry to board public transportation, preventing them from finishing the questionnaire because of time constraints. In addition, several respondents ignored some questions, like age, indicating they did not take the questionnaire seriously.

This was followed by a key-in procedure using the 23rd version of the Statistical Package for Social Science (SPSS). All the collected data was reported and analyzed using statistical tests. A quantitative research methodology is used based on the questionnaire survey and the application of statistical tests. As suggested by Ahamad and Ariffin (2018), Saadia et al. (2010), and Wen et al. (2021), for each question that had a Yes response, the respondents will receive 1 point. Otherwise, they will receive 0 points. There are seven attitude questions in the attitude section. Hence, the highest overall score is seven. Consequently, each respondent will have the total scores for their attitude towards E-waste, and respondents will be grouped based on the total scores according to low, moderate, and high levels of attitude.

The Findings

Analysis of demographic variables is based on the SPSS. Descriptive statistics frequency analysis is used to analyse all the elements in the demographic variables of the respondents. Most respondents were female (57.5%), as for the age variable, the majority of the respondents are between the ages of 25 and 49 years old (56.9%). More than half of respondents (58.5%) have higher educational background, whereas, respondents working in the private sector reported as the largest group of respondents (39.9%). The results of demographic variables are displayed in Table 1.

Table 1. Demographic variables of respondents in Kuala Lumpur (N = 936)

Demographic variables		Frequency	Percentage (%)
Gender	Male	398	42.5
	Female	538	57.5
Age (years old)	Less than 24	316	33.8
	25 - 49	533	56.9
	More than 50	87	9.3
Educational background	Higher education	548	58.5
	Secondary school	352	37.6
	Primary school	17	1.8
	No formal education	19	2.0
Occupation	Government	105	11.2
	Private	373	39.9
	Self-employed	118	12.6
	Housewife	99	10.6
	Student	230	24.6
	Pensioner	11	1.2

Source: Data collection from respondents (2021)

Table 2 describes the attitudes of respondents in Kuala Lumpur toward E-waste recycling. Only 623 (66.6%) of the 936 respondents in Kuala Lumpur agreed that they upgrade their electrical and electronic appliances to ensure they are up to date. The proportion of those intending to upgrade their appliances is higher than those who refrain from doing so. Azodo et al. (2017), Miner et al. (2020), and Rafia et al. (2013) agreed that consumer upgrade their appliances due to advancements and additional features, even if their previous appliances can still be used. According to this, it can be seen that advancements in technology and design prompt consumers to replace appliances quickly, influenced by social and economic factors.

According to Bashir et al. (2018), environmental information should be offered in formal educational institutions and promoted through talks and campaigns. It can be seen that 827 out of 936 respondents in Kuala Lumpur (88.4%) expressed a willingness to participate in the E-waste recycling campaign, reflecting a favourable public attitude. This indicates a good attitude from respondents in Kuala Lumpur. Similarly, a study conducted in Bangalore, India, discovered that most respondents were willing to participate in E-waste recycling. Borthakur and Govind (2018) highlighted that a good attitude will eventually result in more responsible waste management, which in turn will encourage more people to recycle.

Segregation is the first step in recycling unwanted electrical and electronic appliances. As suggested in Abduh et al. (2018), early implementation of household waste segregation practices can mitigate prevalent environmental pollution and its consequences. Consumers should segregate domestic waste, especially E-waste, to lessen its effect. It has been reported that 860 out of 936 respondents (91.9%) agreed to segregate domestic waste and E-waste. A prior survey in Kuala Lumpur by Afroz et al. (2012) revealed that 61% of respondents were ready to separate their electronic waste from other domestic waste. This demonstrates a moderate attitude toward E-waste segregation, which has increased over time. E-waste segregation at source is crucial, especially for toxic and hazardous materials that require special handling. This facilitates easier disposal in recycling centres and bins.

This study indicates that 837 (89.4%) of the 936 respondents in Kuala Lumpur voluntarily consented to deliver their E-waste to a formal collection centre near their residence. This reflects a good attitude amongst the public in Kuala Lumpur, which should be implemented into good practice. Afroz et al. (2013) surveyed Kuala Lumpur and found that just 3% of respondents agreed to employ this disposal technique. The current study found that respondents in Kuala Lumpur are more inclined to send their E-waste to collection centres than the previous study. This also indicates that the public's attitudes toward sustainable E-waste handling have improved over the years.

According to Shevchenko et al. (2019), E-waste has economic value and should be recovered. Therefore, introducing economic incentives can improve consumer involvement. In Asia, economic motivations or incentives are identified as the primary factors of recycling activities. As seen in this study, of the 936 respondents in Kuala Lumpur, 835 (89.2%) expressed a willingness to recycle their E-waste if incentives were offered. This good attitude is similar to those reported in Abila & Kantola (2019), where this

research in Finland revealed that most respondents acknowledged that financial incentives influenced their propensity to recycle waste.

Besides that, recycling facilities are one of the important elements in the success of this sustainable approach. This study acknowledges that the majority of the respondents in Kuala Lumpur, 830 (88.7%) from the total of 936 respondents, agreed to dispose of their E-waste if there is a recycling facility available at home, such as door-to-door collection or collection that can be made at their office for recycling. Kumar (2017) asserts that E-waste recycling is challenging without E-waste collection channels. The presence of collection facilities and services correlates with customer engagement in E-waste recycling initiatives (Qu et al., 2019; Kumar, 2019).

This attitude section also underlines this approach, resulting in a positive attitude among 936 respondents. Note that 814 (87.0%) agreed and were willing to reduce the amount of E-waste. The willingness and good attitude of respondents are aligned with the first principle of the waste management hierarchy. This is to reduce the generation of waste, which is the most sustainable and least detrimental to environmental damage, as highlighted in Cole et al. (2019). This output shows that the public is aware of the need to reduce the production of E-waste. However, both immediate and long-term solutions are needed to guarantee effective management. This entails promoting high-quality appliances, offering information, and designating disposal locations. A cradle-to-grave guideline ought to be developed by stakeholders as well.

Table 2. Frequency and percentage of respondents for each attitude question (N = 936)

	Attitude questions on E-waste recycling	**Frequency (%)**	
		Yes	**No**
A1	Upgrading electrical and electronic appliances	623 (66.6)	313 (33.4)
A2	Taking part in E-waste recycling campaigns	827 (88.4)	109 (11.6)
A3	Segregation of E-waste at the source	860 (91.9)	76 (8.1)
A4	Sending off the E-waste to the recycling centre	837 (89.4)	99 (10.6)
A5	Receiving incentives for recycling activity	835 (89.2)	101 (10.8)
A6	Recycling facilities at house or office	830 (88.7)	106 (11.3)
A7	Reducing the electrical and electronic appliances	814 (87.0)	122 (12.0)

Source: Data collection from respondents (2021)

In this section, chi-squared analysis was run to test for the significant difference between total attitudes and demographic variables scores among 936 respondents in Kuala Lumpur. The significance level was set at 0.05, which has been adopted from the previous study (Arain et al., 2020). The majority of the respondents in this study scored between 6 and 7 on the attitude of E-waste recycling, as reported by about 689 (73.6%) of the 936 respondents. Based on this result, the public in Kuala Lumpur has a good attitude. Nonetheless, there is still room for improvement for respondents with low (2.1%) and moderate (24.3%) total scores of attitudes toward E-waste recycling. To achieve the objective of this study, the chi-squared analysis reported that gender and occupation reported significant p-values <0.05, 0.005, and 0.008, respectively. The cross-tabulation results are reported descriptively in Table 3(a) for total scores based on gender and Table 3(b) for total scores based on occupation.

Table 3(A). Level of attitude based on gender variables

Variables	**Level of attitude based on total scores**					
	Low (0-2)		**Moderate (3-5)**		**High (6-7)**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Male	10	50%	120	52.9%	268	38.9%
Female	10	50%	107	47.1%	421	61.1%
Total	20	100%	227	100%	689	100%

Source: Data collection from respondents (2021)

Table 3(B). Level of attitude based on occupation variables

Variables	Level of attitude based on total scores					
	Low (0-2)		Moderate (3-5)		High (6-7)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Government	4	20%	24	10.6%	77	11.2%
Private	9	45%	76	33.5%	288	41.8%
Self-employed	0	0%	40	17.6%	78	11.3%
Housewife	2	10%	15	6.6%	82	11.9%
Student	5	25%	67	29.5%	158	22.9%
Pensioner	0	0%	5	2.2%	6	0.9%
Total	20	100%	227	100%	689	100%

Source: Data collection from respondents (2021)

Results of the chi-square for demographic variables indicate that the gender variable is significant, with the total scores of attitudes on E-waste recycling reported p-value<0.05(0.005). Hence, Table 3(a) indicates There is a difference between both genders for moderate and high levels of attitude. However, for low levels of attitude, both genders score similarly. The tendency of female respondents to have a high level of attitude is due to the responsibility that females have taken to manage the house chores, such as waste segregation and disposal. This also been highlighted in Oyegoke (2022) where; female in their role as family caretakers, participate in diverse daily activities in which each of activities have tandency to produce considerable waste and may adversely affect the environment. Female respondents tend to be pro-environmentalists compared to male respondents. In contrast, male respondents should be acknowledged with adequate information to level up their attitude on E-waste management focusing on the recycling activity.

As highlighted in this study that occupation is significant in the total scores of attitudes on E-waste recycling, which resulted in a p-value<0.05(0.008). Tabulated in Table 3(b), the listed occupation respondents that are working in the private sector reported the highest percentage of respondents that have low (45.0%), moderate (33.5%), and high (41.8%) for each level of attitude. The differences can result from several situations, including the workplace, coworkers, waste management training or seminars offered by organizations, and whether the business is involved in sustainability or environmental management, which will provide positive exposure to E-waste.

Discussion

Based on the findings, it can be seen that most respondents agreed that they tend to upgrade their electrical and electronic appliances to ensure they are the latest version. However, this situation is alarming as when electrical and electronic appliances tend to be replaced easily in a short period, the amount of E-waste will keep rising. E-waste, especially in urban areas, is increasing faster in the waste stream than other types of waste, hence changing the composition of waste. This will threaten the environment and human health due to E-waste's harmful components compared to municipal solid waste. A few factors influencing consumers to upgrade their electrical and electronic appliances are related to the consumer's socioeconomics, which rapidly grows with their lifestyle, technology advancement, and product design. All the listed factors lead to a reduction in the lifespan of electrical and electronic appliances. For example, the average lifespan for household electrical and electronic appliances is about 15 years. For personal electrical and electronic appliances such as personal computers, the average lifespan is about 5 years. Consumers should be encouraged to buy long-lasting appliances, which should be promoted by manufacturers and retailers via information and labelling to increase the lifespan of electrical and electronic appliances. This approach will help minimize the environmental impacts, reduce the consumers' demands on electrical and electronic appliances, and establish a circular economy (Bhutta et al., 2011; Gnanapragasam et al., 2017; Mmereki et al., 2015; Parajuly et al., 2017).

As suggested in the previous studies, campaigns are a great platform and method to deliver the message to create a sustainable consumer. Environmental awareness programmes, for example, work as an aid to raise awareness of waste management recycling practises and then increase collection and recycling rates. In creating a more productive public awareness programme for waste management, the government, local authorities, and private companies are taking significant measures. It is also challenging to attract and maintain

new recyclers, so any potential recyclers should become dedicated. Campaigns will aid in increasing the public's knowledge and participation. The campaign approach should be conducted at the electrical and electronic appliance stores to acknowledge the consumer at the earliest stage of purchasing (Bergeron, 2016; Martinho et al., 2017; Moh, 2017; Welfens et al., 2016). As Raj (2021) suggested, animated videos related to E-waste management and recycling can be a part of the campaign, which also works as a source of information to educate the public and will help shape the public's perspective and behaviour.

The first step to obtaining and achieving sustainable E-waste management is for producers, manufacturers, and consumers to be active in E-waste management, such as transporting and segregating E-waste. There are a few ways to handle E-waste at the consumer level: segregating E-waste, handing it out to recyclers, and giving it out as a charity. E-waste segregation is the first step in any household that will make E-waste management more feasible and efficient, as this approach will be able to extend the lifetime of E-waste. It promotes sustainable use by promoting reuse, recycling, and recovery activities, increasing economic benefit and financial gain by reducing labour costs and time and reducing landfill overload to generate more land space. While waste segregation is necessary and acts as an aid to reduce the amount of waste on the municipal landfill, this operation is not formally undertaken at the household level and practises. For example, there is discouragement in segregating the waste. The collection service mixed the separated waste instead of separately collecting it. There is also a shortage of facilities, thus a structured method for managing E-waste (Alhassan et al., 2020; Pandey et al., 2018; Ravindra & Mor, 2019; Razali et al., 2020). Among 936 respondents in Kuala Lumpur, 860 (91.9%) were ready to segregate their E-waste, which reflects the good attitude of the public in Kuala Lumpur. This good attitude should be supported by motivation through equipment such as specific coloured bins, proper facilities, door-to-door collection, and monetary incentives. This is to ensure that this good attitude will become the catalyst for a successful practice of waste segregation among the public (Alhassan et al., 2020; Pandey et al., 2018; Ravindra & Mor, 2019; Razali et al., 2020).

Conducting E-waste recycling provides a few advantages. Namely, it reduces the mining activity on virgin elements, helps in reducing waste disposal costs, becomes the source of income through the values of elements such as copper and gold, also helps to reduce raw material costs (Garlapati 2016; Heacock et al., 2016). As underlined in the previous studies, there are few issues or problems in conducting recycling and ensuring good recycling activity. Lack of information on nearby recycling centres the inconvenient facilities for recycling activities, which then reduces the effectiveness and efficiency (Arain et al., 2020; Kochan et al., 2016; Martinho et al., 2017; Moh, 2017; Ravindra & Mor, 2019, Welfens et al., 2016).

As referred to in the output of the study, apart from the respondents' attitude, other motivations led to a successful involvement of the public, which can be implemented as a voluntary recycling activity, also known as habit. A formal recycling centre should be located near the housing area. The proximity of facilities has an impact on the activity itself. Similarly, for the convenience of the students, an E-waste recycling centre or drop-off should be located near the campus, and a specific mobile E-waste bin should be on campus. This activity should be supported via monetary incentives such as discounts or cashback when recycling at the recycling centre. This sustainable movement is the responsibility of everyone from different backgrounds, mainly the consumer, with the involvement of local authorities, NGOs, and private contractors. Suggested that stakeholder and responsibility bodies should inform the public regarding the E-waste recycling centres and improve the accessibility to the recycling centres (Arain et al., 2020; Kochan et al., 2016; Martinho et al., 2017; Moh, 2017; Ravindra & Mor, 2019; Welfens et al., 2016).

In addition to communication, education, enforcement, equipment, facilities, techniques, penalties, appropriate systems, engagement of people, policy strategies, social impact, and transportation facilities, incentives also act as a tool to increase public awareness of waste management (Alhassan, 2020; Bergeron, 2016; Martinho et al., 2017; Moh, 2017; Pandey et al., 2018, Ravindra & Mor, 2019; Razali et al., 2020; Welfens, 2016). According to previous studies, there are few advantages or effects of incentives towards achieving sustainable waste management, such as recycling. Namely, incentives work as a drive towards good behaviour, are key to achieving sustainable consumption among consumers, and become the motivation for every household. They also affect consumer willingness to participate in the E-waste recycling incentive programme. There are a few suggested incentives at different levels and approaches. For example, the government should offer financial incentives to the public to encourage sustainable waste recycling and

reward companies that make green devices or appliances with less dangerous substances. Besides, other responsibility bodies such as regional government and local authorities can offer incentives for the informal recyclers to become former recyclers and promote incentives in promoting source separation practises. In addition, incentives in the form of coupons or cashback may help to ensure the distribution of E-waste (Alhassan, 2020; Bergeron, 2016; Martinho et al., 2017; Moh, 2017; Pandey et al., 2018; Ravindra & Mor, 2019; Razali et al., 2020, Welfens, 2016).

One of the major problems in conducting E-waste recycling is the lack of structured and formal recycling facilities across the globe. On the other hand, many informal E-waste recycling facilities conduct manual dismantling and metal recovery with a small amount of output due to lack of technology installation (Kumar et al., 2017). This situation puts the secondary sources at waste and impacts the environment and human health. In the previous study, Kumar et al. (2017) and Osibanjo and Nnorom (2007) underlined that a proper structure of recycling facilities will lead to an effective E-waste process. This gives an advantage in increasing the recovery rate of different valuable secondary sources, besides reducing the impact of toxic release and a sustainable practice. However, these recycling facilities should be supported by strict implementation of waste management laws, updated environmental protection, and awareness and information on the risks of insufficient waste management. Government, stakeholders, manufacturers, recyclers, and the public need to cooperate to reduce the amount of E-waste that keeps piling up from one day to another.

Another sustainable approach that consumers can implement is reducing the usage of electrical and electronic appliances. As the amount of E-waste keeps rising, consumers need to reduce it. According to Garlapati (2016), consumers can reduce the quantity of E-waste as electrical and electronic appliances must be purchased whenever necessary. Hence, to increase the life span of the appliances, they need to be serviced regularly. Additionally, unwanted and old appliances can be donated, refurbished, and reused.

Without the cooperation and engagement of consumers, government, private concessionaires, and stakeholders in waste management, the segregation at source and recycling activities will be a major challenge (Moh 2017). Hence, this study also underlined the significant p-value between the total scores of attitudes on E-waste recycling and the respondents' demographic variables, which can be the reference for tackling this E-waste issue at the consumers' level. According to the previous study conducted by Kochan et al. (2016), attitude is one of the elements that shows significance to the intention and behaviour of E-waste recycling among the public. It is similarly reported by Rasool and Ogunbode (2015) that there are gender gaps in the environmental issue. Gender is a demographic variable commonly evaluated as a factor whose results are not similar to the study conducted by Rybova (2019), underlining that gender is insignificant in recycling activity. It suggests that the number of households and time spent at home are more significant than gender.

The findings of this study will contribute to the existing literature, particularly regarding Malaysian E-waste management. As a result, contributing knowledge and information will greatly aid in reaching the national aim of sustainable waste management. It aligns with the Twelfth Malaysia Plan (2021–2025), SDGs 2030 and Net Zero by 2050. The action plan that is now available can be examined in conjunction with all pertinent facts. Additionally, it may assist in explaining the current state of E-waste recycling, especially at the public level. Consider the following, for instance, how the public regularly uses and maintains electrical and electronic devices, eventually turning those appliances into E-waste as consumers. Furthermore, the establishment of recycling campaigns can also be conducted by stakeholders such as government and NGOs in accordance with the findings of this study, which highlighted that gender and occupation play a significant role in the public's attitude.

Conclusion

In conclusion, this study emphasizes that everyone needs to pay attention and cooperate to ensure that E-waste can be managed sustainably. This study is a baseline study that highlighted the public's attitude in Kuala Lumpur towards E-waste recycling. This will aid in providing clearer strategies for government agencies, NGOs, businesses, and other related stakeholders. As highlighted in this study, the respondents showed a good attitude. Governments play a vital role in promoting urban mining activities to maximise the usage of secondary sources and reduce the generation of E-waste in the waste stream. Besides, policymakers should improve regulations and enforcement, which will also aid in raising awareness among consumers. As for

business owners, especially those in the electrical and electronic field, implementing a circular economy would be a good movement, as it is also parallel with the sustainable pillar. At the household level, family members can encourage one another to segregate their E-waste, conveying the message of sustainable E-waste management and helping the household send their E-waste to the formal recycling centre.

Since this study is limited, the researcher would like to suggest future research to determine the suitable location of a formal E-waste recycling centre or drop-off point for every residential area around Kuala Lumpur. It focuses on collecting, providing services such as trade-ins, repairing and giving incentives to the public. This technical study may be executed in collaboration with the Geographic Information System (GIS) specialist. This will assess the distance and accessibility rate for the general public to engage in E-waste recycling. Distance and accessibility can be seen from this study as important catalysts that create a good attitude among the public. Apart from this technical study, future research on inventory analysis should be performed to ascertain the efficacy of the existing recycling centres. This inventory analysis is an important aspect of ensuring the existing recycling centres are working well, requiring cooperation from related agencies. To make it easier for the public to dispose of their unwanted appliances, information about the locations of the current recycling facilities needs to be updated periodically.

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