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Knowledge of E-Waste Recycling Among Communities in Selangor, Malaysia

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Abstract

The environment and human health can be jeopardized if E-waste is not properly managed. Global E-waste production continued to rise as a result of rapid technological advancement and increased purchasing power among the global population. One of the possible sustainable methods for managing E-waste is to recycle E-waste. This study aims to find out which demographic factor has the most influence on local residents' understanding of E-waste recycling in Selangor. Selangor is one of Peninsular Malaysia's wealthiest states, with a wide range of ethnic and racial backgrounds among its residents. In 2019, 779 people took part in a survey to learn more about local residents' understanding of E-waste recycling and the social and demographic factors influencing that understanding. Three characteristics of a person's background stand out: their educational attainment, the nature of their job, and the amount of money they make. The p-value for each of these variables was less than.05. Respondents with the following social backgrounds have the best understanding of E-waste recycling: higher education, employment in the private sector, and a monthly income between RM1,501 and RM3,000. The government and other stakeholders, such as non-profits and the private sector, should take more comprehensive and coordinated actions to ensure that the public is informed about E-waste recycling.

Keywords: *Environment, E-waste recycling, Human health, Knowledge, Public*

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Introduction

E-waste is a global environmental problem, and Malaysia is not exempt from it. E-waste generation in Malaysia reached 706,295 metric tons in 2010, and that it is expected to rise to 1,119,155 metric tons by 2020 (Nair, 2018). E-waste is defined as electronic and electrical goods that have already been used and discarded from households, industries, and commercial entities (Afroz et al. 2013; Tiep et al. 2015). Consumer demand for electrical and electronic appliances has fueled the electronic industry's explosive expansion into the world's fastest-growing manufacturing sector (Afroz et al. 2013; Babington et al. 2010; Sivathanu, 2016). As a result of the rapid development of the electrical industry and the advancement of technology, electrical and electronic appliances are constantly evolving in terms of their design, features, and style. As a result, new technology will lead to more affordable and easier-to-use appliances (Akhtar et al. 2014; Soo & Doolan, 2014). As a result of these factors, the product's lifespan will be reduced, which will lead to an increase in the number of products produced and consumed worldwide, which in turn will lead to an increase in E-waste generation (Jang, 2010; Kiddee et al. 2013; Umair et al. 2015; Zeng et al. 2013; Zhong & Huang, 2016).

Plastic, ceramic, ferrous and non-ferrous metals, as well as precious metals such as gold and silver, are among the materials that make up E-waste (Tesfaye et al. 2019). Electronic waste contains a variety of substances, including lead, mercury, cadmium, beryllium, brominated flame, manganese, cobalt, iron, gold, polybrominated diphenyl ethers (PBDEs), phthalates, niobium, cobalt, titanium, platinum, chromium, and polychlorinated dibenzodioxins and dibenzofurans (PCDD/PCDF) (Babington et al. 2010; Jang, 2010; Sivathanu, 2016; Tiep et al. 2015; Xavier et al. 2018; Xu et al. 2015). Similar to the First Schedule Environmental Quality (Scheduled Waste) Regulations 2005 (code SW 110), the 'E-waste is defined as waste from electrical and electronic assemblies that contain components such as accumulators and mercury switches, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors, or that is otherwise contaminated with the above-mentioned hazardous materials.

Since electronic waste releases toxic pollutants into the environment, it must be properly disposed of in order to avoid harming wildlife and the people who live in the vicinity of recycling and dumping facilities for

electronic waste (Kiddee et al., 2013). E-waste recycling is one environmentally friendly approach. E-waste can be recycled because it contains a lot of toxic and hazardous materials but is still valuable, and it will help reduce carbon and greenhouse gas emissions, increase environmental protection, conserve natural resources, reduce landfill usage, reduce energy consumption, and help create a sustainable production and consumption model for the general public (Babington et al. 2013; Nguyen et al. 2019; Realff et al. 2004; Zhong & Huang, 2016). E-waste must be separated from household waste at the point of generation and disposed of separately (Sivathanu et al., 2016). The nearest collection centre or points that have been legally registered must therefore be contacted. Some challenges in managing electronic waste, such as lack of monitoring, transboundary movement of electronic waste, financial issues, and lack of knowledge about the proper disposal methods, have been identified (Nduneseokwu et al., 2017). This investigation will focus on determining the public's awareness of this E-waste recycling activity. To have knowledge, one must have a thorough familiarity with the subject under study, as well as a grasp of the larger societal context, as well as a grasp of universal truths and scientific facts (Ahmad et al. 2015; Babaei et al. 2015; Launiala, 2009).

Materials and method

Study area

Located at 3.0738°N, 101.5183°E on the Malaysian peninsula, the state of Selangor has a total land area of approximately 7,931 km2 (Official Portal of Selangor State Government, 2019). About 5,462,141 people live in Selangor (Town and Country Planning Department, 2017). Kuala Langat, Kuala Selangor and Sabak Bernam are the nine districts in the state of Selangor. Petaling and Klang are the two other districts. There is a local authority in charge of each district in Selangor, Malaysia. Perak, Negeri Sembilan, Pahang, and the Straits of Malacca border the north, south, east, and west of Peninsular Malaysia's west coast state of Selangor (Official Portal of Selangor State Government, 2019; Department of Statistics Malaysia Official Portal, 2019) (Figure 1).

Figure 1: Maps of Negeri Selangor

As of September 1, 2011, Malaysia's parliament has finally put into effect the Solid Waste and Public Cleansing Management Act 2007 (Act 672), which was passed in 2007. The privatization of waste management is mandated in order to provide a better service. Although Selangor is one of the states in Malaysia that hasn't implemented Act 672, it's still a state (Alias et al., 2018). It was not implemented in Selangor because the local authorities were not satisfied with the private services and operational costs, according to Abas and Wee (2014). Overall, Selangor generates 4,800 tonnes of waste daily, and this figure is expected to rise to 7,200 tonnes per day in 2035 (Selangor Town and Country Planning Department, 2017). KDEB Waste Management is responsible for waste collection in

Selangor, and the frequency of collection varies based on the residential area (KDEB Waste Management, 2019). Malaysia, on the other hand, still has no specific guidelines for the management of e-waste.

The Environmental Quality (Scheduled Wastes) Regulations 2005, First Schedule, lists E-waste as code SW 110 in Malaysia (Regulations 2). SW 110 defines E-waste as 'waste from electrical and electronic assemblies containing components such as mercury-switches and glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors, or contaminated with CdMn, HgCl2, PbCl2 or polychlorinated biphenyl'. The Household Scheduled Waste Regulation 201X, on the other hand, is still under development and has not yet been published by the Department of Environment Malaysia.

Sampling and conducting the survey

Seven hundred seventy-six people in Selangor took part in this cross-sectional study. A survey was conducted to find out how much people know about electronic waste recycling based on their sociodemographics. A questionnaire-based survey was used to collect personal data all over Selangor. This method was chosen because it has questions in a logical order that will yield consistent results and can be analyzed statically (Chaudhary & Vrat, 2019). According to Islam et al. (2016), conducting a questionnaire-based survey is a convenient way to gather information about people's current knowledge of E-waste management. Face-to-face data collection yields a response rate of between 90 and 98 percent (Babaei et al. 2015; Huang et al. 2006; Vidanrachchi et al. 2006; Zhuang et al. 2008).

Instrument

The public has been given copies of the survey based on filling out paper questionnaires. Gender, age, education, marital status, number of people living in the home, type of people living in the home, occupation and income were all included in the questionnaires' first section (Part A). When determining the relationship between the study topic and the demographic variables, Castagna and colleagues (2013) and Chu and colleagues (2016) in Almasi and colleagues (2019) say that demographic variables are the most important factor. In the second section, there were eight questions pertaining to knowledge of electronic waste recycling (Part B). This material was mostly taken from Akhtar et al. (2014) and Akhtar (2015),

Ahmad et al. (2015) and Babaei et al. (2015). It was also taken from Babington et al. (2013) and Chibunna et al. (2013) as well as Malik et al. (2015), and Sivathanu (2016 & 2007).

Research design and data analysis

As part of this research, surveys and statistical tests are utilized to conduct quantitative research. After data collection was completed, the data were entered into the Statistical Package for Social Science (SPSS) and analyzed. The percentage of people who know about E-waste recycling was used as a measure of public awareness. A statistical analysis of the collected data was used to demonstrate the correlation between demographic background and knowledge of E-waste recycling.

Results and discussion

Respondent's background

Selangor-based respondents were asked to complete Part A of the questionnaires, and the results are shown in Table 1. Age, level of education, marital status, occupation, as well as the size of the household are all important variables in community-based surveys (Almasi et al., 2019). Gender, income level, and residence type are just a few of the variables examined in this study.

Table 1. Respondent's background in Selangor (N=779)

Demographic background		Frequency	Percentage (%)
Gender	Male	304	39.0
	Female	475	61.0
Age (Years old)	< 24	298	38.3
	25-34	319	40.9
	35-44	93	11.9
	45-54	47	6.0
	> 55	22	2.8
Educational background	Higher Education	611	78.4
	High School	164	21.1
	Primary School	3	0.4
	No Formal Education	1	0.1
Marital status	Single	495	63.5

	Married	277	35.6
	None above	7	0.9
Household numbers (Persons)	1-5 6-10 > 11	Mean ± SD 4.27 ± 2.412	
Type of residents	Strata Houses	272	34.9
	Twin house/Bungalow	50	6.4
	Terrace	311	39.9
	Village	122	15.7
	Townhouse	24	3.1
Occupation	Government Sector	102	13.1
	Private Sector	340	43.6
	Self Employed	89	11.4
	Housewife	37	4.7
	Student	203	26.1
	Pensioner	8	1.0
Income (RM)	< 1500.00	160	20.5
	1501.00 – 3000.00	259	33.2
	3001.00 – 4500.00	113	14.5
	> 4501.00	73	9.4
	No income / No stated / Not related	174	22.3

Source: Authors

Of the total of 779 respondents, the male respondents are about 39%, and the female respondents are about 61%. The highest percentage of respondents aged between 25-34 years old (40.9%) and the least percentage of respondents aged more than 55 years old (2.8%). The majority of the respondents had higher education (78.4%), and most respondents were working in the private sector (43.6%). About 63.5% of 779 respondents are not married yet. With the mean size of a household of 4 persons, most live-in terrace houses (39.9%). For those respondents who are working, the majority have an income between RM1,501 and RM3,000 (33.2%), and about 9.4% have an income of more than RM4,501. With respect to each of the knowledge items listed in the following section, only three demographic variables will be discussed from among all those listed respondents' histories: educational background, occupation, and income.

Respondents' educational background is an important consideration (Al-Khateeb et al. 2017), because those with more education are more likely to respond positively to a given stimulus. A higher salary means that more people can afford to buy electrical and electronic appliances, which in turn means that more people can get better training and education. This is one of the measurement levels (Al-Khateeb et al. 2017; Miner et al. 2019; Tarawneh & Saidan, 2013).

Knowledge on E-waste recycling among the public in Selangor

Community participation can only be ensured if the community has an understanding of what is going on, which is why it has been agreed that knowledge is the most important factor (Babaei et al. 2015; in El-Gilany et al. 2017; Keramitsoglou & Tsagarakis, 2013; Mathur et al. 2011; Madhukumar & Ramesh, 2012; Refsgaard & Magnussen, 2009). Knowledge about E-waste disposal, generation, and segregation has also led to a positive shift in attitudes (Iyer, 2018). When it comes to environmental knowledge, Akhtar et al. (2014) argue that an individual's demographic background is critical. As a result, eight questions for the knowledge section of Part B have been developed, which resulted in five questions related to education, five questions related to occupation, and five questions related to the respondents' incomes. Table 2 shows the p-value .05 for the association between three demographic variables and the knowledge questions. According to the findings, educational attainment, employment status, and household income all play a significant role in one's ability to correctly answer the knowledge items. It was found that knowledge items were also significant for educational background and occupation in Almasi (Laor et al 2019; Mangiri et al 2017; Patchen et al. 2006; Shorofi et al. 2017; Song et al. 2012).

Table 2. Association between knowledge items and demographic variables

Knowledge items		**Demographic variables (p-value)** ***Insignificant p-value*		
		Educational background	**Occupation**	**Income**
B1:	Definition E-waste	<.001	.005	**
B2:	Content of electrical and	.022	**	**

	electronic applications			
B3:	Impact of E-waste on the environment	.001	**	<.001
B4:	Impact of E-waste on the human health	.009	.005	<.001
B5:	Generation of E-waste in Malaysia	**	.008	.008
B6:	E-waste recycling will reduce the impact on the environment and human health	<.001	.003	<.001
B7:	E-waste recycling will reduce the usage of raw materials	**	**	.006
B8:	E-waste needs to be disposed of separately from domestic waste	**	.004	**

Sources: Authors

Ninety-point-nine percent (90.9%) of the 779 people who took the survey are familiar with the term "E-waste." Only 80.6 percent of those polled know what E-waste is, and that percentage is statistically significant (p=.001). A person who did not receive formal education stated that they were unaware of the term E-waste. Question B2, p-value =.022, where most respondents know that electrical and electronic appliances contain toxic and harmful substances, is the only educational background that shows significance. The majority of respondents, 88.6 percent, have a college degree or higher, compared to the reported 79.4 percent. This study's findings are in line with those of a similar study conducted in Ghana's capital city, Accra. A previous study found that educational level had a p-value of less than.001 when it comes to respondents' knowledge of the toxic chemicals in E-waste (Owusu et al. 2017). In this way, education serves as a means of encouraging, promoting, and increasing community awareness (Jekria & Daud, 2016; Sharifah et al. 2018; Mathatha et al. 2018) argues that proper

training can help students gain a better understanding of their subject matter.

P-values of.001 were reported for both questions related to the environmental impacts of E-waste on the environment (B3) and human health (B4) with income variables. In a survey of 779 people, 86.1% agreed that E-waste has an impact on the environment, and 79.7% agreed that E-waste has an impact on human health. Based on this, Selangor residents are aware that electronic waste will have a negative impact on the environment and human health. Compared to the Kampala, Uganda study, the percentages in this one reflect a better outcome; only 64.84 percent of those polled are well-versed in the dangers of E-waste to the environment and human health (Nuwematsiko et al. 2021). E-waste, according to the findings of a study by Juyal et al. (2018), could be harmful to the environment and human health in the Madri Industrial Area (MIA) of Udaipur, Rajasthan. E-waste has also been linked to environmental and human health issues in a study conducted by students at Kurnool Medical College in Kurnool, Andhra Pradesh (Subhaprada & Kalyani, 2017). When it comes to (B3) and (B4), 34.4 and 34.9 percent of respondents, respectively, reported having incomes between RM1,501 and RM3,000, respectively, in this study. Respondents who had a higher income were found to purchase and own more appliances because of their purchasing power; however, they also tend to use their appliances for a longer period of time (Islam et al. 2021). As a result, consumers with higher incomes are more aware of the negative effects of E-waste and are making better use of their appliances to lessen those effects.

According to Mane et al. (2019), only a few reasons, such as the loss of functionality or permanent damage to electrical or electronic equipment, are acceptable to consumers for purchasing new appliances. A shorter lifespan and an increase in E-waste generation are both a result of changing consumer habits that necessitate buying new appliances. According to the Department of Environment (DOE), Malaysia generated 706,295 metric tonnes of E-waste in 2010, which is expected to rise to 1,119,155 metric tonnes by 2020 (Nair, 2018). As a result, it's clear that the volume of E-waste generated each year is on the rise. Where is it predicted that in the future, mobile phones and rechargeable batteries will be the most significant sources of E-waste? (Tiep et al. 2015). A significant p-value of.008 indicates that 75.9 percent of Malaysian respondents are aware that E-waste generation is on the rise. As a result, the general public should be

aware of the growing problem of E-waste generation. E-waste disposal practices can be improved with this information, allowing the public to rethink their purchases before making a final decision. People who earn between RM1,501 and RM3,000 per month in the private sector account for the vast majority of survey participants, with 45.2% of them and 32.7% of them reporting the highest incomes.

When a product has reached the end of its useful life, it can be recycled to create something new, according to Chibunna et al. (2013). Ultimately, waste can be a valuable material and resource if it is properly reprocessed and recycled. To conserve raw materials and ecosystems, these activities will help to increase the value of waste while also reducing the amount of waste in landfills (Brosius et al. 2013; Desa et al. 2011; Schill & Shaw, 2016; Sharifah et al. 2018). Ninety-two percent of those polled agreed that recycling E-waste would lessen its negative impact on the environment and health. Respondents with higher education (81.0 percent) and those with an annual income of between RM1,501 and RM3,000 made up the majority of those who were aware of this sustainable method of managing E-waste, according to the p-value of.001 for both groups. Next, 80.6 percent of the total respondents are aware that recycling E-waste can reduce theamount of raw materials used in the manufacturing process. A p-value of.006 was found to be associated with this item, with respondents who earned between RM1,501 and RM3,000 reporting the highest percentage of respondents who agreed.

In order to protect the health of humans and the environment, electronic waste must be disposed of separately from household waste (Hendricks, 2012; Kiddee et al. 2013; Shumon et al. 2014), which contains chemicals, flame retardants, heavy metals, and toxic gases (Kiddee et al. 2013; Sivathanu et al. 2016). About 84.9% of those who answered the question in Selangor agreed that E-waste could not be dumped with other types of waste, such as household waste. Question B8 reported this. Among those with knowledge (44.2 percent), the majority (p-value =.004) work in the private sector, as indicated by their occupation. E-waste cannot be disposed of in the same way as other types of waste, so it is critical that the public, as a key consumer, understands this. At the household level, E-waste segregation needs to be practiced before E-waste is sent for recycling.

Conclusion

The majority of respondents in Selangor are aware of E-waste recycling in all eight questions. In general, about 70 to 90 percent of the respondents know the definition of E-waste, the content and impact of electrical and electronic appliances, the management and advantages of recycling electronic waste, and the definition of E-waste. According to these findings, people in Selangor are well-versed in the subject of E-waste recycling. In order to encourage the public to help reduce E-waste generation, knowledge can be seen as a key to influencing the public's attitude and encouraging good practice. Despite the fact that residents of Selangor are well-versed in the recycling of E-waste, the general public still requires education on this topic, particularly in the locations where E-waste can be collected. Television, radio, Facebook, newspaper, public talk, or any other relevant source can provide the information and facts. Thus, the public will be better informed about this major global environmental issue as a result of this effort to provide adequate information. In order to make the public aware of this global environmental issue, various forms of information will be used to ensure that the public is adequately informed. Good environmental awareness is a result of both adequate information and the demographic background of the respondents. Since the majority of those who participated in the survey were from the private sector, had a degree, and made between RM1,501 and RM3,000 per month, the government, non-governmental organizations, and other accountable bodies are in charge of disseminating the findings to the general public, and the study's findings can be used to help determine the best method for doing so in light of the respondents' demographics.

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