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# E-WASTE RECYCLING BEHAVIOUR IN MALAYSIA – A REVIEW

Nur Shuhada Ya'acob (a)*, Bakhtiar Alrazi (b), Nik Amalena Najebah Nik Azman (c),
Sharina Mohd Salleh (d), Norzarina Md Yatim (e)
*Corresponding author

(a) Universiti Tenaga Nasional, Sultan Haji Ahmad Shah Campus, Muadzam Shah, Pahang, Malaysia,
Shuhada@uniten.edu.my
(b) Universiti Tenaga Nasional, Sultan Haji Ahmad Shah Campus, Muadzam Shah, Pahang, Malaysia,
Bakhtiar@uniten.edu.my
(c) Universiti Tenaga Nasional, Sultan Haji Ahmad Shah Campus, Muadzam Shah, Pahang, Malaysia,
Amalena@uniten.edu.my
(d) Universiti Tenaga Nasional, Sultan Haji Ahmad Shah Campus, Muadzam Shah, Pahang, Malaysia,
Sharina@uniten.edu.my
(e) Multimedia University, Persiaran Multimedia, Cyberjaya, Selangor, Malaysia, Norzarina.yatim@mmu.edu.my

## Abstract

The United Nation Sustainable Development Goal (SDG) 12 aims, among others, to reduce the generation of waste globally by the year 2030. The goal calls for preventing, reducing, recycling and reusing of waste, including those of electronic in nature, or better known as e-waste. The accumulation and mismanagement of e-waste could impact the public health and environment negatively. Therefore, it is the responsibility of everyone at all levels, from individuals' endeavours to international accords, to take necessary actions towards realising this goal. ln a similar vein, there have been growing interest among the researchers to understand the waste recycling behaviour among the public. The current research reviews some of these studies focusing its attention on one of the world's most open economies, Malaysia whose e-waste generation experienced increasing trend in the recent five years or so. Based on the assessment of the extant literature, it identifies the gaps and offers avenue for further research which are of significance to both body of knowledge and the practice.

*Keywords:* E-waste, disposal behaviour, literature review, Malaysia

## 1. Introduction

Using electronics today is so much a part of our daily lives. Literally thousands of everyday devices that we use constantly make use of electronics technology in order to operate. Advancement in science and technology, particularly the development of electric and electronic appliances is being made providing positive contributions to human life. However, a major issue coming up from this situation is what to do with electric and electronic appliances that can no longer be used or that are no longer needed. These are called as 'e-waste'. According to the Department of Environment, Malaysia (DOE, 2020), e-waste can be defined as "broken, non-working or old/obsolete electric electronic appliance such as TV, PC, air conditioner, washing machine and refrigerator". Consequently, the more electrical and electronic equipment are being produced, the more e-wastes are being generated (Mahat et al., 2019).

Concern over the e-waste problem is valid. Globally, the volume of e-waste generated has been steadily rising since year 2010. By year 2019, there was an increase of 44.4 million metric tons in five years resulting into approximately 53.6 million metric tons of e-waste being produced. This trend is projected to continue with the increase by 30 percent to 74.7 million metric tons in 2030 (Statista, 2021). It is alarming to note that only 17.4% was officially reported as properly collected and recycled (Forti et al., 2020). The finding, which is part of the Global E-waste Monitor 2020, also documented that recycling activities have not been keeping up with the amount of e-waste that people are generating each day. In essence, while recycling activities have grown to 1.8Mt since 2014, the total number of e-waste has increased by 9.2Mt. In Malaysia, e-waste generation also shows an increasing trend in recent years. According to DOE, in year 2016, Malaysia generated 12.344 million units of e-waste and continued to increase by 38 percent to 17.065 million units in year 2020. It is also anticipated that the volume will increase further to 24.504 million units in year 2025 (DOE, 2020). This trend of increasing e-waste will continue for the foreseeable future in line with the rapid technological developments (Ibitz, 2012).

The increasing trend in global e-waste and its improper or unsafe disposal pose significant challenges to the environment and to human health. Therefore, the United Nations (UN) and all Member States have addressed this issue through, among others, Sustainable Development Goals (SDGs). SDGs were launched in year 2015 as part of UN's 2030 Agenda for Sustainable Development (UN, 2022). At the heart of this Agenda is 17 SDGs in which some are related to waste management, namely SDG 3 (Good health and Well-being), SDG 6 (Clean water and Sanitation), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production) and SDG 14 (Life Below Water) (Forti et al., 2020).

For example, SDG 12 sets Target 12.4 and Target 12.5 aiming for achieving the environmentally sound management of all waste and reducing waste generation through preventing, reducing, recycling and reusing of waste by the year 2030. Essentially, these targets promote for the reduction of the impacts of hazardous wastes on human health and the environment as well as the fundamental shift in emphasis from remedial measures to preventive measures such as reduction at source, reuse, recycling and recovery. To achieve the targets, it requires knowledgeable and experienced people, appropriate facilities, sufficient financial resources as well as technical and scientific capacities. Thus, a better understanding on e-waste is believed will contribute greatly to the achievement of the goals set for 2030 Agenda for Sustainable Development.

### 1.1. Problem statement

Electrical and electronic appliances contain toxins such as lead, mercury and cadmium that are harmful when released into the environment, contaminating water, soil and air. In fact, e-waste also contains polychlorinated biphenyls (PCBs) that can cause carcinogenic effects in humans, and thus can be harmful to human health (Forti et al., 2020). This means that the end-of-life of electric and electronic appliances has to be managed through proper mechanisms. They need to be well-managed in order to ensure environmental sustainability (Mahat et al., 2019). If e-waste is discarded without implementing environmentally sound manner such as into the river, landfill, burning or sent to informal sector, e-waste may endanger our life, affecting human health and causing deterioration of environmental quality.

Besides the alarming rate of e-waste statistics in Malaysia, landfills capacity has also become one of motivation for this research to focus on Malaysia. According to Malaysian Investment Development Authority (MIDA), Malaysia generating a tremendous amount of waste and about 83 per cent is disposed in landfills (MIDA, 2021). Most landfills in Malaysia are now facing their expected lifetime. This is due to the increasing amount of waste being generated in line with population growth. It is very challenging and often emerges as a national issue. In addition, the recycling rate for Malaysia in year 2020 is 30.67 per cent and is lower than other developed countries such as Singapore (59 per cent), Korea (49 per cent), and Taiwan (60 per cent) (Daim, 2022). Therefore, there is an urgent call to respond to these mounting issues, i.e., to reduce the rate of dispose in landfills and to increase the rate of recycling in Malaysia. Furthermore, e-waste management in Malaysia is still in its early stages, including the e-waste recycling system, management and disposal control mechanisms for these appliances (Ahmad Faisal et al., 2014; Mahat et al., 2019). The main problem relating to the e-waste in Malaysia is the poor attitude of Malaysians towards e-waste recycling (Ho et al., 2015).
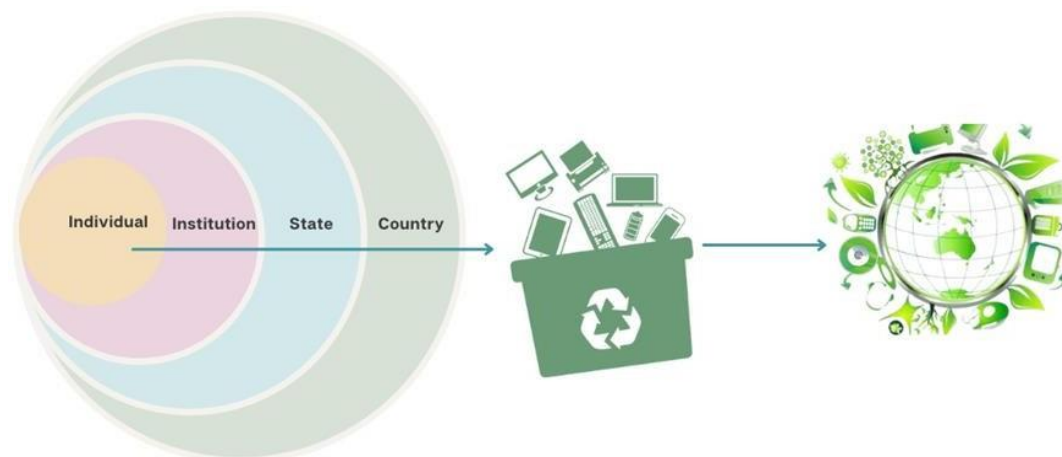


**Figure 1.** E-waste ecosystem (Authors' own illustration)

As targeted by UN via SDG12, all countries must respond to the alarming rate of e-waste generation. However, to have a change at the country level, it must have to start within individuals. It is believed that, if all or majority of individuals are aware of and properly managing their e-waste, they could potentially influence the management of e-waste at their respective institutions and this, in turn, will bring positive

impact to the e-waste management at the state and country levels, and ultimately at the global level (see Figure 1). Significantly, this envisioned ecosystem of e-waste management will contribute to better statistics of e-waste and will help achieve the SDGs by 2030. Therefore, the more electrical and electronic equipment are being produced, the more e-waste needs to be disposed or managed properly by all the stakeholders including individual, generators, collectors, retailers and recovery facilities.

There have been a number of research reviewing literature on e-waste behaviour among the public (Anandh et al., 2021; Gilal et al., 2021; Islam et al., 2021; Phulwani et al., 2021, 2020; Thukral et al., 2022). However, to the best of our knowledge, there is no prior study reviewing the e-waste recycling behavior focusing specifically on Malaysia. Differences in institutional, regulatory, economic and cultural settings could lead to different behaviour relating to e-waste; hence, there is a need to provide in-depth review on how Malaysian public had responded to the issue of e-waste management, factors influencing their perception and the aspects of e-waste investigated by previous researchers.

Therefore, the paper aims to evaluate the extant literature on e-waste recycling behaviour in Malaysia. This enables the identification of the gaps in the literature and provides avenue for further research. Furthermore, it enhances our understanding of the current practice of e-waste recycling in Malaysia, which is of importance for relevant authorities in their efforts to strengthening e-waste management in years to come.

The remainder of the paper is structured as follows. Section 2 describes the methodology undertaken to conduct the research. Section 3 presents the outcome of the review and offers some recommendations for further research. Section 4 concludes the paper.

## 2. Method

In conducting the review, several steps were taken. Firstly, the database was identified. There are several databases available, including SCOPUS, Web of Science (WOS) and Google Scholar. According to Phulwani et al. (2020), SCOPUS provides greater coverage than WOS in terms of citation analysis, while Google Scholar, despite being free offers low quality of output. Therefore, SCOPUS database was selected for this research. Secondly, the related articles were searched using 'Search > Documents' tool. In the 'Search within' box, with the 'Article title, Abstract, Keywords' option being activated, the following keywords were typed: "E-waste dispos*", "E-waste recycle*", E-waste aware*", E-waste manag*", "behave*", and "Malaysia". These keywords have produced 734 documents results (see Figure 2).
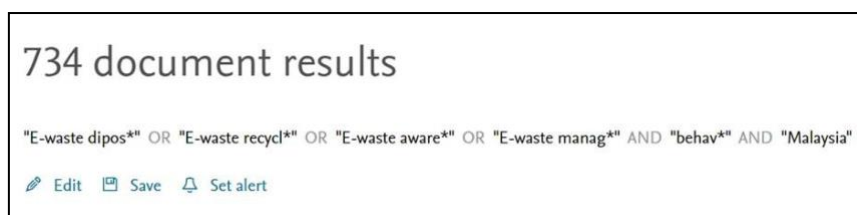


**Figure 2.** SCOPUS database search results

The titles and abstracts of each document were read through to assess their relevance to the context of research. Of the 734 documents (only two being non-English), there were 17 documents identified to be

related to e-waste behaviour in Malaysia. The full texts were downloaded and for some which were not available or accessible, the respective authors were contacted to have a copy of the papers. A table of summary was prepared to identify the research sample, underpinning theories, set of variables and main findings.

## 3. Findings and Recommendations

Table 1 presents the findings of the analysis, where the research being divided into two panels, namely literature focusing on the behaviour (Panel A) and literature examining the factors influencing the behaviour (Panel B). A study by Lim and Haw (2011) is perhaps the earliest research being conducted in assessing the awareness of Malaysian residents on e-waste recycling. Using 137 students at College of Information Technology (currently known as College of Computing and Informatics) Universiti Tenaga Nasional as the sample, they found that one-third of them had no idea at all about e-waste and the existence of recycles collector in the vicinity where they lived. In dealing with e-waste, they either kept them in the storeroom or sold them to a recycling centre. Furthermore, a small majority would send their e-waste to a recycling centre with a condition of having monetary return, suggesting financial reward as motivation for pro-environmental behaviour.

More recent literature documented evidence on increasing awareness and knowledge about e-waste among the public. They concurred that e-waste recycling helps protect the environment (Afroz et al., 2013; Wan Abdul Kadir et al., 2022) and acknowledged their responsibility for proper e-waste management. Some had considered the environmental impact prior to purchasing any electrical and electronic equipment, while others had expressed their willingness to pay for improvement in the collection and disposal of e-waste (Afroz et al., 2013). Despite a high level of knowledge and attitude, this did not often translate into actual practice (Mahat et al., 2019). Many of the residents were unclear about the proper recycling method and claimed that recycling is challenging (Wan Abdul Kadir et al., 2022). This is evident from throwing into a bin, keeping in storeroom (George et al., 2019), selling as used appliances and switching to new equipment (Mahat et al., 2019) remained as the most preferred methods.

Studies examining the e-waste recycling behaviour have considered various factors, often underpinned by theories, including theory of planned behaviour (Kianpour et al., 2017; Shaharudin et al., 2020), configurational theory (Rezaei & Ho, 2021), knowledge, attitude and practice model (Tengku Hamzah et al., 2020), Kohlberg's stage of moral development theory (Jayaraman et al., 2019), and consumer's disposition behaviour model (Ting et al., 2019). Both Shaharudin et al. (2020) and Kianpour et al. (2017) indicated the significance of attitude and perceived behavioural control (but not subjective norms). In a different approach of measuring e-waste behaviour, Rezaei and Ho (2021) found a total of 11 configurations among the variables contributed to a university student's inclination to talk about e-waste with others. They also found that market maven tendency (i.e., the attribute that indicates one's likeliness to share general market information) explained 87 percent of likelihood of sharing e-waste information. Tengku Hamzah et al. (2020), in a study among residents in Port Dickson, observed greater e-waste knowledge, attitudes and practices among those with higher level of education. Using laptop as the specific equipment of interest, Jayaraman et al. (2019) found conviction on laptop disposal practice was a factor of laptop usage, laptop disposal practice and computer literacy. Ting et al. (2019) differentiated the disposition

decisions into keep, get rid of temporarily and get rid of permanently. They found compatibility, usefulness, social influence and product attachment as the significant determinants.

Furthermore, there were studies investigating the role of demographic variables (Afroz et al., 2015; Chibunna et al., 2013; Mohd Yahya et al., 2020) and the level of attitudes and awareness (Akhtar et al., 2014), hinting at the importance of gender, age, marital status, occupation, type of residents, income, attitudes and awareness. Using factor analysis, Ho et al. (2013) found the six factors – attitude, perceived knowledge, awareness of consequences, subjective norm, willingness, and perceived convenience – were reliable and having high intercorrelations among the factors. Finally, in a study determining the barriers for practising e-waste management, Wong et al. (2019) observed lack of knowledge, awareness, cooperation and facilities as significant.

**Table 1.** Summary of previous literature

| No | Authors | Sample | Theory/Model | Variables | Findings |
|---|---|---|---|---|---|
| *Panel A: Literature focusing on the behaviour* | | | | | |
| 1 | Wan Abdul Kadir et al. (2022) | 382 residents in Kulim, Kedah | N/A | • Knowledge<br>• Perception<br>• Attitude | • About one-half agreed that recycling helps the environment and acknowledged their responsibility for proper e-waste management.<br>• More than one-third agreed on the challenges in managing old electronic equipment and that they were unclear about the proper recycling method. |
| 2 | George et al. (2019) | 100 residents in Kota Kinabalu, Sabah | N/A | • Behaviour towards e-waste management | • Throw to bin and keep in store as the most preferred disposal methods. |
| 3 | Mahat et al. (2019) | 500 residents in Selangor | KAP model | • Knowledge<br>• Attitudes<br>• Practices | • Selling as used appliances and switching with new appliances were the most preferred disposal methods<br>• High level of knowledge and attitude but medium level of practices. |
| 4 | Afroz et al. (2013) | 330 residents in Kuala Lumpur | N/A | • Knowledge<br>• Awareness<br>• Willingness to pay | • About 59% knew the environmental impact of waste electric and electronic equipment and 65% considered the impact in purchase decision<br>• About 53% willing to pay for the improvement in collection and disposal. |

| 5 | Lim & Haw (2011) | 137 students of Universiti Tenaga Nasional | N/A | • Awareness<br>• Disposal method<br>• Willingness to recycling | • About 33% were not aware about e-waste and the existence of recycles collector<br>• Keep in the store room and sale to recycling center were the most preferred disposal methods.<br>• The majority (37%) will send for recycling if with monetary return. |
|---|---|---|---|---|---|
| **Panel B: Literature examining the factors influencing the behaviour** | | | | | |
| 1 | Rezaei and Ho | 459 students from public and private universities | Configurational theory | • Lack of concern<br>• Relative advantage<br>• Complexity<br>• Information- sharing desire<br>• Moral attitude<br>• Market maven tendency<br>• E-WOM generation (DV) | • Market maven tendency explained 86.8% of likeliness to promote e-waste.<br>• A total of 11 configurations contributed to e- waste promotion |
| 2 | Mohd Yahya et al. (2020) | 543 residents in Kuala Lumpur | N/A | • Demographic variables<br>• Knowledge (DV) | • 96% had either high or moderate knowledge about e-waste<br>• Higher knowledge were among male, aged between 25 and 49 years old, married, working in the private sector and living either in terrace housing, townhouses or traditional houses. |
| 3 | Shaharudin et al. (2020) | 110 residents in Putrajaya | TPB | • Perceived convenience<br>• Perceived benefits<br>• Perceived norms<br>• Perceived policy effectiveness<br>• Intention to dispose portable e- waste (DV)<br>• Proper disposal behaviour (DV) | • About 72% have heard about portable e-waste disposal and 47% disposal were through returning the device to manufacturers.<br>• Perceived policy effectiveness and perceived convenience determined the intention, which in turn, led to proper disposal behaviour. |
| 4 | Tengku Hamzah et al. (2020) | 271 residents inPort Dickson | KAP model | • Level of education<br>• Knowledge(DV)<br>• Attitude (DV)<br>• Practices (DV) | • Higher level ofeducation was associated with greater knowledge,better attitude and more proper practices towards e-waste. |
| 5 | Jayarama et al. (2019) | 123 residents | Kohlberg's stage of moral | • E-waste hazard<br>• Social consequences<br>• Laptop usage | • Conviction on laptop disposal practice was determined by laptop |

| | | | development theory | • Laptop disposalpractice<br>• Computer literacy<br>• Conviction on laptop disposal practice (DV) | usage, laptop disposal practice and computer literacy. |
|---|---|---|---|---|---|
| 6 | Ting et al. (2019) | 165 university students | Consumer's disposition behaviour model | • Price<br>• Brand<br>• Compatibility<br>• Usefulness<br>• Social influence<br>• Product attachment<br>• Decision to keep (DV)<br>• Decision to get rid of temporarily (DV)<br>• Decision to get rid of permanently (DV) | • Compatibility led to the decision to keepor get rid of permanently<br>• Usefulness affected decision to keep<br>• Social influencewas a significant factor for decidingto get rid of temporarily<br>• Product attachment influenced the decision to keep or get rid of temporarily. |
| | Wong et al. (2019) | 140 residents in Cheras, Kuala Lumpur | N/A | • Lack of knowledge<br>• Lack of awareness<br>• Lack of cooperation<br>• Lack of facilities<br>• Barriers for practicing e-waste management (DV) | • All factors are significant barriers for practising e-waste management |
| 8 | Kianpour et al. (2017) | 468 electronic product customers | Decomposed TPB | • Complexity<br>• Eco-literacy<br>• Incentive<br>• Perceived product risk<br>• Relative advantages<br>• Compatibility<br>• Normative influences<br>• Collection method<br>• Information<br>• Self-efficacy<br>• Attitude<br>• Subjective norm<br>• Perceived behavioral control<br>• Participation intention in reverse supplychain management (DV) | • Significant factors: eco-literacy, perceived product risk, relative advantages, normative influences, collection method, information, self- efficacy, attitude and perceived behavioural control |
| 9 | Afroz et al. (2015) | 330 residents in Kuala Lumpur | N/A | • Demographic variables<br>• Willingness to pay for wasteelectrical and electronic equipment management (DV) | • About 74% were willing to pay at an average price of RM23.47.<br>• Greater willingness to pay among respondents who were younger and had higher educational level, greater income and better attitude towards waste management. |
| 10 | Akhtar et al. (2014) | 200 residents inKuala Lumpur | N/A | • Awareness<br>• Knowledge<br>• Risk perception<br>• Attitudes (DV) | • About 34% re-used the waste, 30% threw them in the waste bins and |

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|---|---|---|---|---|---|
| | | | | • Recycling behaviour (DV) | 27% kept them in the house. |
| | | | | | • All factors influenced the attitudes towards e-waste recycling. |
| | | | | | • Attitudes and awareness impacted recycling behaviour. |
| 11 | Chibunna et al. (2013) | 470 students and employees of Universiti Kebangsaan Malaysia | N/A | • Demographic variables<br>• Participation<br>• Perception<br>• Reason forconcern<br>• Attitudes towards repair/refurbishment | • Only 28% participated in e-waste recycling, whilst 83% agreed with the collection and recycling within the campus.<br>• About two-third attributed their concern with environmental health and 54%were positive with repair/ refurbishment.<br>• Level of education, income and age did not affect the attitudes. |
| 12 | Ho et al. (2013) | 150 residents in Melaka | N/A | • Attitude<br>• Perceived knowledge<br>• Awareness of consequences<br>• Subjectivenorm<br>• Willingness<br>• Perceived convenience | • All the six factors are reliable and having high intercorrelations among the factors. |

Note: N/A – not available; DV – dependent variable; TPB – theory of planned behaviour; KAP – knowledge, attitude, practice.

Table 1 summarises the literature according to sub-components, namely sample of survey, theory or model underpinning the research, variables examined and the resultant findings which allow the identification of gaps in the literature. In terms of sample, firstly, the large majority of the studies (65 percent) were conducted among residents in the West Coast of Malaysia, with 82 percent of them were based on Klang Valley (i.e., Kuala Lumpur, Putrajaya and Selangor). Although these areas have been the central focus of researchers in the past, statistics have shown that other states such as Pulau Pinang, Sarawak, Johor and Melaka were among the top five states in terms of generated industrial e-waste in year 2017 (Yong et al., 2019). Furthermore, Malaysia is geographically divided into two broad areas, namely Peninsular Malaysia (which is sub-divided into West Coast and East Coast) and East Malaysia. Although the West Coast is deemed more industrialised as compared to the other areas, which is expected to have generated greater volume of e-waste than their counterparts, the e-waste recycling behaviour among residents of the East Coast and East Malaysia is relatively unknown, hence addressing this gap will provide greater understanding of e-waste recycling behaviour in Malaysia.

Secondly, four of the studies were using higher educational institutions (HEIs) as the context of analysis (Chibunna et al., 2013; Lim & Haw, 2011; Rezaei & Ho, 2021; Ting et al., 2019), with one of them also analysed the behaviour of employees. In essence, they have been greater inclination among the

researchers to examine the behaviour of public at large. If HEIs were being involved, they often focused on a single institution and a specific group of respondents which hinder meaningful comparisons. In Malaysia, there are several types of HEIs, including public universities, government-linked universities, private universities. Differences in the vision, mission and even geographical location are expected to have impact on the behaviour of their employees and students. Moreover, since previous literature found the influence of demographic factors such as age, occupation and level of education (Afroz et al., 2015; Mohd Yahya et al., 2020; Tengku Hamzah et al., 2020), it is of interesting to examine the e-waste recycling behaviour across institutions (e.g., public versus private) and groups of respondents (e.g., employees versus students).

As mentioned earlier, the most utilised theory in predicting the e-waste recycling behaviour in Malaysia was theory of planned behaviour. This is also consistent with the findings of other review papers which investigated the same issue globally (Gilal et al., 2021; Islam et al., 2021; Phulwani et al., 2021, 2020; Thukral et al., 2022). Theory of planned behaviour was introduced by Ajzen (1991) which postulates that attitudes, subjective norm and perceived behavioural control are salient factors in determining one's intention which, in turn, influences his/her behaviour. Figure 3 below depicts the diagrammatic representation of the theory (Ajzen, 2019).
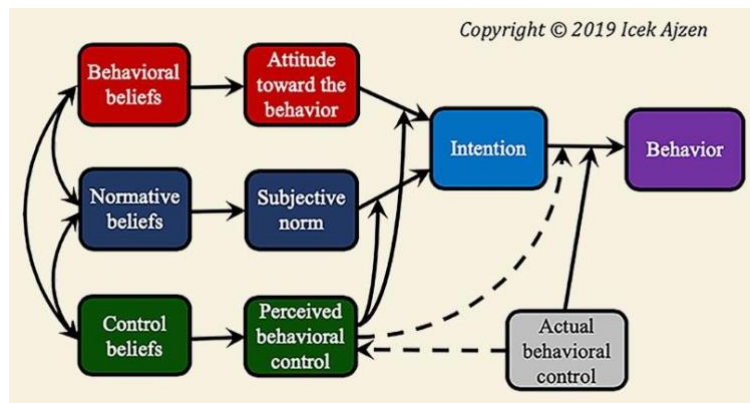


**Figure 3.** Theory of planned behaviour

Behaviour – including related to e-waste – is complex, hence will not be able to be explained by a single model alone (Phulwani et al., 2020). In this regard, Phulwani et al. (2021) proposed the inclusion of considerations such as awareness of consequences, economic benefit, convenience and product specific factors. Besides awareness of consequences and convenience, Kumar (2019) also examined individual responsibility and sense of duty. This is akin to moral obligation added by Mohamad et al. (2022) in their research. Finally, de Leeuw et al. (2015) incorporated individual, demographic and societal factors as determinants for behavioural, normative and control beliefs. Integrating all these factors will provide more holistic understanding of e-waste recycling behaviour in Malaysia.

## 4.   Conclusion

E-waste is certainly harmful to the environment and to human health. One of the factors that can help reduce this impact is individuals' behaviour. This research presents a review of studies on e-waste

behaviour among the public in Malaysia as available in SCOPUS database. Overall, based on the examination of the literature, it can be concluded that the awareness of e-waste among the public shows increasing trend. Despite that, the behaviour towards e-waste, judging by the preferred disposal methods, is far from promising. This certainly requires intervention by the regulatory authority (e.g., DOE) to equip the public with necessary knowledge and means to properly manage their e-waste.

This research also documented the various factors that have been significant contributors to the public's dealing with e-waste. These include attitude, perceived behavioural control, market maven tendency and the demographics variables such as gender, age, marital status, occupation, type of residents, income and level of education. These factors are of importance to be understood not only by future researchers in framing their research but also to the industry players and policy makers in designing intervention mechanisms more effectively.

Moreover, the findings from the analysis reveals the dearth of literature examining e-waste recycling behaviour in Malaysia. Therefore, we call for more research into this area by incorporating residents from other parts of Malaysia (e.g., East Coast and West Malaysia), comparative analysis of behaviour across different institutions and groups of respondents, and factors beyond the common TPB approach such as awareness of consequences, economic benefit, convenience, product specific, individual responsibility, sense of duty and many other demographic variables not examined by the previous literature.

Like any other research, this study has a number of limitations. First, this study is limited to 17 documents from SCOPUS and only pertaining to e-waste recycling in Malaysia. As the number is small (and inclined to certain geographical locations and groups of respondents), the generalisation of the review should be made with careful consideration. Second, this study is only relied on the SCOPUS database as the source of collection of documents without considering the other useful databases like Web of Science (WOS). Third, this study is mainly focused on the e-waste behaviour for the purpose of measuring the level of awareness and behaviour towards e-waste in Malaysia. Thus, this study excluded previous literature examining the issue of waste management as a whole. Therefore, the aforementioned limitations could also have uncovered the path for further study.

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## References

Afroz, R., Akhtar, R., Masud, M. M., & Duasa, J. (2015). Analysis of household preferences on waste electrical and electronic equipment management. *International Journal of Environment and Sustainable Development, 14*(2), 116-131. http://doi/abs/10.1504/IJESD.2015.068572

Afroz, R., Masud, M. M., Akhtar, R., & Duasa, J. B. (2013). Survey and analysis of public knowledge, awareness and willingness to pay in Kuala Lumpur, Malaysia - a case study on household WEEE management. *Journal of Cleaner Production, 52,* 185-193. https://doi.org/10.1016/j.jclepro.2013.02.004

Ahmad Faisal, A., Mohd Bakri, I., Siti Nur Awanis, M. Z., & Rusamah, A. J. (2014). Ewaste management: An emerging global crisis and the Malaysian scenario. *International Journal of Environmental Sciences, 4*(4), 444–457.

Ajzen, I. (1991). The theory of planned planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2019). Theory of planned behavior diagram. University of Massachusetts Amherst. https://people.umass.edu/aizen/tpb.diag.html

Akhtar, R., Masud, M. M., & Afroz, R. (2014). Household perception and recycling behaviour on electronic waste management: A case study of Kuala Lumpur, Malaysia. *Malaysian Journal of Science, 33*(1), 32-41. https://doi.org/10.22452/mjs.vol33no1.5

Anandh, G., Prasanna Venkatesan, S., Goh, M., & Mathiyazhagan, K. (2021). Reuse assessment of WEEE: Systematic review of emerging themes and research directions. *Journal of Environmental Management, 287,* 112335. https://doi.org/10.1016/j.jenvman.2021.112335

Chibunna, J. B., Siwar, C., Mohamed, A. F., & Begum, R. A. (2013). The role of university in e-waste recycling: Case of University Kebangsaan Malaysia. *Research Journal of Applied Sciences, 8*(1), 59-64. https://doi.org/10.36478/rjasci.2013.59.64

Daim, N. (2022, July 19). No land left if waste not reduced, warns expert. New Straits Times. http://surl.li/cstbi

de Leeuw, A., Valois, P., Ajzen, I., & Schmidt, P. (2015). Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: Implications for educational interventions. *Journal of Environmental Psychology, 42,* 128-138. https://doi.org/10.1016/j.jenvp.2015.03.005

DOE. (2020). What is e-waste? Department of Environment, Malaysia. https://ewaste.doe.gov.my/index.php/what-is-e-waste/

Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). The Global E-waste Monitor 2020. United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam, 120.

George, F., Mapa, M. T., & Dinggai, M. S. A. (2019). Preliminary study on waste electrical and electronic equipment (WEEE) management by households in the Kota Kinabalu City. *IOP Conference Series: Earth and Environmental Science, 286,* 012023. https://doi.org/10.1088/1755-1315/286/1/012023

Gilal, F. G., Shah, S. M. M., Adeel, S., Gilal, R. G., & Gilal, N. G. (2021). Consumer e-waste disposal behaviour: A systematic review and research agenda. *International Journal of Consumer Studies, 46*(5), 1785-1803. https://doi.org/10.1111/ijcs.12767

Ho, S. T., Tong, D. Y. K., Ahmed, E. M., & Lee, C. T. (2015). E-waste management practices of households in Melaka. *International Journal of Environmental Science and Development, 6*(11), 811–817. https://doi.org/10.7763/IJESD.2015.V6.704

Ho, S. T., Tong, D. Y. K., Musa Ahmed, E., & Lee, C. T. (2013). Factors influencing household electronic waste recycling intention. *Advanced Materials Research,* 622-623, 1686-1690. https://doi.org/10.4028/www.scientific.net/AMR.622-623.1686

Ibitz, A. (2012). Environmental policy coordination in ASEAN: the case of waste from electrical and electronic equipment. *ASEAS - Austrian Journal of South-East Asian Studies, 5*(1), 30-51. https://doi.org/10.4232/10.ASEAS-5.1-3

Islam, M. T., Huda, N., Baumber, A., Shumon, R., Zaman, A., Ali, F., Hossain, R., & Sahajwalla, V. (2021). A global review of consumer behavior towards e-waste and implications for the circular economy. Journal of Cleaner Production, 316. https://doi.org/10.1016/j.jclepro.2021.128297

Jayaraman, K., Vejayon, S., Raman, S., & Mostafiz, I. (2019). The proposed e-waste management model from the conviction induvial laptop disposal practices – An empirical study in Malaysia. *Journal of Cleaner Production, 208,* 688-696. https://doi.org/10.1016/j.jclepro.2018.10.125

Kianpour, K., Jusoh, A., Mardani, A., Streimikiene, D., Cavallaro, F., Md. Nor, K., & Zavadskas, E.K. (2017). Factors influencing consumers' intention to return the end of life electronic products through reverse supply chain management for reuse, repair and recycling. *Sustainability, 9*(9), 1657. https://doi.org/10.3390/su9091657

Kumar, A. (2019). Exploring young adults' e-waste recycling behaviour using an extended theory of planned behaviour model: A cross-cultural study. *Resources, Conservation and Recycling, 141,* 378-389. https://doi.org/10.1016/j.resconrec.2018.10.013

Lim, F. C., & Haw, W. Y. (2011). E-waste management: Are we ready for it? A study on the awareness of COIT students toward e-waste management. Proceedings of the 5th International Conference on IT & Multimedia. IEEE. https://doi.org/10.1109/ICIMU.2011.6122729

Mahat, H., Hashim, M., Nayan, N., Saleh, Y., & Norkhaidi, S. B. (2019). E-waste disposal awareness among the Malaysian community. *Knowledge Management & E-learning, 11*(3), 393-408. https://doi.org/10.34105/j.kmel.2019.11.021

MIDA. (2021). Waste to Energy for a Sustainable Future. Malaysian Investment Development Authority. https://www.mida.gov.my/waste-to-energy-for-a-sustainable-future/

Mohamad, N. S., Thoo, A. C., & Huam, H. T. (2022). The determinants of consumers' e-waste recycling behavior through the lens of extended theory of planned behavior. *Sustainability, 14.* https://doi.org/10.3390/su14159031

Mohd Yahya, A. S., Tengku Hamzah, T. A. A., & Shafie, A. (2020). Public knowledge regarding e-waste recycling in Kuala Lumpur, Malaysia. Arab World Geographer, 23(2-3), 136-151. https://doi.org/10.5555/1480-6800.23.2.136

Phulwani, P. R., Kumar, D., & Goyal, P. (2020). A systematic literature review and bibliometric analysis of recycling behavior. *Journal of Global Marketing, 33*(5), 354-376. https://doi.org/10.1080/08911762.2020.1765444

Phulwani, P. R., Kumar, D., & Goyal, P. (2021). From systematic literature review to a conceptual framework for consumer disposal behavior towards personal communication devices. *Journal of Consumer Behaviour: An International Research Review, 20*(5), 1353-1370. https://doi.org/10.1002/cb.1940

Rezaei, S., & Ho, R. C. (2021). E-waste-word of mouth (EW-WOM) generation: a fuzzy set qualitative comparative analysis (fs/QCA). *Online Information Review, 45*(7), 1341-1361. https://doi.org/10.1108/oir-11-2019-0343

Shaharudin, M. R., Said, R., Hotrawaisaya, C., Nik Abdul Rashid, N. R., & Azman Perwira, N. F. S. (2020). Linking determinants of the youth's intentions to dispose of portable e-waste with the proper disposal behavior in Malaysia. *The Social Science Journal.* https://doi.org/10.1080/03623319.2020.1753157

Statista. (2021). Projected Electronic Waste Generation Worldwide from 2019 to 2030 (in Million Metric Tons). Statista. https://www.statista.com/statistics/1067081/generation-electronic-waste-globally-forecast/

Tengku Hamzah, T. A. A., Mohd. Yahya, A. S., & Shafie, A. (2020). Knowledge, attitude, and practices on e-waste recycling among public in Port Dickson. *Pertanika Journal of Social Science & Humanities, 28*(4), 2731-2748. https://doi.org/10.47836/pjssh.28.4.13

Thukral, S., Shree, D., & Singhal, S. (2022). Consumer behaviour towards storage, disposal and recycling of e-waste: Systematic review and future research prospects. Benchmarking: An International Journal, https://doi.org/10.1108/BIJ-12-2021-0774

Ting, H., Thaichon, P., Chuah, F., & Tan, S. R. (2019). Consumer behaviour and disposition decisions: The why and how of smartphone disposition. *Journal of Retailing and Consumer Services, 51,* 212-220. https://doi.org/10.1016/j.jretconser.2019.06.002

UN. (2022). History. *United Nations.* https://sdgs.un.org/goals

Wan Abdul Kadir, W. H., Hassin, N. H., Muhammad Noor, A. N., Abas, M. A., Muhamad, M., & Alhaji Dauda, S. (2022). Public knowledge, perception and attitude on e-waste recycling management in Kulim, Kedah. *AIP Conference Proceedings, 2454*(1). AIP Publishing LLC. https://doi.org/10.1063/5.0078569

Wong, P. S. Y., Ng, K. M., & Rajendran, S. D. (2019). A study on barriers to implement e-waste management. E3S Web of Conferences, 136. https://doi.org/10.1051/e3sconf/201913602026

Yong, S. Y., Lim, Y. A., & Ilankoon, I. M. S. K. (2019). An analysis of electronic waste management strategies and recycling operations in Malaysia: Challenges and future prospects. *Journal of Cleaner Production, 224,* 151-166. https://doi.org/10.1016/j.jclepro.2019.03.205