

The Role of Environmental Education in Waste Segregation-at-Source Behaviour among Households in Putrajaya

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Abstract

Fast population, rapidly changing lifestyle, great urbanization along with aggressive economic development and the rapid changes in consumption rate have accelerated the daily generation and volume rate of municipal solid wastes. Efficient solid waste management has become one of the daunting national challenges, typically in developing countries, including Malaysia, to cope with the solutions for many serious environmental problems. The main purpose of this research is to examine the moderating effect of environmental education in relationships between households' attitude, perceived behavioural control and subjective norm with waste segregation-at-source behaviour. The subject of this research was households who are living in Putrajaya and the sample was selected via multistage sampling and systematic sampling method. It was quantitative research by distributing a self-administrative questionnaire. The measurements were adapted from different sources to examine participants' attitude, perceived behavioural control, subjective norm and environmental education with waste segregation-at-source behaviour. The results reveal that environmental education does moderate the relationships between attitude and perceived behavioural control with waste segregation-at-source behaviour positively. However, environmental education does not moderate the relationship between subjective norm with waste segregation-at-source behaviour positively. The findings provide an insight particularly for the local pro-environmental groups on factors that they should consider in developing pro-environmental policies. Furthermore, future research recommended using the online questionnaire in a bid to further improve the respond's rate and be more cost-effective in various aspects.

Keywords – Attitude, environmental education, perceived behavioural control, subjective norm, waste segregation-at-source behaviour

Introduction

Waste segregation-at-source behaviour is expressed as a separation process which takes place onto the proposed “useful” material from the waste stream that begins at the point of waste’s generation (Sujauddin, Huda, & Rafiqul, 2008). Verma, Borongan, and Memon (2016) revealed that municipal solid wastes as unwanted wastes or materials that primarily produced by households which including institutions, shopping complexes, hotels, housing estates, shops, offices, schools and from municipal services of street cleaning and the maintenance of gardens, parks and other recreational areas. Waste generation is an intrinsic part of human existence. However, the volume of solid waste day-by-day in Malaysia has increased proportionally with its population growth until it reached the level of concern due to social, cultural, economic and financial status among Malaysian citizens. This scenario can be justified by the data published by Solid Waste Management and Public Cleansing Corporation (SWCorp) in 2017. It summarised that the recyclable waste collection from Johor, Kedah, Melaka, Negeri Sembilan, Pahang, Perlis, Wilayah Persekutuan Kuala Lumpur, and Wilayah Persekutuan Putrajaya have increased dramatically from 73.5 tonnes in September 2015 to 194.0 tonnes in August 2016. Meanwhile, the total number of populations in Malaysia is approximately 30 485.2 million in 2015 and it is expected to rise to 36.8 million by 2040 (Department of Statistics Malaysia, 2016).

Waste materials are usually categorized by their quality, nature, and components. The major types of municipal solid wastes in Malaysia are paper, plastic, glass and ceramic, metal, aluminium and steel, electronic waste and appliances, leather, rubber and fabric, garden and farm waste, hazardous waste and bulky waste (Ministry of Housing and Local Government, 2015). The chemical and physical characteristics of solid waste which produced by households, industries, schools, hospitals, and other communities are also vary depending on the demography of individuals and the prevailing activities in each of the locations.

The issues associated with solid waste management in developing countries cannot be over-emphasized (Addo-yobo & Ali, 2003). The huge quantities of municipal solid waste exert immense and significant additional pressures on the existing number of human health hazards (Onyanta, 2016), including spreading communicable diseases, nuisance, bad odour and severe environment negative consequences, which are contamination of water, air and soil, if the waste is not managed in a proper

manner. Furthermore, in the Southeast Asian Cities, including Malaysia, proper and efficient municipal solid waste management should be given utmost attention to build a "zero waste" society and to manage the generated solid waste systematically. Ideally, waste management is an essential public health service which basically including a series of managing activities, namely collection, transportation, landfilling, recycling and composting of solid waste materials in an environmentally compatible manner that it would be in accordance with the standards that best encompassing the consideration of the principles of energy, environment conservations, aesthetics, health, and economics.

Literature Review

Attitude, Environmental Education and Waste Segregation-at-Source Behaviour

Even though there is no literature can be found between attitude, environmental education and waste segregation-at-source behaviour, but there is similar research which can be obtained from other different disciplines of research. In the research field of tourism, Bruyere, Nash, and Mbogella (2011) have examined the relationship between attitude, environmental education and environmentally responsible behaviour for sustainable tourism development (Alessa, Bennett & Kliskey, 2003; Kafyri, Hovardas & Poirazidis, 2012). This research has indicated the role of environmental education in educating individuals to change their personal attitude (Duerden & Witt, 2010; Lee, 2011; Stern, Dietz, Abel, Guagnano, & Kalof, 1999) which in turn to reduce their adverse tourism-related behaviour (Miller, Rathouse, Scarles, Holmes, & Tribe, 2010) and environmental degradation impacts.

Educating the tourists on how to raise their environmental concerns (Atik, 2010) is relatively important to decrease they're intended as well as unintended behaviours which will adversely lead to ecological or environmental degradation of a recreation area (Dawson, Stewart, Lemelinc, & Scott, 2010). Through the environmental education, tourists can acquire environmental knowledge which is beneficial to them in order to perform positive environmental behaviours, including staying in designated areas (Davis, Green, & Reed, 2009; Kaiser, Doka, Hofstetter, & Ranney, 2003), abstaining from overturning rocks (Alessa et al., 2003), as well as abstaining from collecting fauna and flora specimens (Alessa et al., 2003; Kim & Han, 2010) while having their recreation activities. To conclude, tourists who are environmentally educated with poses higher sensibility of environmental attitudes will improve the likelihood of portraying environmentally responsible behaviour.

Perceived Behavioural Control, Environmental Education and Waste Segregation-at-Source Behaviour

There is the same concern as mentioned in the previous section whereby to the best knowledge of the researcher, there is no existing literature which has focused primarily on how does environmental education influence the perceived behavioural control towards the waste segregation-at-source behaviour. Saribas, Kucuk, and Ertepinar (2016) have critiqued that research which examined the effect of specific features of an environmental education course are hard to be found so far. Hence, this current research will play its significant role to contribute a good dataset to the literature concerning this issue by examining the moderating effect of environmental education in the relationship between household's perceived behavioural control and waste segregation-at-source behaviour.

Perceived self-efficacy of behaviour is one of the dimensions of a person's sense which studied under the perceived behavioural control variable (Ajzen & Fishbein, 2004). By definition, perceived self-efficacy refers to "people's judgments of their capabilities to execute and organize courses of an action which required in attaining designated types of certain performances" (p. 391). Moreover, Ozdem, Dal, Ozturk, Sonmez, and Alper (2014) have researched climate change and investigated the secondary school students' general environmental concerns, beliefs and actions relating to the issue of climate change. Their results reflected that students do care about the climate change issue, but they do not believe in themselves that they can do anything to solve the crucial problem. Consequently, it is a challenge to educate the students about the understanding of climate change at many stages of education. In this respect, their self-efficacy belief which related to environmental education is worth studying as well.

Individuals who have a sense of self-efficacy belief are more preferring to work hard on a task given. When they face any difficulties, they will persevere longer than those who have self-doubts. With this, Bandura (1986) has addressed the effect of self-efficacy belief on individuals' efforts, persistence and activities. Subsequently, he found that to those who have high self-efficacy belief, they believe that they will succeed with adequate effort, time and persistence.

Similarly, the self-efficacy belief of pre-service teachers should be enhanced. In a sample of seventy-two educators who attended a three-day outdoor environmental

education program (Moseley, Reinke, & Bookout, 2002); their pre-test scores on Sia's (1992) Environmental Education Efficacy Belief Instrument were high. Their further results also revealed that their scores did not change significantly after the program but their self-efficacy rate dropped after seven weeks. As such, Ozdemir, Aydin, and Akar-Vural (2009) concluded that the more educators learn about the environmental education and teaching strategies, the more concerned they can be regarding their ability and confidence to teach environmental education.

Contradictory evidence was found whereby educators who holding low self-efficacy belief will be more focus on their negative aspects of the classrooms and are less likely to be effective (Pintrich & Schunk, 2002). Hence, after strengthening the educators' self-efficacy belief by sufficient environmental education, they will, in turn, to be more effective in improving their performance to shape the capacities and self-efficacy beliefs of future generations through transversal and comprehensive environmental education programs (Ozdemir et al., 2009).

Subjective Norm, Environmental Education, and Waste Segregation-at-Source Behaviour

To date, there has been no detailed research that has discussed the role of environmental education as a moderator on the association between subjective norm and waste segregation-at-source behaviour. Therefore, the nature of environmental education to act as a moderating variable remains unclear. Understanding stakeholder perspectives is an effective step that will give direction to implementing environmental education system to influence the key referents that in turn will encourage the respondents to engage in waste segregation-at-source behaviour. Thus, to contribute to the body of knowledge by creating a good data set on waste segregation-at-source behaviour which pertaining environmental education and subjective norm; this present research is designed to explore the moderating effect of environmental education in the relationship between household's subjective norm on waste segregation-at-source behaviour.

In the research's field of conservation biology, the issue of species extinction is getting worried by the World Wild Fund for Nature. Endanger species conservation programme cannot be efficient enough without considering the cooperation of local community (Andrade, 2004; Infield & Namara, 2001; Kellert, Black, Rush, & Bath, 1996)

because extinction of species is often due to irresponsible human activities (Dickman, 2010, Espinosa & Jacobson, 2012; Zimmermann, Baker, Inskip, Linnell, Marchini, Odden, & Treves, 2010). It becomes clear the necessity for an environmental education program to be integrated into the society in shaping specific pro-environmental behaviour.

In addition to that, the success of any action of conservation towards the endangered species fully relies on the past, current, and future environmentally friendly behaviour of locals. Therefore, it is worthy to note that many conservation efforts will include the significant role of environmental education as one of the integral parts of their conservation program (Andrade, 2004; Infield & Namara, 2001; Kellert et al., 1996; Rakotomamonjy, Jones, Razafimanahaka, Ramamojisoa, & Williams, 2015).

Lastly, the phrase of environmental education is more frequent to be employed to emphasize the promotion and education efforts of information and awareness on environmental sustainability. In addition to that, there is a growing demand from local society for the actions of universities on sustainable development, turning these institutions into agents for a change in the trend of environmental concern amongst local community (Ceulemans, Molderez, & Liedekerke, 2015; Lozano, Lozano, Mulder, Huisingh, & Waas, 2013; Ramos, Caeiro, Hoof, Lozano, Huisingh, & Ceulemans, 2015; Stephens & Graham, 2010; Suryawanshi & Narkhede, 2015). Interestingly, environmental education will more focus on information about proper waste management (Perez-Belis, Bovea, & Simo, 2015), and focus on the strategies to promote critical thinking and ecological friendly behaviours (Carleton-Hug & Hug, 2010; Frantz & Mayer, 2014; Kibbe, Bogner, & Kaiser, 2014; Zsoka, Szerenyi, Szechy, & Kocsis, 2013) so as to encourage more people to engage in pro-environmental behaviour in daily routine after they obtain sufficient information on protecting environment which surrounding them through environmental education program.

Research Methodology

Population and Sampling Design

The target population of this research was the households who are living in Putrajaya. The estimated total number of residents in 2018 is 88 700 people. It consists of 83 900 Malay residents, 950 Bumiputera residents, 600 Chinese residents, 950 Indian residents, 150 other ethnics residents and 2 150 non-Malaysian citizens (Department of Statistics Malaysia, 2018). The sample size of respondents in this present research was calculated by using the sample size determination equation proposed by Yamane (1967) to obtain a reliable and valid representative for this research. As a result, a total number of 400 respondents were selected to participate in this research.

Putrajaya was chosen as the present research location because it had been selected as a showcase city for "Pioneer Township in Green Technology" in 2010. A preliminary study which consisted of three sub-sections being "Cooler Putrajaya", "Low Carbon Putrajaya" and "3R Putrajaya" were also carried out at Putrajaya to fulfil the goal of developing a Low Carbon Society by 2025 (Irwan, Basri, Watanabe, & Abushammala, 2013). Hence, for the procedure of sampling, this research employed a multistage sampling method in selecting the respondents. For the first stage of the multistage sampling method, Putrajaya had been purposely selected due to its special criteria for practising waste segregation-at-source behaviour. Subsequently, the area of housing estates in Putrajaya had to be ascertained and identified. Therefore, Precinct 5, Precinct 8, Precinct 9, Precinct 10, Precinct 11, Precinct 14, Precinct 15, Precinct 16, Precinct 17 and Precinct 18 had been listed out as the focal point to conduct this survey.

For the third stage of choosing the sample, the systematic sampling method was employed in the present research. Consequently, the sample was chosen by selecting a random starting point and then picking every 10th element in succession from the sampling frame of each precinct to answer the questionnaire. In other words, the sampling unit was 10, 20, 30, 40 and so on until a total of four hundred respondents were being selected to answer the questionnaire. All the household from various races regardless of their age, race and religion were selected in this research.

Research Instrumentation

A set of self-administered bilingual questionnaire was used to collect the necessary data. The questionnaire was set in both open and closed format which consisted of seven sections which included the socio-demographic information of respondents, attitude, perceived behavioural control, subjective norm, environmental education, and waste segregation-at-source behaviour. Subsequently, a discussion regards to the measurement of studied variables is presented in the subsequent sub-sections.

Demographic Information

This section comprises of both open-ended and close-ended questions. Respondents were asked to answer the questions about the socio-demographic and socio-economic profile of respondents which included age, sex, ethnic group, religion, marital status, and monthly household income.

Attitude

The attitude measurement of respondents is designed by adopting the scale applied in previous research (Babaei, Alavi, Goudarzi, Teymouri, Ahmadi, & Rafir, 2015; Tonglet, Phillips, & Read, 2004; Zhang, Huang, Yin, & Gong, 2015). There are ten statements framed to interpret the attitude of respondents on waste segregation-at-source behaviour in Putrajaya. Out of these ten items, three items are negatively stated. Thus, the negative statement items are well reverse coded before data analysis takes place. This section is measured based on a 5-point Likert scale which ranged from "option 1" for "strongly disagree" to "option 5" for "strongly agree". Respondents were required to rate whether they agree with the statements by providing their responses according to the five response categories in a bid to reflect their attitude towards waste segregation-at-source behaviour.

Perceived Behavioural Control

There are nine positive statements designed to verify the perceived behavioural control of respondents on the concept of waste segregation-at-source. Perceived

behavioural control was measured by using the questionnaire proposed in previous research (Cabaniss, 2015; Tonglet et al., 2004). It is noted that the respondents' rates ranged from 1 "strongly disagree" to 5 "strongly agree" to tap the extent to how difficult or easy performance of the behaviour is likely to be and how much control they have over the behaviour of interest. Respondents were requested to rate how well each of the nine different statements describes them by using a five-point response format.

A total of the score will be computed in a bid to analyze the perceived behavioural control with waste segregation at-source behaviour. Hence, the higher score corresponds to better perceived behavioural control on waste segregation-at-source behaviour.

Subjective Norm

Seven positive statements which measure the subjective norm with waste segregation-at-source are presented in Section D. It is further noted that these questions are adapted from Apinpath (2014), DL and SJ (2018), and Tonglet et al. (2004). This section measured how does subjective norm can influence the practice of waste segregation-at-source behaviour. The five-point Likert scale which ranged from 1 "strongly disagree" to 5 "strongly agree" is used to rate the agreement level of respondents towards the statements in this section. The total score of this construct is then computed to interpret the raw scores in a more manageable way. Subsequently, the summated scores are further segregated into three categories, namely Low (7-15), Moderate (16-24), and High (25-35). To conclude, the higher the score, the higher the subjective norm towards waste segregation-at-source behaviour.

Environmental Education

In Section E, a total of nine positive closed-ended questions are designed to observe environmental education towards waste segregation-at-source behaviour. This section is adapted from the questionnaires released by Department of Statistics Malaysia (2015) to avoid bias and confusion as the researcher took the initial consideration that there is no detailed explanation of environmental education in this

research area. Hence, respondents were asked to choose the most appropriate response to measure the intensity of respondents' view concerning the statements constructed in this section to test the moderating variable of environmental education in this research. Hence, five-point Likert scale ranges from (1) strongly disagree, (2) disagree, (3) not sure, (4) agree, too (5) strongly agree is used to measure Section E.

Waste Segregation-at-Source Behaviour

The measurement of this variable is completed by using a closed-end question which is intended to picture the repeated action of segregating the unwanted materials based on their recycling potential in respondents' daily routine. The measuring item in this section is adapted from the online questionnaire published by the Department of Statistics Malaysia (2015) which is specifically reflecting the frequency of practising waste segregation-at-source behaviour. Consequently, a Likert-type scale ranging from (1) never, (2) once in the past 6 months, (3) in a month, (4) once a week, (5) twice a week and (6) every day is employed to measure this section.

Data Analysis and Discussion

Respondents' Demographic Information

As depicted in Table 1, data were collected from a total of four hundred respondents in which consisted of 40.3 per cent of male (n=161) and 59.8 per cent of female (n=239) respondents. There was 39.5 per cent of the respondents' age ranged from 22 to 31 (n=158). Only two respondents aged above 61 years old while 16 of the respondents' age ranged from 52 to 61. Bumiputera respondents appeared as the largest group in the sample (93.8%). It was followed by the percentage distribution of the Chinese and Indian group, both comprising of 3.5 per cent and 2.3 per cent respectively. In Putrajaya, there was 35.5 per cent of the respondent's household monthly income ranged between RM3001 and RM5000 (n=142). Respondents who were never married were 59.3 per cent (n=237) while those who were married were 39.8 per cent (n=159).

Table 1: Distribution of Respondents' Demographic Information, N=400

Variables	Number of Respondents	Percentage (%)
Age (years old)		
≤ 21	30	7.5
22 – 31	158	39.5
32 – 41	118	29.5
42 – 51	74	18.5
52-61	18	4.5
> 61	2	0.5
Sex ^a		
Male	161	40.3
Female	239	59.8
Ethnic Group ^a		
Bumiputera	375	93.8
Chinese	14	3.5
Indian	9	2.3
Others	2	0.5
Religion ^a		
Islam	373	93.3
Buddhism	9	2.3
Christianity	12	3.0
Hinduism	5	1.3
None	1	0.3
Marital Status ^a		
Never married	237	59.3
Married	159	39.8
Widowed	2	0.5
Divorced	2	0.5
Monthly Household Income		
^a	111	27.8
≤ RM 3000	142	35.5
RM 3001 – RM 5000	73	18.3
RM 5001 – RM 7000	36	9.0
RM 7001 – RM 9000	38	9.5
> RM 9000		

Note: ^a = Totals do not sum to 100.0 due to rounding.

Evaluation of Measurement Model Results

In this research, Structural Equation Modeling analysis of Partial Least Squares Regression (PLS-SEM) method was employed to evaluate the proposed theoretical model. Therefore, for the initial assessment of a reflective measurement model in PLS-SEM, it is essential to establish the reliability and validity of the latent variables which used to represent each construct in the model because structural model estimation will not be examined until the reliability and validity of the constructs has been established (Hair, Ringle, & Sarstedt, 2011). With more specifically, composite reliability, convergent validity, and discriminant validity were evaluated with the aid of PLS-SEM software before estimating the model. Consequently, Table 2 portrays the summary of composite reliability and average variance extracted while Table 3 shows the summary of Fornell-Larcker Criterion for the model.

The accepted value for composite reliability should be 0.70 or higher (Nunnally & Bernstein, 1994; Christie & Higgins, 2012). Based on Table 2, all the composites reliabilities are beyond the level of 0.70. The highest value of composite reliability comes from waste segregation-at-source behaviour, which is 0.9110 but the lowest value of which comes from attitude, which is 0.7681, and it is still above 0.70, a suggested threshold of reliability. Hence, the measurement instrument for this present research is reliable.

Table 2: Assessment of Measurement Model Results

Construct	Composite Reliability	Average Variance Extracted
Attitude	0.7681	0.5097
Perceived Behavioural Control	0.8535	0.5087
Subjective Norm	0.8628	0.8448
Environmental Education	0.8448	0.8535
Waste Segregation-at-Source Behaviour	0.9110	0.8628

Bagozzi and Yi (1988) explained that convergent validity for a model can be confirmed if all of the AVE values are ideally greater than the acceptable threshold value of 0.50, meaning that 50 per cent or more variance of the indicators should be

accounted for measured constructs. Subsequently, all the values of AVE demonstrated in Table 2 are greater than the acceptable value of 0.50. The highest value of AVE comes from waste segregation-at-source behaviour, which is 0.8628 but the lowest value of which comes from perceived behavioural control, which is 0.5087, and it is still above 0.50, a suggested threshold of AVE. Hence, the results show that the convergent validity in this model is confirmed.

The figures shown in Table 3 represent the square root of AVE whereas the off-diagonal represent the correlations of variables. Correspondingly, by observing Table 3, Fornell-Larcker criterion for the latent variable of WSSB is found to be 0.686. This number is larger than the value of Fornell-Larcker criterion in the column of WSSB (0.464, 0.328, 0.137) and larger than those in the row of WSSB (0.252). A similar observation is also made for the latent variables of ATT, EE, PBC, and SN. Many previous kinds of researches (Bagozzi & Yi, 1988; Saunders, Lewis, & Thornhill, 2016; Shevlin, 2015) also applied the same way of data analysis and data interpretation to justify the discrimination validity. Hence, the results in Table 3 indicate that the discriminant validity of this current model is well established.

Table 3: Summary of Fornell-Larcker Criterion for the Model

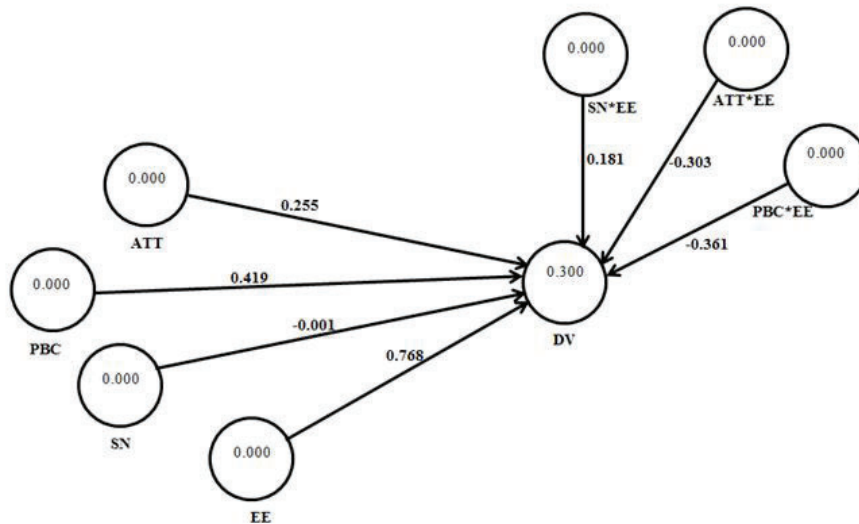
	ATT	WSSB	EE	PBC	SN
ATT	0.714				
WSSB	0.252	0.686			
EE	0.272	0.463	0.726		
PBC	0.174	0.328	0.307	0.723	
SN	-0.020	0.137	0.195	0.310	0.757

Note: ATT = Attitude, WSSB = Waste Segregation-at-Source Behaviour, EE = Environmental Education, PBC = Perceived Behavioural Control, SN = Subjective Norm

1. Evaluation of Structural Model Results

This section is to provide evidence on the assessment of the hypothesized structural model which involving interpretation on moderating effect of environmental education in relationships between attitude, perceived behavioural control and subjective norm with waste segregation-at-source behaviour, as illustrated in Figure 1. The moderating effect of an interaction variable on the endogenous variable can

be estimated by multiplying the construct coefficients of the exogenous variable with the moderator in PLS-SEM analysis (Esposito, 2010; Henseler, Hubona, & Ray, 2017). Consequently, the PLS algorithm was being analyzed to get the R2 value after the moderation effect has been introduced to the hypothesized structural mode



Note: ATT = Attitude, DV = Waste Segregation-at-Source Behaviour, EE = Environmental Education, PBC = Perceived Behavioural Control, SN = Subjective Norm, * = Multiplication

Figure 1: Results of Structural Model Interaction with Moderating Variable

As the results visualized in Figure 1, the interaction of the moderating variable has existed after introducing the environmental education as a moderator to each predictor variable in the model. The output of the PLS algorithm after moderation has resulted in the R2 value of 0.300. The coefficient of determination, R2 value will represent the exogenous latent variables' combined effects on the endogenous latent variable. It also represents the amount of variance in the endogenous constructs explained by all the exogenous constructs linked to it in the structural model. The R2 value ranges from 0 to 1. Henseler et al. (2017) recommended that an R2 value of 0.250 will be deliberated as weak while 0.500 and 0.750 are regarded as moderate and substantial accordingly. In this research, the coefficient of determination, the R2 value is 0.300 of the endogenous latent variables in the path model. Thus, it can be concluded that the model variance has its predictability of 30.0 per cent after the introduction of environmental education as a moderator.

Nonetheless, the R2 value of 0.300 in the hypothesized structural model is described as moderate in this research (Henseler et al., 2011).

2. Bootstrapping of Hypothesised Structural Model Interaction with Moderating Variable

The critical ratios to determine structural parameter significance were tested via the bootstrapping procedure in the PLS-SEM analysis, as the preferred means to test significance and final interpretation of the structural model outcomes (Efron & Tibshirani, 1993) by using T-statistic. Hence, Table 4 outlines the bootstrap output obtained from SmartPLS software which consists of mean, standard deviation and t-value for the path coefficient of the hypothesized structural model.

Table 4: Test of PLS Path with Bootstrapping

Relationship	Mean for Path Coefficient	STDEV for Path Coefficient	T-Statistics for Path Coefficient	Significance Levels
ATT * EE → DV	-0.3325	0.2633	1.1492	NS
PBC * EE → DV	-0.3302	0.2470	1.4206	NS
SN * EE → DV	0.1888	0.0597	3.0294	***

Note: ATT = Attitude, PBC = Perceived Behavioural Control, EE = Environmental Education, SN = Subjective Norm, DV = Waste Segregation-at-Source Behaviour, STDEV = Standard Deviation, NS = Non-significant

*** Significant at $p < 0.01$ level

The critical t-values for a two-tailed test are 1.65 ($\alpha = 0.10$), 1.96 ($\alpha = 0.05$), 2.575 ($\alpha = 0.01$), or 3.29 ($\alpha = 0.001$). By comparing the t-values with the critical values from the standard distribution, if the empirical t-value is larger than the critical t-values at a selected α level, then the path coefficient is significantly different from zero. More specifically, the t-statistics in Table 4 indicated that there are two out of three structural path coefficients are statistically insignificant at the $p < 0.05$ level after the interaction model of environmental education was introduced as a moderator. Note that the only significant path in the inner model is SN * EE → DV (t-value = 3.0294).

To the best knowledge of researcher in the field of social sciences, there was no trail of previous research that has been conducted by using environmental education as a moderating variable in certain research, either in the context of Malaysia or in the field of waste segregation-at-source. Therefore, this research could be represented as one of the preliminary attempts in evaluating and discussing these respective elements in detail. Subsequently, this research represented one of the earliest researches in Malaysia to use environmental education as a moderating variable to measure the relationship between attitude, perceived behavioural control and subjective norm towards waste segregation-at-source behaviour. As a result, no comparison could be carried out to identify the variations within the context.

Implication and Recommendation for Future Research

The findings of the present research will enable local pro-environmental groups to build up their publicity forces via mass media (Chan, 1998) to educate the environmental significance of waste segregation-at-source behaviour. Associated with that, bad and good examples of the practices of waste segregation-at-source in the community can be included in a bid to establish a social influence because the influence from the social network is mainly symbolic (Hamid & Cheng, 1995). In addition to that, leaders and artists can be the role model to generate personal influence through the channel of mass media to demonstrate what kinds of behaviours are friendly to the environment. This mean will enable all citizens to increase their awareness of the importance of waste segregation-at-source behaviour in their daily routine.

For future research, it is necessary to find a better way to distribute the questionnaire in more different channels to enhance the efficiency and effectiveness of data collection. The examples for other modes of an administrative survey would be a phone call, email, fax, post and online. As the advanced evolution of ICT in the 21st century, online administration survey could be considered as another mean to replace the traditional way of collecting data, i.e., employed field assistants to distribute paper-based self-administrated questionnaire at certain research location. By using online administration, respondents would be directed to a specific website to answer the questionnaire by using their digital devices. This mean can further

improve the respond's rate and be more cost-effective in terms of manpower, time, and money.

References

- Addo-Yobo, F. N. & Ali, M. (2003). Households: Passive users or active managers? - The case of solid waste management in Accra, Ghana. *International Development Planning Review*, 25(4), 373–389. <https://doi.org/10.3828/idpr.25.4.4>
- Ajzen, I. & Fishbein, M. (2004). Questions raised by a reasoned action approach: Comment on Ogden. *Health Psychology*, 23(4), 431-434. DOI: 10.1037/0278-6133.23.4.431
- Alessa, L., Bennett, S. M., & Kliskey, A. D. (2003). Effects of knowledge, personal attribution, and perception of ecosystem health on depreciative behaviours in the intertidal zone of Pacific Rim National Park and Reserve. *Journal of Environmental Management*, 68(2), 207-218.
- Andrade, S. E. (2004). *Evaluation of an environmental education program for the Andean Bear in an Ecuadorian protected area* (Master's thesis). University of Florida, F. L.
- Apinhapath, C. (2014). Community mapping and the Theory of Planned Behaviour. *Journal of Waste Management*, 20, 1–8.
- Atik, M. (2010). Environmental protection in coastal recreation sites in Antalya, Turkey. *Coastal Management*, 38(6), 598-616.
- Babaei, A. A., Alavi, N., Goudarzi, G., Teymouri, P., Ahmadi, K., & Rafiee, M. (2015). Household recycling knowledge, attitudes, and practices of solid waste management. *Resources, Conservation and Recycling*, 102, 94–100. <https://doi.org/10.1016/j.resconrec.2015.06.014>
- Bagozzi, R. P. & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/BF02723327>
- Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

- Bruyere, B., Nash, P. E., & Mbogella, F. (2011). Predicting participation in environmental education by teachers in coastal regions of Tanzania. *The Journal of Environmental Education*, 42(3), 168-180.
- Cabaniss, A. (2015). Message matters: Application of the Theory of Planned Behaviour to increase household hazardous waste program participation. *ProQuest LLC*, 1–19. Retrieved from <http://scholar.google.com>
- Carleton-Hug, A. & Hug, J. W. (2010). Challenges and opportunities for evaluating environmental education programs. *Evaluation and Program Planning*, 33, 159–164. doi:10.1016/j.evalprogplan.2009.07.005
- Ceulemans, K., Molderez, I., & Liedekerke, L. V. (2015). Sustainability reporting in higher education: a comprehensive review of the recent literature and paths for further research. *Journal of Cleaner Production*, 106, 127-143. <http://dx.doi.org/10.1016/j.jclepro.2014.09.052>
- Chan, K. (1998). Mass communication and pro-environmental behaviour: waste recycling in Hong Kong. *Journal of Environmental Management*, 52(November 1996), 317–325. <https://doi.org/10.1006/jema.1998.0189>
- Christie, B. & Higgins, P. (2012). *The impact of outdoor learning experiences on attitudes to sustainability: A Review of the literature*. Retrieved from University of Edinburgh website: <Http://anaturalcurriculum.org.uk/assets/Literature-review-UofE.pdf>
- Davis, J. L., Green, J. D., & Reed, A. (2009). Interdependence with the environment: Commitment, interconnectedness, and environmental behaviour. *Journal of Environmental Psychology*, 29, 173-180.
- Dawson, J., Stewart, E. J., Lemelinc, H., & Scott, D. (2010). The carbon cost of polar bear viewing tourism in Churchill, Canada. *Journal of Sustainable Tourism*, 18(3), 319-336.
- Department of Statistics Malaysia. (2015). *Yearbook of Statistics Malaysia 2015*. Percetakan Negara Berhad. ISSN 0127-2624.
- Department of Statistics Malaysia. (2016). *Report on the Population Projection, Malaysia 2016*. Percetakan Negara Berhad.
- Department of Statistics Malaysia. (2018). *Report on the Population Projection, Malaysia 2018*. Percetakan Negara Berhad.

- Dickman, A. (2010). Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation*, 13(5), 458–466.
- DL, M., & SJ, M. (2018). Survey Carried Out in Cosmo City, South Africa, about Recycling Practices and Local Community Perceptions on Waste Management Practices. *International Journal of Applied Science - Research and Review*, 05(1). doi:10.21767/2394-9988.100068
- Duerden, M. D. & Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitude, and behaviour. *Journal of Environmental Psychology*, 30, 379-392.
- Efron, B. & Tibshirani, R.J. (1993). An introduction to the bootstrap. New York: Chapman & Hall.
- Espinosa, S. & Jacobson, S. K. (2012). Human-wildlife conflict and environmental education: Evaluating a community program to protect the Andean bear in Ecuador. *The Journal of Environmental Education*, 43(1), 55–65.
- Esposito, V. V. (2010). *Handbook of partial least squares: Concepts, methods, and applications*. Berlin: Springer.
- Frantz, C. M. & Mayer, F. S. (2014). The importance of connection to nature in assessing environmental education programs. *Studies in Educational Evaluation*, 41, 85–89. doi:10.1016/j.stueduc.2013.10.001
- Hair, J. F., C. Ringle, & M. Sarstedt. (2011). “PLS-SEM: Indeed a silver bullet.” *Journal of Marketing Theory and Practice*, 19(2), 139-51.
- Hamid, P. N. & Cheng, S.-T. (1995). Predicting antipollution behaviour: The role of molar behavioural intentions, past behaviour, and locus of control. *Environment and Behaviour*, 27(5), 679–698. <https://doi.org/10.1177/0013916595275004>
- Henseler, J., Hubona, G., & Ray, P. A. (2017). Partial Least Squares Path Modeling: Updated Guidelines. *Partial Least Squares Path Modeling*, 19-39. doi:10.1007/978-3-319-64069-3_2
- Infield, M. & Namara, A. (2001). Community attitudes and behaviour towards conservation: An assessment of a community conservation program around Lake Mburo National Park, Uganda. *Oryx*, 35(1), 48–60.

- Irwan, D., Basri, N. E., Watanabe, K., & Abushammala, M. F. (2013). Influence of Income Level and Age on Per Capita Household Solid Waste Generation in Putrajaya, Malaysia. *Jurnal Teknologi*, 65(2). doi:10.11113/jt.v65.2186
- Kafyri, A., Hovardas, T., & Poirazidis, K. (2012). Determinants of visitor pro-environmental intentions on two small Greek islands: Is ecotourism possible at coastal protected areas? *Environmental Management*, 50(1), 64-76.
- Kaiser, F. G., Doka, G., Hofstetter, P., & Ranney, M. A. (2003). Ecological behaviour and its environmental consequences: A life cycle assessment of a self-report measure. *Journal of Environmental Psychology*, 23(1), 11-20.
- Kellert, S. R., Black, M., Rush, C. R., & Bath, A. J. (1996). Human culture and large carnivore conservation in North America. *Conservation Biology*, 10(4), 977–990.
- Kibbe, A., Bogner, F. X., & Kaiser, F. G. (2014). Exploitative vs. appreciative use of nature – Two interpretations of utilization and their relevance for environmental education. *Studies in Educational Evaluation*, 41, 106–112. Doi: 10.1016/j.stueduc.2013.11.007
- Kim, Y. & Han, H. (2010). Intention to pay conventional-hotel prices at a green hotel - A modification of the Theory of Planned Behaviour. *Journal of Sustainable Tourism*, 18(8), 997-1014.
- Lee, T. H. (2011). How recreation involvement, place attachment, and conservation commitment affect environmentally responsible behaviour. *Journal of Sustainable Tourism*, 19(7), 895-915.
- Lozano, R., Lozano, F. J., Mulder, K., Huisingh, D., & Waas, T. (2013). Advancing higher education for sustainable development: International insights and critical reflections. *Journal of Cleaner Production*, 48, 3–9. <http://dx.doi.org/10.1016/j.jclepro.2013.03.034>
- Miller, G., Rathouse, K., Scarles, C., Holmes, K., & Tribe, J. (2010). Public understanding of sustainable tourism. *Journal of Tourism Research*, 37(3), 627-645
- Ministry of Housing and Local Government. (2015). Separation-at-Source. Retrieved from <http://www.kpkt.gov.my/separationatsource/en/>
- Moseley, C., Reinke, K., & Bookout, V. (2002). The effect of teaching outdoor environmental education on preservice teachers' attitudes toward self-efficacy

- and outcome expectancy. *The Journal of Environmental Education*, 34(1), 9–15.
- Nunnally, J. C. & Bernstein, I. H. (1994). *Psychometric theory*, New York: McGraw-Hill.
- Onyanta, A. (2016). Cities, municipal solid waste management, and climate change: Perspectives from the South. *Geography Compass*, 10(12), 499-513. doi:10.1111/gec3.12299
- Ozdem, Y., Dal, B., Ozturk, N., Sonmez, D., & Alper, U. (2014). What is that thing called climate change? An investigation into the understanding of climate change by seventh-grade students. *International Research in Geographical and Environmental Education*, 23(4), 294–313.
- Ozdemir, A., Aydin, N., & Akar-Vural, R. (2009). A scale development study on self-efficacy beliefs through environmental education. *Dokuz Eylul University Buca Education Faculty Journal*, 26, 1–8.
- Pérez-Belis, V., Bovea, M. D., & Simó, A. (2015). Consumer behaviour and environmental education in the field of waste electrical and electronic toys: A Spanish case study. *Waste Management*, 36, 277–288. Doi: 10.1016/j.wasman.2014.10.022
- Pintrich, P. R. & Schunk, D. H. (2002). Social Cognitive Theory. In J. W. Johnston & K. M. Davis (Eds.), *Motivation in Education: Theory, Research, and Applications*. Columbus, OH: Merrill Prentice Hall.
- Rakotomamonjy, S., Jones, J., Razafimanahaka, J., Ramamonjisoa, B., & Williams, S. (2015). The effects of environmental education on children's and parents' knowledge and attitudes towards lemurs in rural Madagascar. *Animal Conservation*, 18(2), 157–166.
- Ramos, T. B., Caeiro, S., Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, 106, 3-10. <http://dx.doi.org/10.1016/j.jclepro.2015.05.110>
- Saribas, D., Kucuk, Z. D., & Ertepinar, H. (2016). Implementation of an environmental education course to improve pre-service elementary teachers' environmental literacy and self-efficacy beliefs. *International Research in*

Geographical and Environmental Education, 26(4), 311-326.

doi:10.1080/10382046.2016.1262512

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research methods for business students*. Harlow (Essex: Pearson.

Shevlin, M. (2015). Exploratory and confirmatory factor analysis in clinical and health psychology. *Oxford Clinical Psychology*.

doi:10.1093/med:psych/9780198527565.003.0019

Sia, A. P. (1992). *Preservice elementary teachers' perceived efficacy in teaching environmental education: A preliminary study*. Paper presented at the annual meeting of the North American Association for Environmental Education, Toronto.

Stephens, J. C. & Graham, A. C. (2010). Toward an empirical research agenda for sustainability in higher education: Exploring the transition management framework. *Journal of Cleaner Production*, 18, 611–618. doi:10.1016/j.jclepro.2009.07.009

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: the case of environmentalism. *Human Ecology Review*, 6(2), 81-97.

Sujauddin, M., Huda, S. M. S., & Rafiqul Hoque, A. T. M. (2008). Household solid waste characteristics and management in Chittagong, Bangladesh. *Waste Management*, 28, 1688-1695.

Suryawanshi, K. & Narkhede, S. (2015). Green ICT for sustainable development: A higher education perspective. *Procedia Computer Science*, 70, 701 – 707. doi: 10.1016/j.procs.2015.10.107

Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resources, Conservation and Recycling*, 41(3), 191–214. <https://doi.org/10.1016/j.resconrec.2003.11.001>

Verma, R. L., Borongan, G., & Memon, M. (2016). Municipal Solid Waste Management in Ho Chi Minh City, Viet Nam, Current Practices and Future Recommendation. *Procedia Environmental Sciences*, 35, 127–139. <https://doi.org/10.1016/j.proenv.2016.07.059>

Yamane, T. (1967). *Elementary sampling theory*. Englewood Cliffs, N.J.

- Zhang, D., Huang, G., Yin, X., & Gong, Q. (2015). Residents' waste separation behaviours at the source: Using SEM with The Theory of Planned Behaviour in Guangzhou, China. *International Journal of Environmental Research and Public Health*, 12(8), 9475–9491. <https://doi.org/10.3390/ijerph120809475>
- Zimmermann, A., Baker, N., Inskip, C., Linnell, J. D., Marchini, S., Odden, J., & Treves, A. (2010). Contemporary views of human-carnivore conflicts on wild rangelands (129–151). In J. T. du Toit, R. Kock & J. Deutsch (Eds.), *Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-arid Ecosystems*. Oxford, UK: Blackwell Publishing Ltd.
- Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behaviour and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, 48, 126–13