INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v11-i10/11492 DOI:10.6007/IJARBSS/v11-i10/11492

Received: *11* August *2021,* ***Revised:*** *29* August *2021,* ***Accepted:*** *19* September *2021*

Published Online: 06 October 2021

In-Text Citation: (Zulkipli & Jamian, 2021)

To Cite this Article: Zulkipli, F., & Jamian, N. H. (2021). Correlation and Exploratory Factor Analysis on Awareness of Solid Waste Management in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *11*(10), 1151 – 1164.

Vol. 11, No. 10, 2021, Pg. 1151 – 1164

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Correlation and Exploratory Factor Analysis on Awareness of Solid Waste Management in Malaysia

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Abstract
The objective of this study is to determine the awareness on solid waste management in Malaysia using an exploratory factor analysis. A questionnaire is developed and comprised of two sections, which are Section A for the background of respondent and Section B for the awareness on solid waste management. The sample for this preliminary study is 261 respondents. An exploratory factor analysis was implemented in order to classify the 19 items into specific proposed components. Moreover, the correlation analysis is conducted to examine the relationship between the items. As a result, the study revealed that the 19 items can be classified in to five main components which are awareness, practice, knowledge, attitude and perception. Thus, the results lead to formulate a new questionnaire. In addition, the new questionnaire will be distributing in future for identify the level of awareness on solid waste management among citizen in Malaysia.
Keywords: Solid Waste Management, Awareness, Practice, Knowledge, Attitude, Perception, Correlation Analysis, Exploratory Factor Analysis.

Introduction

Solid waste management (SWM) is a complex issue with political, economic, institutional, and environmental dimensions. It has become one of the most critical concerns confronting urban spaces in every country as a result of exponential urban growth. Malaysia's growing solid waste generation has reached an alarming level (Zulkipli et al., 2020). The abundance of solid waste generated by our daily activities has put our communities at risk (Zulkipli et al., 2019; Jamian et al., 2018). Growth of solid waste generation in Malaysia reach an increase annually due to an increment in the number of populations. Economic growth and rapid urbanisation are significantly influent in the increment number of solid waste generation respectively. Currently the amount of solid waste generation in Malaysia is 38,209.041 kg/capita/day in 2020 has increased by 0.4% compared to 38,051.91 kg/capita/day in 2019 as reported by Department of Statistics Malaysia. This amount of solid waste generation is predicted to rise gradually year by year. This is the consequence of many parties' commitment and effort to carry out development projects such as new urban construction planning, infrastructural facilities, and so on. In Figure 1 is presented the total waste generation and daily waste per

capita (kg) in Malaysia from 2013 until 2018 (Noor Azlina, 2018; Chu, 2019; DOSM, 2019). The trend of waste generation growths immensely every year.

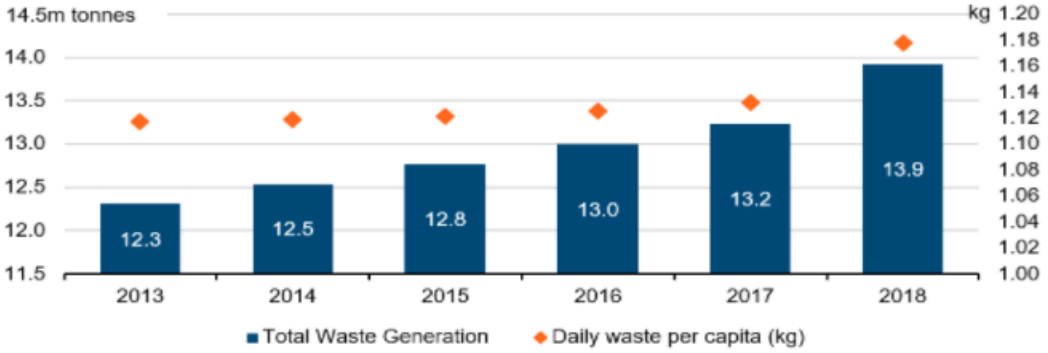

Figure 1. Total Waste Generation and Daily Waste per capita (kg) in Malaysia

Previous researchers had conducted a survey on public awareness towards solid waste management. As in Figure 2, Bashir et al (2018) investigated on public concerns and behaviors towards solid waste minimization using composting in Kampar district, Malaysia. The result shows that more than 50% respondents are willing to practice the correct ways on solid waste management, while 37.77% are not willing to practice. The unwillingness is due to lack understanding on how to manage the solid waste in a proper way with 72.9% feedback from respondents. Moreover, only 23.33% of the respondents contribute in participate to solid waste management activities conducted in Kampar, Perak.

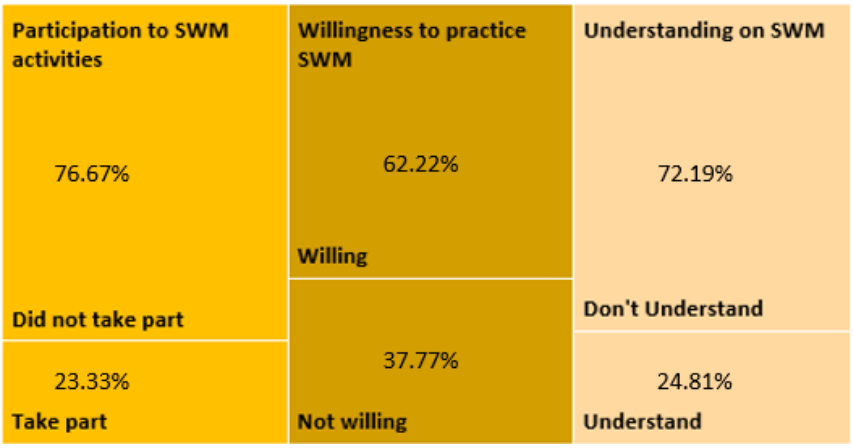

Figure 2. Respondents' Feedback

Another study conducted by Chung et al (2019) on level of recycling awareness among household in Selangor. The results show that only 16% of the respondents had the highest level of awareness on recycle. Majority 66% of the respondents had a moderate level of awareness on recycle, while the 18% of the respondent had a low level of awareness on recycle. It can be concluded that the awareness level among community in Selangor is moderate on recycle of solid waste. Thus, Lack of awareness and mismanagement on solid waste are the main causes of present human health damage and ecosystem quality deterioration (Hassan et al., 2019).

Unfortunately, these advances and the less caring and responsible society's attitude have had serious consequences for ecosystems, the environment, and human quality of life (Sabri & Teoh, 2006). Biodiversity problems, natural resource depletion, global warming, and other forms of pollution make this a nuisance and a frightening future challenge for

environmental conservation (Ferronato & Torretta, 2019). Given the growing urgency of environmental preservation, the need to establish a more environmentally responsible society is also pressing.

The young generation, who are considered as the state's heirs, should be educated in order to promote awareness about the consequences of future actions related to environmental protection. In order to attain a sustainable environmental environment, this preparation is critical in order to develop caring human capital and a more favourable attitude toward the environment. Therefore, the solid waste management should continuously efficient and sustainable. In order to overcome this problem, the awareness on solid waste management among citizen especially should be growth organically in every mind set.

These issues and problems lead to motivate the authors to further determine the public awareness on solid waste management among citizen in Malaysia. Therefore, this study is aim to conduct exploratory factor analysis on awareness among Malaysian citizen towards solid waste management. Hence, the objective of this study is to determine the awareness on solid waste management in Malaysia using an exploratory factor analysis (EFA) and correlation analysis. The following actions were taken in order to achieve this goal: (i) determined the respondents' backgrounds; ii) developed constructed factors that reflect the students' responses and feedback on awareness of solid waste management; iii) Using the exploratory factor analysis approach, classified the questionnaire questions by each component.

Methodology

a) Development of conceptual framework

Figure 3 shows the development of conceptual framework for awareness on solid waste management in Malaysia. This study is a preliminary survey among Malaysian citizen. A questionnaire is adopted and modified based on Hussin et al (2015). The questionnaire modified by authors was included an information on waste separation, which this policy is introduced by the government with the national aims to reduce the amount of waste generation. Based on Figure 3, the conceptual framework and comprised of two sections, which are Section A for the background of respondent and Section B for the awareness on solid waste management. The sample for this preliminary study is 261 respondents.

b) Exploratory Factor Analysis

Exploratory factor analysis (EFA) is a procedure often used by researchers to identify, reduce and organize a large number of questionnaire items into specific constructs under a dependent variable in a study. In general, the EFA procedure involves three stages as shown in Figure 4 and Figure 5 based on Chua (2014).

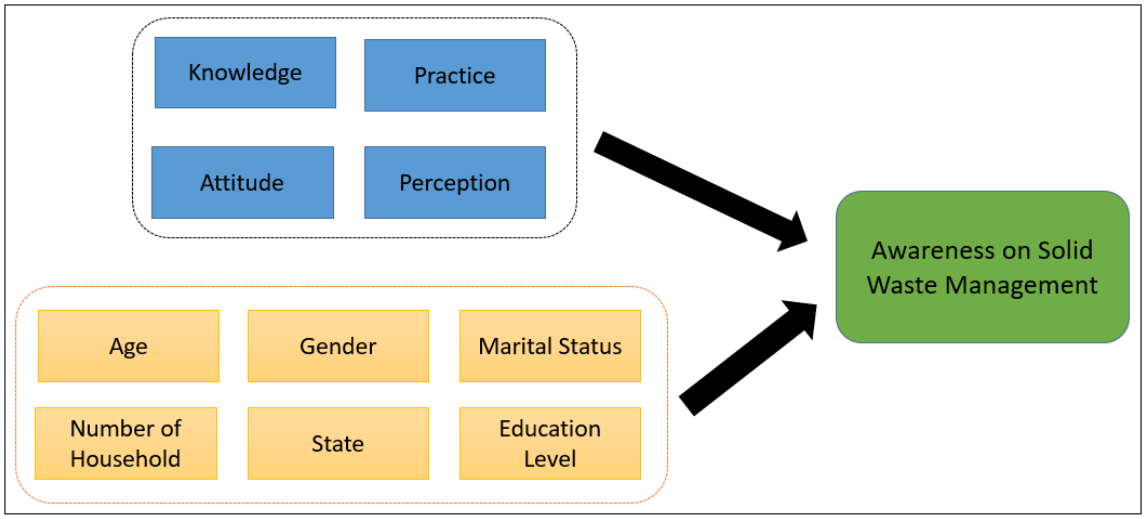

Figure 3. Conceptual Framework for Awaness on Solid Waste Management

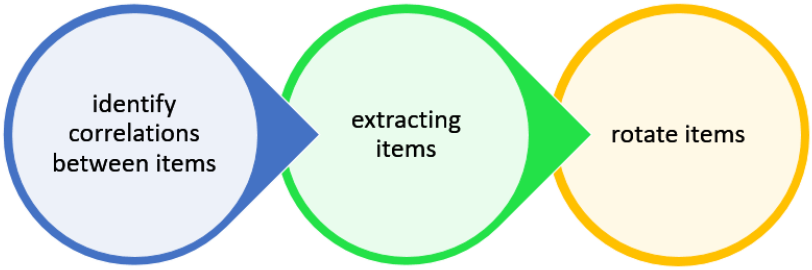

Figure 4. Procedure of Exploratory Factor Analysis

This study is used five-point Likert scale in the survey instrument where the range of agree level is beginning with 1 assigned as strongly disagree until 5 assigned as strongly agree. The process of constructing questionnaire initially reviewed by 7 experts from both academic and non-academic to evaluate the validity of every item included in term of relevancy of the items, the terms used, the sequence of questionnaire, the flow of statements, the format, the length of questionnaire in term of duration taken to response the questionnaire.

This study applied primary source and the target population is all Malaysians. There are 261 Malaysians involved in this study. The respondents are selected conveniently where they are voluntarily filled in the online questionnaire (Awang, 2010). The questionnaire is created using google form and the link are shared to multiple applications such Telegram and WhatsApp, e-mail and social media such as Facebook and Instagram. This method of data collection is currently relevant due to the COVID-19 outbreak is severe in Malaysia. The questionnaire used in this study consists of two sections. Section A consist of a background of respondent such as gender, age, marital status, number of households, states and education level. While in Section B consist of awareness, perception, attitude, knowledge and practice towards solid waste management in Malaysia. Overall, there are 19 items considered in this questionnaire.

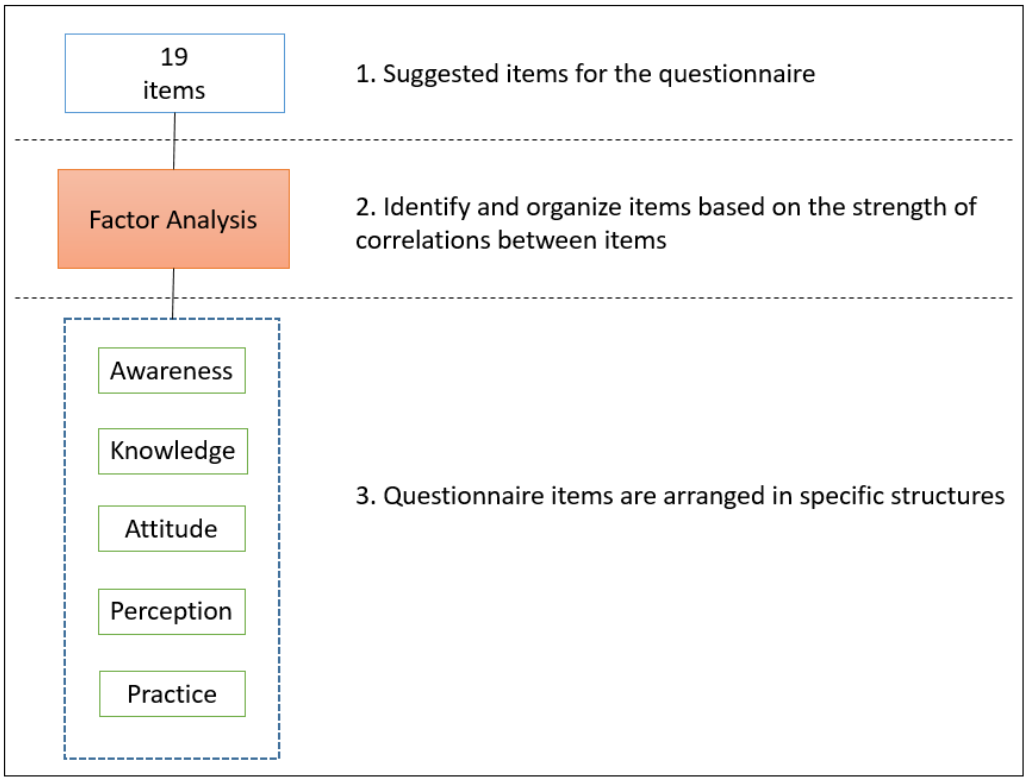

Figure 5. Concept of Factor Analysis

This study employed two analyses that are descriptive analysis for Section A and Exploratory Factor Analysis (EFA) for Section B. The descriptive analysis is used in this study to present the data in manageable and informative way in terms of frequency and percentage (Zulkipli et al., 2018). The EFA is then performed by priory presenting the normality test and correlation analysis.

Results and Discussions

a) Descriptive Analysis on Respondent's Background

Table 1 presented the information about respondents' demography in terms of frequency and percentage. It found that most of the respondents were female by 75.1% (196 respondents) meanwhile male was 24.9% (65 respondents). For the age group, most of the respondents were between 20 and 27 years old by 42.1% (110 respondents) followed by aged between 36 and 43 years old by 23% (60 respondents), aged 19 years old and below by 19.2% (50respondents), aged between 28 and 35 years old by 5.8% (15 respondents) and aged 44 and above by 9.9% (26 respondents) respectively.

According to marital status, it identified that almost half of the total respondents were single by 49% (128 respondents) followed by married which was 33.4% (87 respondents) respectively. For the number of households, more than half of respondents stated that they had less than 5 number of households per family which is contributed to 53.6% (140 respondents) then 46.4% (121 respondents) stated more than 6 number of households. This study obtained that most of the respondents came from the Selangor, Kuala Lumpur and Putrajaya with 61.3% (160 respondents) followed by respondent from Perlis, Kedah, Pulau Pinang and Perak, which was 16.1% (42 respondents), Johor, Melaka and Negeri Sembilan by 8.4% (22 respondents) and Pahang, Terengganu and Kelantan also 804% (22 respondents) and finally there was 5.7% (15 respondents) from Sabah and Sarawak respectively. Regarding

to Educational level, most of the respondents currently doing their diploma/STPM by 36.8% (96 respondents) followed by 35.6% (93 respondents) was degree students, 8.4% (22 respondents) was master students, 5% (13 respondents) was Certificate/Matriculation students and 4.2% (11 students) was PhD students.

Table 1. Descriptive Analysis on Respondent's Background

Demography	Attributes	Frequency	Percentage (%)
Gender	Male	65	24.9
	Female	196	75.1
Age	19 and below	50	19.2
	20-27	110	42.1
	28-35	15	5.8
	36-43	60	23.0
	44 and above	26	9.9
Marital status	Single	128	49.0
	Married	87	33.4
Number of household	Less than 5	140	53.6
	More than 6	121	46.4
State	Perlis, Kedah, Pulau Pinang, Perak	42	16.1
	Selangor, Kuala Lumpur, Putrajaya	160	61.3
	Johor, Melaka, Negeri Sembilan	22	8.4
	Pahang, Terengganu, Kelantan	22	8.4
	Sabah, Sarawak	15	5.7
Education level	SPM	26	9.9
	Certificate /Matriculation	13	5.0
	Diploma/STPM	96	36.8
	Degree	93	35.6
	Master	22	8.4
	PhD	11	4.2

b) Normality Test

The normality assumption is measured using skewness statistic for all 19 items responded by 261 individuals. Based on Table 2, the skewness statistic of each item indicated that that the data follows normal assumption. It is due to all skewness statistics were lies within the range 3 and -3. It means that this data can proceed with Correlation and Exploratory Data Analysis.

Table 2. Skewness Statistics of Items

Items	Skewness Statistics	Items	Skewness Statistics
1	-1.440	11	-0.593
2	-1.292	12	-0.709
3	-2.160	13	-0.663
4	-2.841	14	-0.286
5	-1.978	15	-0.566
6	-0.773	16	-0.385
7	-0.174	17	-1.0351
8	-0.716	18	-1.694
9	-0.891	19	-1.119
10	-0.259		

c) Exploratory Factor Analysis

In Table 3 showed the correlation statistics between two items where most items have some correlation. Some of the correlation between two items showed relatively high ranging r = 0.380 to r=0.860. This is good to perform factor analysis in order to model the interrelationships between items with fewer variables. These interrelationships can be divided into multiple components. Exploratory factor analysis (EFA) is a statistical technique to explore the underlying structure of a set of observed variables and scaling development process. The initial step in EFA is factor extraction using principal components analysis to find out the best factor structure (component) (Zulkipli et al., 2018). The crucial coefficients of the EFA, which is Kaiser-Meyer-Olkin (KMO) is considered in this study to identify the accuracy of the analysis. A Varimax rotation is carried out for all 19 items. Based on Table 4, it found that KMO value was 0.850 greater than 0.6 recommended by (Latif et al., 2013). It indicates that sampling adequacy is 0.850 where the data is suitable for principal component analysis. Similarly, the Bartlett's Test of Sphericity was significant since the Chi-square value was 2334.060 with p-value less than 0.001 indicating sufficiency correlation between all pairs of items. Since both KMO and Bartlett's Test of Sphericity measures are significant, it allows to continue the data reduction procedure. (Habidin & Yusof, 2013; Zulkipli et al., 2018).

Table 3. Correlation Analysis between Items

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	0.222	0.412	0.296	0.349	0.228	0.143	0.263	0.126	0.125	0.241	0.119	0.219	0.076	0.076	0.060	0.313	0.320	0.100
2	0.222	1	0.371	0.311	0.387	0.325	0.209	0.251	0.344	0.226	0.243	0.204	0.102	0.148	0.132	0.145	0.237	0.199	0.164
3	0.412	0.371	1	0.653	0.655	0.243	0.175	0.192	0.199	0.117	0.174	0.130	0.162	0.013	-0.022	-0.049	0.359	0.336	0.239
4	0.296	0.311	0.653	1	0.648	0.337	0.180	0.253	0.208	0.187	0.207	0.185	0.164	0.056	0.014	-0.062	0.333	0.390	0.258
5	0.349	0.387	0.655	0.648	1	0.402	0.179	0.255	0.248	0.200	0.313	0.152	0.191	0.157	0.104	0.066	0.309	0.362	0.203
6	0.228	0.325	0.243	0.337	0.402	1	0.422	0.368	0.373	0.389	0.315	0.265	0.318	0.174	0.171	0.205	0.204	0.257	0.183
7	0.143	0.209	0.175	0.180	0.179	0.422	1	0.448	0.398	0.437	0.184	0.315	0.342	0.265	0.337	0.386	0.094	0.096	0.118
8	0.263	0.251	0.192	0.253	0.255	0.368	0.448	1	0.459	0.527	0.334	0.369	0.359	0.384	0.370	0.416	0.145	0.162	0.132
9	0.126	0.344	0.199	0.208	0.248	0.373	0.398	0.459	1	0.551	0.214	0.392	0.321	0.227	0.270	0.333	0.218	0.222	0.222
10	0.125	0.226	0.117	0.187	0.200	0.389	0.437	0.527	0.551	1	0.380	0.522	0.446	0.364	0.391	0.456	0.129	0.172	0.199

11	0.241	0.243	0.174	0.207	0.313	0.315	0.184	0.334	0.214	0.380	1	0.427	0.435	0.356	0.333	0.299	0.175	0.198	0.059
12	0.119	0.204	0.130	0.185	0.152	0.265	0.315	0.369	0.392	0.522	0.427	1	0.546	0.419	0.435	0.493	0.155	0.151	0.185
13	0.219	0.102	0.162	0.164	0.191	0.318	0.342	0.359	0.321	0.446	0.435	0.546	1	0.414	0.384	0.451	0.093	0.120	0.133
14	0.076	0.148	0.013	0.056	0.157	0.174	0.265	0.384	0.227	0.364	0.356	0.419	0.414	1	0.860	0.673	-0.011	-0.005	0.008
15	0.076	0.132	-0.022	0.014	0.104	0.171	0.337	0.370	0.270	0.391	0.333	0.435	0.384	0.860	1	0.712	-0.017	0.009	0.051
16	0.060	0.145	-0.049	-0.062	0.066	0.205	0.386	0.416	0.333	0.456	0.299	0.493	0.451	0.673	0.712	1	0.001	0.033	0.118
17	0.313	0.237	0.359	0.333	0.309	0.204	0.094	0.145	0.218	0.129	0.175	0.155	0.093	-0.011	-0.017	0.001	1	0.737	0.539
18	0.320	0.199	0.336	0.390	0.362	0.257	0.096	0.162	0.222	0.172	0.198	0.151	0.120	-0.005	0.009	0.033	0.737	1	0.638
19	0.100	0.164	0.239	0.258	0.203	0.183	0.118	0.132	0.222	0.199	0.059	0.185	0.133	0.008	0.051	0.118	0.539	0.638	1

d) Exploratory Factor Analysis

Exploratory factor analysis (EFA) is a statistical technique to explore the underlying structure of a set of observed variables and scaling development process. The initial step in EFA is factor extraction using principal components analysis to find out the best factor structure (component) in Zulkipli et al (2018). The crucial coefficients of the EFA, which is Kaiser-Meyer-

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Table 4. Result of KMO and Barlett's Test

Test	Statistic
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.850
Bartlett's Test of Sphericity:	
Approximation Chi-Square	2334.060
Degree of freedom	170
p-value	0.000

Table 5 showed the list of components generated and the items extracted through principal component procedures. It was splits into five components. This study takes into account at least 0.4 factor loading to be included in a particular component (Habidin & Yusof, 2013; Hatcher, 1994). Component 1 named as Knowledge and the Component 2 named as Practice consisted of 5 items respectively. Meanwhile Component 3 named as Attitude, Component 4 named as Perception and Component 5 named as Awareness consisted of 3 items respectively.

Table 5. Component Extraction

Component	Component name	Item	Factor Loading
1	Knowledge	1	0.496
		2	0.530
		3	0.824
		4	0.768
		5	0.829
2	Practice	6	0.593
		7	0.703
		8	0.603
		9	0.757
		10	0.697
3	Attitude	11	0.707
		12	0.546
		13	0.701
4	Perception	14	0.904
		15	0.909
		16	0.768
5	Awareness	17	0.815
		18	0.856
		19	0.841

e) Reliability Test

Reliability test is performed to estimate the internal consistency in order to see how closely associated a set of items are as a group. It is considered to be a measure of scale reliability using Cronbach's alpha statistics for each component. It observed as the average inter-item correlation increases, Cronbach's alpha increases as well holding the number of items constant. Based on Table 6, the Cronbach's Alpha statistics for every component point out greater than 0.6 as recommended by (Nunnally, 1978). It means that the components extracted have a reliable measure of consistency among 261 respondents indirectly the questionnaire was reliable too.

Table 6. Reliability Test

Component	Number of items	Cronbach's Alpha statistics
1 (Knowledge)	5	0.733
2 (Practice)	5	0.794
3 (Attitude)	3	0.727
4 (Perception)	3	0.898
5 (Awareness)	3	0.830

Conclusion

As a conclusion, the EFA results had classified the 19 items from a questionnaire into 5 components, which consists of awareness, knowledge, attitude, perception and practice towards solid waste management in Malaysia. In addition, the questionnaire was distributed by online medium due to pandemic situation in Malaysia. Total of 261 number of respondents

had return their feedback and was statistically analyzed. The results had been briefly discussed in the previous section. Hence, for future study, the authors are planning on extending the analysis on Confirmatory Factor Analysis (CFA).

Acknowledgement
This study was supported by the Faculty of Computer and Mathematical Sciences (FSKM) Universiti Teknologi MARA, Perak Branch, Tapah Campus. Our sincere gratitude goes to all respondents for their cooperation of data collection.

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