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# Determinants of Sustainable Waste Management Behavior of Malaysian Academics

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**Abstract:** The global increase of urban solid waste in developing countries is creating highly significant challenges. There is a lack of research on sustainable waste management behavior (SWMB) among university academic staff. Hence, this study aims to examine the effect of attitude, subjective norm, and perceived behavior control on SWMB. This study employed the theory of planned behavior (TPB) as the underlying theory. This study's sample consisted of 252 academic staff from the top three sustainable universities in Malaysia listed by the UiGreenMetric in 2018. The academic staff were surveyed by using an online and self-administered survey and analyzed by using PLS-SEMThe results showed that attitude, subjective norms, and perceived behavioral control positively affect SWMB. This study makes significant contributions to both theory and practice. The study fills in the literature gap and supports the TPB theory. This study provides empirical evidence on the effect of main TPB variables, such as attitude, subjective norms, and perceived behavior control on SWMB through a quantitative research approach, exploring all three of the 3Rs to study academic staff's waste management behavior on campus. From the managerial perspective, this study's results provide empirical evidence on factors that affect SWMB among academic staff. This information is crucial to managers and policymakers to plan strategies to engage academic staff with SWMB. Managers and policymakers should focus on conducting more campaigns on sustainable waste management for academic staff. The campaigns would enhance academic staff's attitude, subjective norms, and perceived behavioral control towards practicing SWMB for a more sustainable campus in the future.

**Keywords:** sustainable waste management behavior; attitude; subjective norms; perceived behavioral control; theory of planned behavior



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## 1. Introduction

Globally, the increase in waste is getting worse day by day. According to the report released by the World Bank in 2019, there has been a 70% global increase in urban solid waste, with developing countries facing the most significant challenges. The estimated rise in the amount of waste, from 2.01 billion tons per year today to 3.40 billion tons per year by 2050, is projected to raise the annual global costs from $205 billion to $375 billion [1]. In Malaysia, with the accelerated development of population and economy, waste generated in urban and rural areas has become a big problem, as in other developing countries. The Malaysian Department of Statistics also released a study on sewage, waste management,

and remediation activities, which reported an 8.1 per cent rise in gross product value to RM14.4 billion in 2017 compared to 2015 [2].

It has been argued that higher education institutions (HEIs) have a moral and ethical obligation to act responsibly towards the environment [3]. They are expected to be leaders in the environmental protection movement. Specifically, universities should drive responsible waste management [3]. Every sector of society generates waste, and educational institutions are no exception [4]. University campuses occupy a wide geographic region and contain numerous buildings, services, and open spaces. Due to the growing student and university employee population, there is also a corresponding increase in the amount of waste generated each day [5,6]. As an example, a previous study conducted in Universiti Teknologi Malaysia (UTM) found per person generation of 0.85 kg per day. At the same time, it also mentioned that there are many waste generations in the campus during significant events like convocations that can be up to 2 kg per person [7]. Hence, universities cannot afford to consistently neglect the challenge of handling campus waste as a big waste generator.

In order to preserve the cleanliness of the campus and the well-being of stakeholders, sustainable waste management (SWM) is necessary [8]. Campus waste management is one of the main techniques used to create a sustainable campus [9,10], particularly through recycling practices [10]. This has to be acknowledged and practiced by all stakeholders at different university levels, but mainly by academic staff, for the effective implementation of sustainability in HEIs, since this group has a significant impact on society and young people. However, campuses persist in being further behind companies in terms of supporting society to adopt sustainable development (SD), and academic staff need to be well-versed in SD to educate students of all ages and support the transition of society into more sustainable development [11].

There have been considerable studies into the determinants and characteristics of the solid waste generated in HEIs. However, to the best of our knowledge, there has been little research on: (1) sustainable waste management behavior of university academic staff and (2) factors influencing university academic staff's sustainable waste management behavior. Therefore, this study aims to investigate factors that influence sustainable waste management behavior of academic staff. More specifically, this study has the following objectives: (1) to examine the effect of attitude on sustainable waste management behavior (SWMB), (2) to assess the effect of subjective norms on SWMB, and (3) to identify the effect of perceived behavioral control on SWMB.

## 2. Literature Review

### *2.1. Theory of Planned Behaviour (TPB)*

The theory of planned behavior (TPB) is an explanatory theory for human behavior, suggested by Icek Ajzen [12]. The theory assumes intentions to execute certain behaviors, including attitude, subjective norms, and perceived behavioral control (PBC). TPB is the most detailed theory and explains behaviors with the fewest number of variables. This theory is one of the theories that researchers commonly consider and establish to understand behavior in many fields, including sociology, psychology, education, and marketing [13,14]. Several studies have recently shown that TPB can help predict waste management behavior [15,16].

From a review of the literature, most research studies mainly describe behavioral intention. It is considered to be the correct predictor of behavior and fully mediates the effects of behavioral attitude and subjective norms on behavior [17–20] or even stops at the 'intention' construct without furthering the research to study 'behaviour' [21]. However, some studies do not consider 'intention' at all to avoid the intention/ behavior gap, as what people say (intention) and, on the other hand, what they do (behaviour) may vary [22,23].

In addition, Davies, Foxall, and Pallister [24] claimed that to comprehend the determinants of SWMB, it is crucial to be aware of the individual's behavior in terms of the environment and waste management. As recycling has become a routine and a daily ritual,

SWMB needs no specific intentions to execute it [25]. In the context of this study, this means that although a person may have the intention to recycle, they might not take action to fulfil that intention or behave accordingly.

### *2.2. Sustainable Waste Management Behaviour*

In this study, sustainable waste management behavior is examined using the 3R practices, i.e., "Reduce, Reuse, and Recycle", which is also known as a waste management hierarchy [10,26]. The concept of dealing with the 3Rs places SWM strategies into various categories, which are primarily based on an individual's willingness to perform them [27]. Society can derive many advantages from recycling and reuse practices, such as jobs, income, and tax revenue [28]. The Report on Recycling Economic Information [29] stated that a more profitable and much less impactful usage of materials enables a nation to remain economically competitive, contributes to prosperity, and protects the environment, which is especially important in the light of the resource-constrained years that lie ahead. In the context of university academics, Jabbour [30] suggested that with or without a formal environmental management system in universities, practicing 3R in the campus environment can directly make them adopt SWMB in universities.

As regards to the first 'R', the main objective of reducing the use of resources and SWM is the control of consumption. Studies such as those by Ding, Yi, Tam, and Huang [31], have stated that the most effective way of managing waste is to reduce the top 'R' in the hierarchy. Chawla and Rajaram [32] described reducing materials usage as modifying behavior to reduce consumption to what people need rather than what people want. In this way, resources such as water, electricity, and the other items that people use in daily life can be conserved. According to Lu and Yuan [33], a strategy for reducing waste at universities is monitoring and conserving resources. By monitoring use and making sure people use tools to conserve resources, waste can be reduced.

The second 'R' refers to 'reusing waste' which involves using the same material more than once [34]. Rather than using raw materials to produce new products, recycled resources are used instead [32]. Reuse is a mechanism in which various methods such as energy recovery, resource recovery, biological reprocessing, pyrolysis, and sustainability are used to recycle used materials [34,35]. This can include paper, which can be optimized for printing on both sides of the sheets by academics. Recycled paper, cans, and bottles can be reused to save valuable natural resources. There is also a reuse method in which previously used material can be utilized as a raw material for a new purpose [27]. For example, greywater produced by a household can be reused to water plants and gardens.

As for the third 'R' in the hierarchy, recycling refers to collecting waste materials and reusing them [27]. The process of transforming used products into new, useful products is known as recycling [27]. For instance, by filtering it and making it safe, toilet water can be turned into drinking water. In the U.S., the recycling of paper, aluminum and glass began in the 1980s and 1990s through coordinated programs that were initiated in all communities [27]. Recycling is now seen as an essential tool in reducing solid waste [36] and supplies necessary raw products to the industrial sector [37]. According to Zen et al. [7], recycling is the best and most efficient form of SWMB on campus to introduce sustainability awareness among UTM academics.

However, the absence of details on well-educated people like academics' attitudes and behaviors regarding 3R practices and the related impacts on waste has led to an information gap that hinders progress towards achieving sustainability on campus [38]. According to Jibril et al. [39], the 3Rs include distinct and skillful methods to reduce the amount of waste produced for disposal. The 3Rs are an internationally accepted waste management strategy that emphasizes reducing waste at the source where waste can be prevented and exploring ways to reuse materials. If that is not possible, recycling is encouraged.

The implementation of SWM programs began approximately twenty years ago in HEIs; such programs are either institutional or voluntary [3,40]. The most used method of reducing waste is implementing a recycling program as a starting point [10,38]. The

practice of 3Rs on campus positively influences the campus community's knowledge, awareness, attitudes, and behavior [38]. Hence the practice of the 3Rs could deliver a range of beneficial results to HEIs.

Since SWMB is mainly about engaging university stakeholders, programs and educational interventions are employed to bring about awareness in most stakeholders, especially academics [6,38,39,41]. For instance, including sustainability issues in educational programs can fill the knowledge gap about sustainability for both students and academics and instill awareness among academics that sustainability is not an annoyance or waste of time [10]. In addition, bringing about a large number of cost reductions through waste management can highly motivate the top management of HEIs to get involved in SD [10,39,42,43].

For many years, waste recycling has garnered significant attention from policymakers and environmental stakeholders because they seek to tackle the issues associated with waste production [44]. To reach zero waste targets or maximize the use and effectiveness of SWM on campus, the 'personal waste management' system is becoming an increasingly common strategy in organizations. In such schemes, rather than the onus being placed on custodial staff, individual employees are responsible for managing the waste generated throughout their office or workspace [42].

As shown in appendix 1, the SWM through 3R practices has been researched both qualitatively and quantitatively. In the context of HEIs, it focused on household and industrial waste management. Some research studies have only focused on the third R, i.e., recycling, not on the other two Rs. However, as stated earlier, recycling is considered an essential method for SWMB in HEIs. Some still do not understand the different priority levels placed on recycling and reducing waste [38].

This study uses a quantitative research approach to explore academics' SWMB in the workplace using all three of the 3Rs. This approach is adopted because more importance is placed on sustainable behaviors in household contexts than workplace contexts and because it has been found that workplaces are mostly overlooked in the literature [44]. Moreover, there has not yet been any widely published research in Malaysia that describes academics' SWMB, including waste reduction, reuse, and recycling.

### *2.3. Attitude and Sustainable Waste Management Behaviour*

Attitude applies to a person's cumulative positive or negative assessment of behavior in general [12]. Attitude is one of the most critical factors influencing behavior. It leads to a persons' belief in their behavior relevant to the environment, such as energy-saving behaviors or recycling [45]. Therefore, the mixture of behavior and attitude represents and reflects an individual's contribution to environmental issues, where there will be a tendency to be unfavorable or favorable towards a behavioral action enjoined upon people [46]. During social-psychological studies, the attitude has been investigated as a significant factor in forecasting SWMB [25].

Attitude has control over behavior, so that any attitude shift will lead to behavior changes [47]. People often foster, alter, or give up attitudes to fulfil ever-changing desires and needs [8]. People's behaviors and attitudes are extremely subjective; hence, it is difficult to figure out whether they control the waste recycling process [16]. According to Oke [44], experts and investigators in waste management have been attempting to understand people's attitudes and behaviors to explore the appropriate methods to resolve the waste production problem.

Attitude generally represents a positive or negative emotion about others that influences behavioral habits. Personal behaviors are almost always dependent on attitudes [48]. Previous research has reported that the attitude predicts SWMB (3R practices) in HEIs strongly [49]. However, Ramayah et al. [43] observed that attitude influence on recycling behavior is significant but weak. It has also been recommended that the direct effect of attitude on behavior needs to be investigated [50]. The various findings and information call for a more in-depth examination. Hence, the study's first hypothesis is:

**Hypothesis 1 (H1).** *Attitude has a positive effect on sustainable waste management behavior.*

### *2.4. Subjective Norm and Sustainable Waste Management Behaviour*

Subjective norms can be described as perceived social pressure to carry out or not carry out specific behavior. In other terms, it is crucial to describe subjective norms as an individual's interpretation of behavior that the other person(s) needs to act out or be involved in. [51]. Because subjective norms concentrate on expectations that an individual has about how others view their behavior, the colleagues' perceptions refer to waste management activity in the workplace [52]. The relationship between subjective expectations and environmental sustainability has been relatively solid [53]. As regards recycling, various studies have already demonstrated that subjective norms significantly impact an individual's recycling behavior that they deem to be maintained by social groups or some other persons attached to them [15].

Similarly, in his research on recycling, Barr [54] reported that the relationship between both behavior and subjective norms is statistically significant. Sometimes campaigns successfully use subjective conformity norms to influence behavior by implying that the majority mostly expect the performance of a particular behavior [55]. Wan et al. [56] show that family, peers, and neighborhood have a significant effect on SWMB. Previous studies have confirmed that subjective norms are a major driver of recycling behavior [13]. Furthermore, Ramayah et al. [43] illustrated that subjective norms are the most effective recycling behavior factor for HEI students in Malaysia. In addition, Taufique and Vaithianathan [55] noticed that subjective norms have a clear positive influence on behavior but an insignificant relationship with the indirect effect of subjective norms and behavior by behavioral intention yet with a direct effect on intention. Therefore, the researcher posits the following hypothesis:

**Hypothesis 2 (H2).** *Subjective norms have a positive effect on sustainable waste management behavior.*

### *2.5. Perceived Behavioural Control and Sustainable Waste Management Behaviour*

The perceived behavioral control can be described as the sensation that the desired behavior could be implemented according to the perceived ease or complexity of performing that behavior. This variable represents the understanding of how well a person can manage factors that restrict the action required to handle a particular situation [51]. The higher the perceived behavioral control for recycling and friendly environmental behavior, the stronger the individual self-efficacy and the more likely it is that the individual would be interested in recycling [57].

In order to support this point of view, a few research studies have shown that perceived behavioral control often has a direct impact on behavior [13,16] In contrast, it has been found that an individual's behavior regarding minimizing waste at work is entirely estimated by perceived behavioral control [24]. In brief, a sense of empowerment at work is critical to behavioral change in minimizing waste. Organizations must also try to create a feeling of freedom and control among employees regarding sustainable development and implementing affined strategies [58,59].

Thus, the factors that can encourage and motivate the behavior, the ease in conduct, and control over behavior are the main elements of psychological influence [60,61]. Ramayah et al. [43], on the other hand, reported that perceived behavioral control includes two dimensions: inconvenience and recycling costs since they are the main obstacles to recycling behavior. Still, both dimensions do not impact SWMB substantially. Thus, this research concluded that the overall impact of perceived behavioral control on SWMB needed to be examined including other dimensions to eliminate various effects. Accordingly, the following hypothesis was formulated:

**Hypothesis 3 (H3).** *Perceived behavioral control has a positive effect on sustainable waste management behavior.*

On the basis of previous elaboration in the literature review section, the proposed research framework as seen in Figure 1 below:

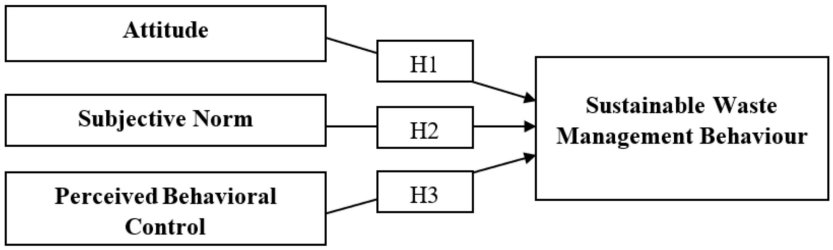


**Figure 1.** Research Framework.

## 3. Materials and Methods

The design of this study is a quantitative approach through survey questionnaire to the top three sustainable universities' academic staff in Malaysia. The sample size was calculated using G-Power version 3.1. This study allowed a model to be tested with three predictors in a sample size of 113. To prevent potential problems caused by the low sample size, this study surveyed 252 academic staff from the top three sustainable universities in Malaysia, namely Universiti Putra Malaysia (UPM), University of Malaya (UM), and Universiti Teknologi Malaysia (UTM). Using a self-administered questionnaire, the data collection consisted of 21 items (see Table 1) collected through a convenience sampling method.

**Table 1.** Summary of construct, items, code and source.

| Construct | Items and Code | Source |
| --- | --- | --- |
| Sustainable Waste Management Behaviour (SWMB) | To reduce environmental impact, I reduce material usage by:<br>Using double-sided printing. (RD1)<br>Going paperless. (RD2)<br>Using green bags. (RD3) | Mactavish (2009); Wee et al., (2017) |
| | I reuse:<br>Paper. (RU1)<br>Plastic bags. (RU2)<br>I use reusable mugs. (RU3) | Mactavish (2009); Coelho et al. (2017) |
| | I recycle:<br>Paper and paper products. (RC1)<br>Cans and aluminum/metal recipients. (RC2)<br>Toner cartridges. (RC3)<br>Plastics. (RC4)<br>Glass (RC5) | Mactavish (2009); Coelho et al. (2017) |
| Attitude (ATT) | I think practicing sustainable waste management is favorable. (ATT1)<br>I think practicing sustainable waste management is a good idea. (ATT2)<br>I think practicing sustainable waste management is positive. (ATT3) | Maichum et al. (2016) |
| Subjective Norm (S.N.) | My family think that I should practice sustainable waste management. (SN1)<br>My colleagues think that I should practice sustainable waste management on campus. (SN2)<br>Most people who are important to me think that I should participate in sustainable waste management activities on campus. (SN3) | Maichum et al. (2016) |

**Table 1.** *Cont.*

| Construct | Items and Code | Source |
| --- | --- | --- |
| Perceived Behavioral Control (PBC) | The decision to engage myself in campus sustainability is completely up to me. (PBC1)<br>For me, to practice waste management at my workplace would be an easy task. (PBC2)<br>I have complete control in deciding whether or not to practice sustainable waste management. (PBC3)<br>If I wanted to, I could manage sustainable waste management on campus. (PBC4) | Karim Ghani et al. (2013) |

This study's measurement items have been adapted from previous research to assess this study's constructs. It assesses SWMB using 11 items covering 3R practices. 11 items were categorized into reducing, reuse, and recycle. A seven-point Likert scale (very seldom (1) to very often (7)) was used to measure the 11 items. The items for this construct were adapted from [62–64]. The other remaining constructs were surveyed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Three items for attitude towards SWMB variable and three items for subjective norm variables were adapted from [65]. As the last construct and remaining variable, 4 items for the perceived behavioral control construct were adapted from [66].

The questionnaire included a demographic part to obtain the respondents' demographic characteristics, including gender, age, marital status, nationality, years in the institute's academic field, and name. The data were analyzed using descriptive statistics, involving the frequency and percentage, using SPSS-25. In addition, this study also conducted an inferential test by using a structural equation model with the partial least square method using SmartPLS 3.2.8 software. SPSS version 25 was used to analyze the respondents' demographic data, and SmartPLS 3.2.8 was used to analyze the proposed model's measurements and structural models. Using PLS-SEM, this research was to analyze the proposed theoretical constructs because it is generally agreed that it is better suited for theory formulation and analysis of relationships between latent variables [9,67].

## 4. Results

### *4.1. Respondents' Demographic Profiles*

The demographic characteristics of the respondents are presented in Table 2. As per the table, most of the respondents were female. 54.4% (n = 137) of respondents were female, and the remainder 45.6% (n = 115) were male. Table 1 shows that the largest group by age consisted of those aged between 40 and 44 (29.8%, n = 75). The next largest group of respondents by age consisted of those aged between 30 to 34 years (18.7%, n = 47), and the smallest group by age consisted of respondents aged between 55 and above (1.6%, n = 4). Overall, it is evident from the data that there was a good mixture of respondents by age. It can be found from the marital status of the respondents that most people were married (71.8%, n = 181), while 27.4%, (n = 69), and 0.8%, (n = 2), were single or separated. Regarding the respondents' nationality, Malaysians comprised the vast majority (98.4%, n = 248) and non-Malaysians the remainder (1.6%, n = 4).

The population of this study came from more than one university. The number of academic staff in each university is shown in Table 3. Most of the participants were from UM (38.1%, n = 96), followed closely by UTM (32.5%, n = 82), and UPM (29.4%, n = 74). Regarding the years of experience of participants in their academic fields, the data showed that those with 1 and 5 years of experience were 34.5% (n = 87), while those with between 6 and 10 years of experience were 31% (n = 78). These categories together constituted the largest group in terms of work experience. The smallest group by years of experience consisted of academic staff with less than 1 year of experience (8.3%, n = 21). The rest of

the respondents had either 11–15 years of experience (12.3%, n = 31) or above 15 years of experience (13.9%, n = 35) in their field.

**Table 2.** Respondents' profile.

| Description | Freq. | % | Description | Freq. | % |
|---|---|---|---|---|---|
| Gender | | | Nationality | | |
| Male | 115 | 45.6 | Malaysian | 248 | 98.4 |
| Female | 137 | 54.4 | Non-Malaysian | 4 | 1.6 |
| Age | | | Years in Academic Field | | |
| Below 25 | 27 | 10.7 | Less than 1 year | 21 | 8.3 |
| 25–29 | 25 | 9.9 | 1–5 years | 87 | 34.5 |
| 30–34 | 47 | 18.7 | 6–10 years | 78 | 31.0 |
| 35–39 | 30 | 11.9 | 11–15 years | 31 | 12.3 |
| 40–44 | 75 | 29.8 | Above 15 years | | |
| 45–49 | 38 | 15.1 | | | |
| 50–54 | 6 | 2.4 | | | |
| 55 and above | 4 | 1.6 | | | |
| Marital Status | | | Name of Institute | | |
| Single | 69 | 27.4 | UPM | 74 | 29.4 |
| Married | 181 | 71.8 | UM | 96 | 38.1 |
| Separated | 2 | 0.8 | UTM | 82 | 32.5 |

**Table 3.** The results of construct validity and reliability.

| Construct | Code | Factor Loading | CR | AVE |
|---|---|---|---|---|
| Attitude (ATT) | ATT1 | 0.917 | 0.936 | 0.831 |
| | ATT2 | 0.908 | | |
| | ATT3 | 0.909 | | |
| Subjective Norm (SN) | SN1 | 0.896 | 0.923 | 0.800 |
| | SN2 | 0.917 | | |
| | SN3 | 0.870 | | |
| Perceived Behavioral Control (PBC) | PBC1 | 0.848 | 0.876 | 0.641 |
| | PBC2 | 0.808 | | |
| | PBC3 | 0.885 | | |
| | PBC4 | 0.638 | | |
| Reduce (RD) | RD1 | 0.883 | 0.909 | 0.768 |
| | RD2 | 0.900 | | |
| | RD3 | 0.846 | | |
| Reuse (RU) | RU1 | 0.896 | 0.923 | 0.800 |
| | RU2 | 0.906 | | |
| | RU3 | 0.882 | | |
| Recycle (RC) | RC1 | 0.767 | 0.879 | 0.645 |
| | RC2 | 0.796 | | |
| | RC3 | 0.799 | | |
| | RC4 | 0.849 | | |
| SWMB | (RD) | 0.779 | 0.876 | 0.703 |
| | (RU) | 0.793 | | |
| | (RC) | 0.934 | | |

### *4.2. Assessment of Measurement Model*

The measurement model analysis will cover the internal consistency, indicators reliability, convergent validity, and discriminant validity of the reflective model [67]. Composite reliability (CR) is used for evaluating internal consistency. Further, the indicator loading is to evaluate indicator reliability; average variance extracted (AVE) for the calculation of convergent validity; for discriminant validity, the use of the Fornell–Larcker test, cross-loading and Heterotrait-Monotrait ratio (HTMT) of correlations [68].

The measurement model criteria are: all the item loadings should be more than 0.7 [68,69], the composite reliability (CR) value ought to be 0.7 or greater, whereas the average variance extracted (AVE) must as a minimum be 0.5 [68,70]. However, according to Hair et al. [68], the loadings that are more than 0.6 are also acceptable. The convergent validity replicates if a certain item estimates a latent variable to be measured [69,71]. Besides that, the AVE assesses the measure of change that builds from its markers contrasted and the sum because of estimation mistakes [69,72,73].

Tables 3 and 4 and Figure 2 display the reliability and validity assessment of the measurement model. As a result of these assessments, one item (RC5) was deleted from the recycle constructs due to low factor loadings. The remaining items were retained as the factor loading values were ranged from 0.638 to 0.917, which is acceptable [68]. As the CR values ranged from 0.876 to 0.936 which is above 0.7, while the AVE for all variables ranged from 0.645 to 0.831, these values indicated the measurement model's reliability [72,73]. Furthermore, the measurements' validity was examined through the convergent and discriminant validity of the measurement model. The convergent validity of accepted items with AVE values greater than 0.5, varied between 0.641 and 0.831.

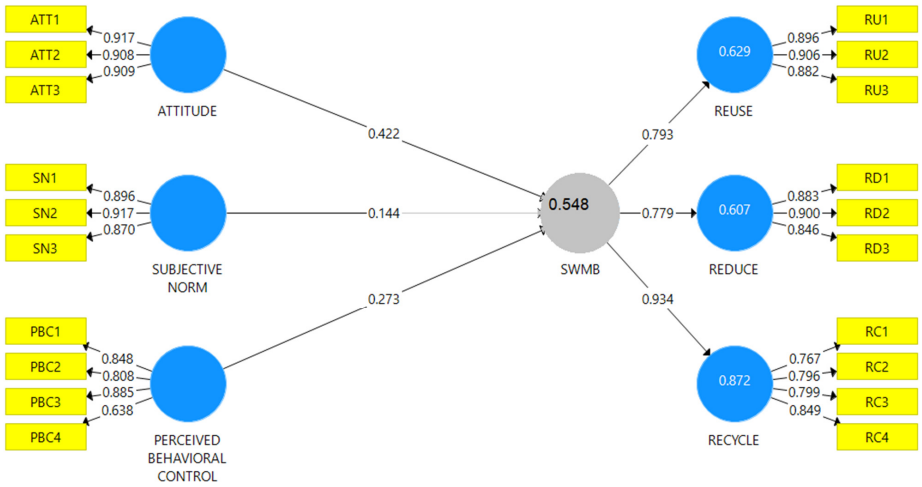


**Figure 2.** Measurement Model Results.

**Table 4.** The result of discriminant validity test using Heterotrait-Monotrait (HTMT) ratio.

| Construct | ATT | PBC | SN | SWMB |
|---|---|---|---|---|
| Attitude (ATT) | | | | |
| Perceived Behavioral Control (PBC) | 0.685 | | | |
| Subjective Norm (SN) | 0.843 | 0.706 | | |
| Sustainable Waste Management Behaviour (SWMB) | 0.769 | 0.702 | 0.704 | |

Note: Background colour is necessary in matrix form.

Discriminant validity is verified if the item loads more on its construct than in other structures. Hence, the researcher assessed discriminant validity through the HTMT ratio [74]. The HTMT values should be less than the necessary value of Kline [75,76] at 0.84 or [77] at 0.90, respectively. Thus, Table 4 reveals that the correlation scores among each construct and the rest of the constructs are greater and indicates that all constructs were acceptable and met discriminant validity. Therefore, it can be decided as the measurement model of this study is reliable and valid.

### *4.3. Assessment of Structural Model*

This study's structural model evaluated the fundamental constructs' model relations by analyzing path coefficients, t-statistics, p-value, and variance. Path significances were estimated via the bootstrapping method using 252 cases and 5000 resamples at the chosen 5% significance level. The predicting power of the proposed model has been determined via the hypothesis test. The summary of the analysis results is presented in Table 5 below. Based

on Figure 2 and Table 5, the SWMB $R^2$ value (0.548) showed that attitude, subjective norms, and perceived behavioral control could determine the variance amount of SWMB. $R^2$ reflects the sum of variation in endogenous constructs clarified by all associated exogenous constructs [67,78]. This research followed the rule of thumb of Cohen (1988) that considered $R^2$ to be high, moderate, and low, with rates of predictive accuracy of 0.26, 0.13, and 0.02. According to Cohen [79], this study's $R^2$ values are high since it is above 0.26.

**Table 5.** The result of hypotheses testing.

| Hypothesis | | B | S.E. | T | LL | UL | VIF | $R^2$ |
|---|---|---|---|---|---|---|---|---|
| H1 | ATT- > SWMB | 0.422 | 0.070 | 6.065 *** | 0.305 | 0.533 | 2.430 | |
| H2 | SN- > SWMB | 0.144 | 0.064 | 2.248 ** | 0.040 | 0.250 | 1.705 | 0.548 |
| H3 | PBC- > SWMB | 0.273 | 0.054 | 5.029 *** | 0.187 | 0.365 | 2.513 | |

Note: ***, ** is significant at the level of 1%, 5%.

Based on Table 5, the path between attitude and SWMB as shown has a significant positive relationship with a medium effect size ($\beta = 0.422$, $t = 6.065$, $p < 0.01$, $f2 = 0.162$), which is supportive of H1. On the other hand, H2 is also supported but there is no effect size of the coefficient path from subjective norm to SWMB ($\beta = 0.144$, $t = 2.248$, $p < 0.05$, $f2 = 0.018$) and the path from PBC to SWMB is also positively significant with low effect size ($\beta = 0.273$, $t = 5.029$, $p < 0.01$, $f2 = 0.097$). This research also checked variance inflation factors (VIF), to report the multicollinearity problem. The VIF values were below 3.3 for all variables and suggested that multicollinearity was not serious [80]. Eventually, this study would be assessed with the predictive relevance (Q2) of the path model. It suggests that if the Q2 value is greater than zero, the path model is relevant to certain constructs [68]. The analysis results predicted the Q2 values of research which were 0.278, which is higher than 0, suggesting the variables' predictive relevance (i.e., attitude, subjective norms, and perceived behavioral control) on SWMB among academic staff.

## 5. Discussion

The researcher has observed that the TPB offers a valuable framework for interpreting and describing SWMB. The findings revealed that attitude (H1), subjective norms (H2), and perceived behavioral control (H3) had a positive and significant impact on SWMB. Such results confirm previous researches suggesting that attitudes [15,16,50], subjective norms [50,55], and perceived behavioral control [12,13,15,23] have a significant effect on SWMB. This finding is one of this study's main contributions as it shows that these variables directly affect and predict academic staff engagement in SWMB [9,81].

The researcher believes that this study contributed theoretically and practically in many ways. Theoretically, the study examined the direct relationships between attitude, subjective norms, and perceived behavioral control with behavior, as mentioned in the literature earlier. However, there is still a lack of studies that examine direct relationships between these variables. According to the author's knowledge, there is a literature gap for academic staff studies based on sustainable waste management and 3R practices. There is a sample of studies carried out in qualitative research for 3R practices [15,42], and when it comes to quantitative research, most studies have focused on recycling behavior [16,27,82–85]. The researcher would like to acknowledge again that this study uses a quantitative research approach to explore all three of the 3Rs to study academic staff's waste management behavior on the campus.

Practically, this study's findings will have significant implications for researchers, universities, businesses, decision-makers, governments, society, and the environment. This research presented academic behavior in the area of workplace waste management with clear and enhanced understanding. Scientists and researchers are expected to be highly interested in this research, as it will lead other researchers in this field through literature review. The goal is to help researchers who wish to perform further SWM studies on campus by serving as both a reference source and a foundation.

As for the limitations, this study collected data only from academic staff working in the top three green universities in Malaysia, according to UiGreenmetric 2018, UM, UPM, and UTM. It could be argued that other universities in Malaysia or other developing countries might have different SWMB. Therefore, it would be useful to compare other universities in Malaysia to reveal the SWMB of Malaysian academic staff and reveal if cultural differences affect SWMB across nations where it comes to other countries. Furthermore, a contrast of results of studies in other developing countries would indicate whether the findings are consistent or not.

## 6. Conclusions

This study focused on investigating the influence of attitude, subjective norms, and perceived behavioral control on SWMB. Although the impact of attitude, subjective norms, and perceived behavioral control on green behavior have been studied in the past the impact of these variables on SWMB remains unclear. To this end, this study proposed a model based on the TPB theory to analyze the impact of attitude, subjective norms, and perceived behavioral control on SWMB. Hence, this study fills in the literature gap and extends the TPB theory to the context of SWMB.

With regard to the study questions and objectives, it was found that attitude, subjective norms, and perceived behavioral control have positive influence on SWMB. Based on these results, university recycling planners need to design recycling strategies that will increase the intrinsic and extrinsic incentives for academics to perform SWMB. For example, universities may wish to consider using multimedia or digital media that visualize basic recycling steps and the benefits of doing so in order to enable academics to learn about the benefits of recycling in the workplace and thereby enhance not only their environmental knowledge, but also their attitude. In addition, it would be worthwhile setting up drop-off points for waste throughout the campus that are visible to academics and other stakeholders and/or appointing responsible persons to collect the waste from the academics' workplace once a month or week in order to make recycling more convenient and also to motivate nonrecyclers to recycle.

The findings of this study also offer some practical guidelines that HEIs may wish to follow to promote recycling on campus among key stakeholders. For instance, in order to encourage academics or other stakeholders to move towards a sustainable future, policy makers or government could initiate the opening of a hub or center on campus to collect recyclable items together with a reward program as an incentive. For instance, after building a center for collecting items for recycling each person gets points according to the weight of the items they bring to the center. Then certain rewards could be given to the participants on an annual or semi-annual basis, according to the points gained. To attract more academics and staff to participate, the rewards could be in the form of an allowance to encourage them to make SWMB a habit that they practice everywhere.

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