Determinants of undergraduate recycling behavior: an extended model of the theory of planned behavior

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Article Info

ABSTRACT

Promoting positive recycling behavior should be part of the higher educational objectives. The main purpose of this research is to identify the determinants of recycling behavior among undergraduates, to assess the differences in undergraduates' recycling behavior based on their demographic, and to explore the relationship between the determinants and behavior of recycling. The research extended the theory of planned behaviors (TPB) by adding environmental awareness as a determinant of recycling behavior in addition to attitude toward recycling, subjective norm of recycling, and perceived behavioral control over recycling. The research population comprises management programs undergraduates from a public university in Malaysia. A total of 259 responses were collected via structured questionnaire. Descriptive and Pearson correlation analysis results suggested that respondents strongly agreed that undergraduates' attitudes and environmental awareness are the most important determinants of recycling behavior, and both determinants are strongly correlated with recycle behavior. The analysis of variance (ANOVA) analysis result also reveals that there is significant difference on recycle behaviors among undergraduates based on year of study, with year 4 undergraduates exhibiting the highest recycling behavior. This finding suggests that the green campus initiatives taken by the university are effective. Additionally, extending the TPB model by adding awareness implies a theoretical contribution of this research.

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1. INTRODUCTION

Considering the swift urbanization and the anticipated rise in global annual waste production to 3.4 billion tons within the next three decades due to population growth, emphasizing the promotion of recycling behaviors becomes essential [1]. On a broader scale, promoting individual recycling behavior has a favorable and far-reaching impact, as it indirectly contributes to environmental care. Public universities in Malaysia are envisioned as primary hubs for innovation and environmental education, fostering changes in human behavior towards sustainability [2]. They serve as crucial platforms for promoting the significance and impact of recycling and play a vital role in addressing global environmental challenges [3]. Public universities in Malaysia have proactively implemented green campus initiatives to tackle issues like global warming and promote a culture of sustainable development among students. Some universities, such as

Universiti Sabah Malaysia, Universiti Malaya, and Universiti Kebangsaan Malaysia, have earned recognition as green institutions, underscoring their dedication to sustainable practices, including recycling [4]. These universities serve as platforms for instilling proper waste disposal habits, providing students in their twenties with the opportunity to understand the significant impact of recycling on both humanity and ecosystems.

Recycling behavior can be seen from various perspectives on how an individual practices recycling. It is described as a motivation that acts as a human drive to perform tasks such as recycling [5]. This behavior serves as a gauge of an individual's commitment to environmental conservation and reflects their values. Thoo *et al.* [6] defined recycling behavior as individuals' initiative to minimize the use of non-renewable resources, engage in product reuse, and participate in recycling when products reach the end of their useful life, contributing to the creation of new items. Meanwhile, other research [7] viewed recycling behavior as the attributes that influence individuals' willingness to incorporate recycled products into daily life, contributing to the sustained practice of waste recycling. Additionally, Ali *et al.* [8] suggested that recycling behavior attributes involve individuals' efforts in segregating recyclables according to predetermined types, promoting recycling to others, and ensuring recyclables are clean before placing them in recycling bins.

The Malaysian Government's 3R (reduce, reuse, and recycle) approach, which emphasizes waste reduction, reuse, and recycling, is widely recognized and advocated at all societal levels, including educational institutions [9]. However, the higher education institution (HEI) sector faces substantial challenges in adopting 3R practices, particularly at the university level, where adherence to 3R and participation in waste minimization campaigns have received less than satisfactory responses [10]. The relatively low involvement rate, particularly in waste separation and recycling, poses a significant threat to effective waste management and environmental sustainability. In conjunction with the Malaysian Government's 3R program, this research views recycling behavior as individuals' initiatives and efforts in practicing waste minimization by focusing on reducing the use of non-recyclable materials and reusing and recycling recyclable materials. Most individuals recognize that recycling can positively contribute to the environment through individual behavior. Furthermore, attitude is the second most influential determinant factor that drives students to adopt recycling behavior [6].

The university serves as a platform for instilling proper waste disposal habits, providing students in their twenties with the opportunity to understand the significant impact of recycling on both humanity and ecosystems. The relatively low involvement rate, particularly in waste separation and recycling, poses a significant threat to effective solid waste management [11]. For instance, Universiti Teknologi Malaysia has implemented various measures to encourage recycling practices among students, including the prohibition of polystyrene and plastic bag. Additionally, the 3R approach, emphasizing waste reduction, reuse, and recycling, is widely recognized and advocated for at all societal levels, including educational institutions [9].

Recycling behavior is one of the main drivers for environmental sustainability [12]. Promoting positive recycling behavior should be part of the national educational objectives, including those of HEIs in Malaysia. Empirical reviews suggest that previous research on recycling has tended to explore determinants for recycling behaviors based on the theory of planned behavior (TPB). TPB has emerged as a prominent social psychological model extensively employed as a reference in research endeavors [13], [14]. Its utility spans various domains, including the elucidation and anticipation of behavioral intentions in areas like waste recycling [15] and waste reduction [16]. The concept of TPB views an individual's behavioral intention as influenced by three determinants: i) the individual's attitudes or beliefs toward the behavior; ii) individual subjective norms or normative beliefs influenced by social pressure; and iii) individual perceived behavior control or perceived ability to perform the behaviors.

The TPB offers the flexibility to include extra variables and make model modifications, enhancing its adaptability [17]. This research argues that, in addition to behavioral beliefs, normative beliefs, and control beliefs, the study of recycling behavior should also include individuals' environmental awareness. Environmental awareness refers to an individual's consciousness or recognition of the importance of environmental sustainability, which is different from the attitude toward recycling that refers to an individual's feelings and beliefs about recycling [10]. Hence, this research explores four determinants of recycling behavior: attitude toward recycling, subjective norm of recycling, perceived behavioral control over recycling, and environmental awareness. As such, this study aims to achieve three research objectives (ROs): i) to identify the important determinants for undergraduates recycling behavior (RO1); ii) to examine difference in undergraduates recycling behavior based on demographic (RO2); and iii) to investigate the relationship between determinants and recycling behavior (RO3).

This research adopts the three common beliefs outlined in the TPB as determinants for recycling behaviors: attitude toward recycling, subjective norm of recycling, and perceived behavioral control on recycling. Additionally, this research extended the TPB concept by adding environmental awareness as a determinant of recycling behaviors [18], [19]. Consequently, the research framework for this study consists of four recycling behavior determinants, as shown in Figure 1. In line with the research framework, four

hypotheses are developed: i) attitude toward recycling is positively related to recycling behavior (H1); ii) subjective norm of recycling is positively related to recycling behavior (H2); iii) perceived behavioral control on recycling is positively related to recycling behavior (H3); and iv) environmental awareness is positively related to recycling behavior (H4).

The novelty of this study lies in its extension of the TPB by incorporating environmental awareness as a key determinant of recycling behavior among undergraduates in a Malaysian public university. While previous research has predominantly focused on attitudes, subjective norms, and perceived behavioral control, this study highlights the critical role of environmental awareness in shaping recycling behavior. By using a structured framework and empirical analysis, the study provides new insights into the importance of environmental consciousness in promoting sustainable waste management practices.
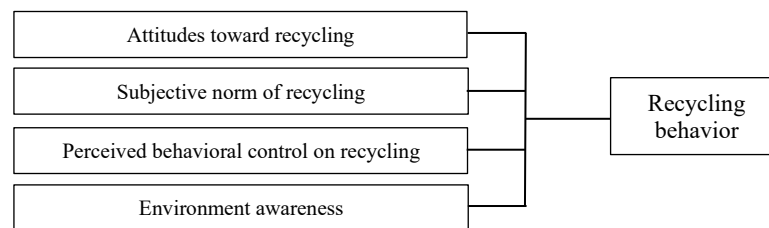

Figure 1. Extended model of the TPB for recycling behavior

2.   METHOD
2.1. Population and sampling
The population for this research comprises management program undergraduates from a public university in Malaysia. There are 791 undergraduates in total from the programs of Technology Management, Marketing, and Accounting. The location of data collection was conduct at Universiti Teknologi Malaysia (UTM), Skudai campus, Johor Bahru, Malaysia. The sample size of 260 was derived based on the Krejcie and Morgan sampling table. A study by Kaur *et al.* [20] revealed that research involving undergraduates in Malaysia yields an average response rate of 47%; hence, the targeted sample size for this study is 553 undergraduates (i.e., 260/0.47). The 553 targeted samples were stratified based on the programs of study, with the stratified sampling size for each program shown in Table 1. Samples for each program were selected based on the random sampling method. Following dividing the population into these strata, the researcher randomly selects a proportionate sample. As stated by Saavedra-Nieves [21], stratified sampling is choosing samples at random from each layer of the parent population rather than from the total population by first dividing the population into several categories or levels. In this study, data from respondents were gathered through the distribution of questionnaires among the students in Faculty of Management in UTM.

2.2. Research instrument
The research was quantitative-based. A structured questionnaire, adopted from [7], [8], [22], was used to collect data from the respondents. The questionnaire consists of 36 questions divided into three parts, namely Part A, Part B, and Part C. Part A collects respondents' demographic data, including type of program and year of study. Part B gathers respondents' perceptions regarding the four recycling behavior determinants, while Part C assesses the level of recycling behavior.

2.3. Analysis tools
The validity and reliability of the data were verified via normality test and Cronbach alpha test. Data from Part B of the questionnaire were analyzed using descriptive analysis to address RO1. Meanwhile, an analysis of variance (ANOVA) test was applied to assess the differences in recycling behavior based on respondents' demographics, utilizing data collected from Parts A and C of the questionnaire. Additionally, the correlation between the determinants (Part B) and recycling behavior (Part C) was tested using the Pearson correlation test.

Table 1. Population and sample size

Programs	Population size	Sample size
Technology management	278	194
Marketing	235	164
Accounting	278	194
Total	791	553

3. RESULTS AND DISCUSSION

3.1. Data screening and missing value

The data collection phase was carried out from September 2023 to January 2024. The research team collected 259 returned questionnaires. Among the respondents, 91 (or 35.1%) were marketing program undergraduates, 86 (33.2%) were technology program undergraduates, and 82 (31.7%) were accounting program undergraduates. Data screening and missing value analysis results suggested that all 259 questionnaires could be used for further analysis.

3.2. Normality and reliability test

Skewness and kurtosis values for the continuous data collected from Part B and Part C of the returned questionnaires were calculated using SPSS to assess the normality of the data. The analysis revealed that the skewness values for the data set ranged from -1.242 to -0.355, while the kurtosis values ranged from 0.173 to 1.007. These values fall within the acceptable range of +/-2, indicating that the continuous data collected are normally distributed [21]. Furthermore, Cronbach's alpha values for the continuous data set ranged from 0.677 to 0.798, which are above the threshold value of 0.6. Therefore, the data collected can proceed for parametric descriptive and inferential tests.

3.3. Results and discussion for RO1

RO 1 is to identify the importance level of undergraduates' recycling behavior determinants. The central tendency of the data collected from Part B of the questionnaires was analyzed via descriptive analysis to generate the mean score for each determinant. The importance level for each determinant was judged based on the importance level scale proposed by Kaur et al. [20], which suggested that a mean score of 3.5 to below 4.5 indicates that respondents regard the determinant as important, while a mean score of 4.5 and above indicates that the determinant is very important. The results of the descriptive analysis and importance levels are summarized in Table 2.

Findings from this research suggest that undergraduates' understanding of environmental awareness, is the most important determinant for promoting recycling behavior among undergraduates. This finding aligns with previous studies, which suggested that environmental awareness is the main driver for improving recycling behaviors [23] and the primary factor influencing the decision to recycle [18]. Environmental awareness involves individuals' understanding, care, and responsibility for the environment [24]. It promotes individuals to engage in recycling activities, and playing a crucial role in fostering a pollution-free and environmentally friendly setting [25]. Awareness of the importance of an environmentally friendly setting subsequently stimulates efforts to reduce waste and pollution and conserve natural resources [26] leading to positive recycling behavior [9]. It was emphasized that general attitudes and beliefs do not directly affect a particular behavior unless they are precisely tied to the environment [27].

Respondents also perceived that attitude toward recycling is a very important determinant of recycling behaviors. Attitude is an element of an individual's belief and evaluation of certain behaviors. It is an important behavioral component that needs to be emphasized to promote specific behaviors [9]. Attitude can be used to predict and describe human behavior [9]. Recycling attitude refers to an individual's evaluation of the outcomes and value of performing recycling activities. A study by Asri and Daud [28] revealed that attitudes toward recycling have a positive impact on recycling behaviors. This is in line with the findings of Juliana et al. [9] emphasizes that attitude is a person's ideas and assessments about behaviors. Huang [29] also notes that individuals with a heightened environmental consciousness often seek information through public relations channels. This finding is consistent with the study [30], which states that attitude is an element of an individual's belief and evaluation of certain behaviors. It is an important factor that needs to be emphasized in promoting specific behaviors, such as recycling behavior [11].

Table 2. Descriptive analysis result

Determinants	Mean	Level
Environmental awareness	4.7266	Very important
Attitudes toward recycling	4.6680	Very important
Perceived behavioral control on recycling	4.1135	Important
Subjective norm of recycling	4.0664	Important

3.4. Results and discussion for RO2

RO2 is to examine if there is any difference in undergraduates' recycling behavior levels based on their demographics. The demographic data collected in Part A of the questionnaire included respondents' age, program of study, year of study, ethnicity, and religion. ANOVA analysis was conducted with

undergraduates' recycling behavior levels assigned as the dependent variable and demographic variables as factors or categorical variables. The p-value for Levene's test for all factors is greater than 0.05, indicating that variances for all factor levels are equal, validating the ANOVA analysis for interpretation. The analysis results of the ANOVA are summarized in Table 3.

In Table 3, the p-value for all demographic factors is greater than 0.05, except for the factor year of study. This suggests that at the 95% confidence level, there is no significant difference in undergraduates' recycling behavior levels based on age, program of study, ethnicity, and religion. However, there is a significant difference in undergraduates' recycling behavior levels based on their year of study. Figure 2 shows the descriptive analysis results of undergraduates' recycling behavior based on their year of study. The data indicates an increasing trend in recycling behavior from year 1 to year 4, with year 4 undergraduates exhibiting the highest level of recycling behavior. Public universities in Malaysia have proactively implemented green campus initiatives to tackle challenges like global warming and promote a culture of sustainable development among students [7], [9]. The finding from ANOVA analysis also aligns with previous studies [6], [31], which revealed that on top of play a vital role in addressing global environmental challenges, university serve as crucial platforms for promoting recycling behavior among undergraduate.

Table 3. ANOVA analysis result

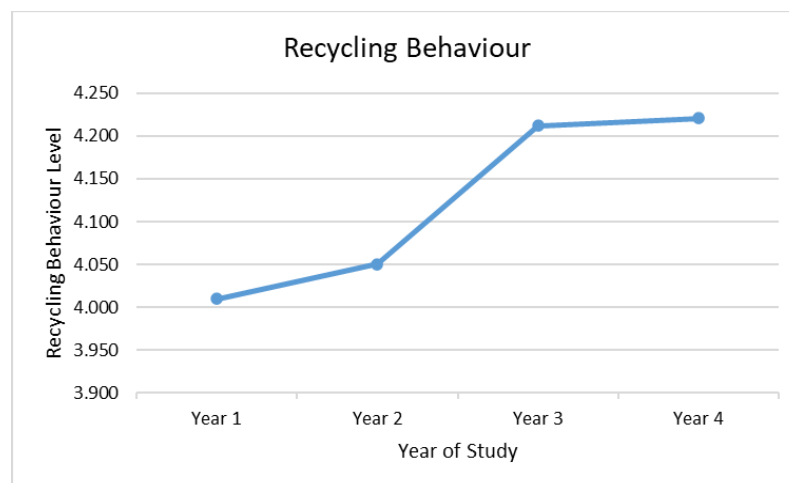| Demographic factor	p-value	Result
Age	0.292	No significant difference
Program	0.834	No significant difference
Year of study	0.013	Significant difference
Ethnicity	0.484	No significant difference
Religion	0.992	No significant difference

Figure 2. Undergraduates' recycling behavior based on year of study

3.5. Results and discussion for RO3

RO3 is to investigate the relationship between the determinants and recycling behavior and to test hypotheses H1 to H4. The bivariate correlation between the determinants and recycling behavior was analyzed using the Pearson correlation test. The results of the analysis are shown in Table 4.

Referring to Table 4, the p-value for all four hypotheses is less than 0.05, suggesting that the relationships between all four determinants (attitude toward recycling (H1), subjective norm of recycling (H2), perceived behavioral control on recycling (H3), and environmental awareness (H4)) and recycling behavior are significant. The results of the correlation coefficients revealed that: attitude toward recycling ($r=0.689$) and environmental awareness($r=0.685$) are strongly correlated with recycling behavior. On the other hand, subjective norm of recycling ($r=0.287$) and perceived behavioral control on recycling ($r=0.247$) also have significant correlation with recycling behavior. The coefficient correlation r-value is significant at 0.10 or higher together with 0.05 confidence level [20]. The Pearson analysis results echo the findings of previous studies and RO1, indicating that both attitude toward recycling [32] and environmental awareness [33] are not only perceived by respondents as very important determinants for practicing recycling behavior, but both determinants are also significantly correlated with recycling behavior.

Table 4. Pearson correlation analysis result

Hypothesis	Coefficient of correlation (r)	p-value	Result
H1	0.689** (Strong)	<0.001	Significant
H2	0.287** (Weak)	<0.002	Significant
H3	0.247** (Weak)	<0.003	Significant
H4	0.685** (Strong)	<0.004	Significant

**correlation coefficient is statistically significant at the 0.05 level

4. CONCLUSION

The TPB is a prominent theory widely adopted in research related to behavioral intentions. This research argues that for the study of recycling behavior, in addition to the common behavioral beliefs, normative beliefs, and control beliefs outlined in TPB, awareness about the importance of environmental sustainability could be another determinant for promoting recycling behavior. Findings from the research revealed that environmental awareness is the most important determinant as perceived by respondents (RO1). Additionally, environmental awareness is also significantly correlated with recycling behavior (RO3). Practically, the research findings imply that to promote recycling behavior among undergraduates, the most important groundwork is to create awareness about the importance and need for recycling, as well as awareness of individual roles and contributions toward environmental sustainability. Environmental awareness is a critical component of environmental protection and is an important focus area in protecting nature and respecting the earth's ecology.

HEIs play a vital role in addressing global environmental challenges. Public universities in Malaysia have proactively implemented recycling and green campus initiatives to tackle global warming and promote a culture of sustainable development among undergraduates. Findings from the ANOVA analysis (RO2) indicate a positive outcome, showing that undergraduates' recycling behavior levels increased significantly from year 1 to year 4 of their studies. This finding suggests that the green campus initiatives taken by the university are effective and could practically be implemented in other HEIs within Malaysia.

Attitude toward recycling is suggested by respondents as the second most important determinant (RO1) and is also significantly correlated with recycling behavior (RO3). Awareness relates to an individual's understanding, while attitude reflects the individual's belief. Empirical findings suggest that within the framework of the TPB, attitude or behavioral belief is commonly viewed as the most important factor related to behavioral intention. However, a group of researchers argue that behavioral belief is driven by an understanding of the importance of the behavior. Extending the TPB model by adding awareness implies a theoretical contribution of this research. Further research could explore awareness as a mediator to verify its role in influencing behavioral intention.

AUTHOR CONTRIBUTIONS STATEMENT

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Lim Kim Yew		✓		✓	✓				✓					
Ong Choon Hee	✓					✓		✓		✓				
Goh Chin Fei				✓	✓					✓	✓			

C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

CONFLICT OF INTEREST STATEMENT
Authors state no conflict of interest.

DATA AVAILABILITY
The data that support the findings of this study are available from the corresponding author [TOK], upon reasonable request.

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