



*Research article*

## **Theory of planned behavior to understand pro-environmental behavior among Universiti Malaya students**

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**Abstract:** Due to industrialization and urbanization, the world is experiencing environmental degradation at an alarming rate. Irresponsible human behaviors have caused environmental concerns that are drastically affecting the natural ecosystem. To ensure a sustainable future for all, pro-environmental behavior should be practiced among university students to protect and conserve the environment. The objective of the study is to determine the key factors affecting pro-environmental behavior among Universiti Malaya (UM) students. A theoretical framework, theory of planned behavior (TPB), was introduced to examine whether environmental attitudes, subjective norms and perceived behavioral control have significant effects on intention and on pro-environmental behavior. Data collected from 394 respondents via online questionnaire was then examined using Statistical Package for the Social Sciences (SPSS). The results show that environmental attitude, subjective norm and perceived behavioral control have significant impact on the intention to adopt pro-environmental behavior among UM students. The results indicate that perceived behavioral control did not significantly influence pro-environmental behavior among UM students. The study also revealed that no significant difference was shown in gender and study background towards pro-environmental behavior. These findings assist higher education institutions in formulating policies, strategies and planning to enhance environmental behavior among the students. They also offer new insights and comprehensive information for researchers in conducting research related to environment behavior.

**Keywords:** environment; behavior; socio-environmental science; perceived behavioral control

## 1. Introduction

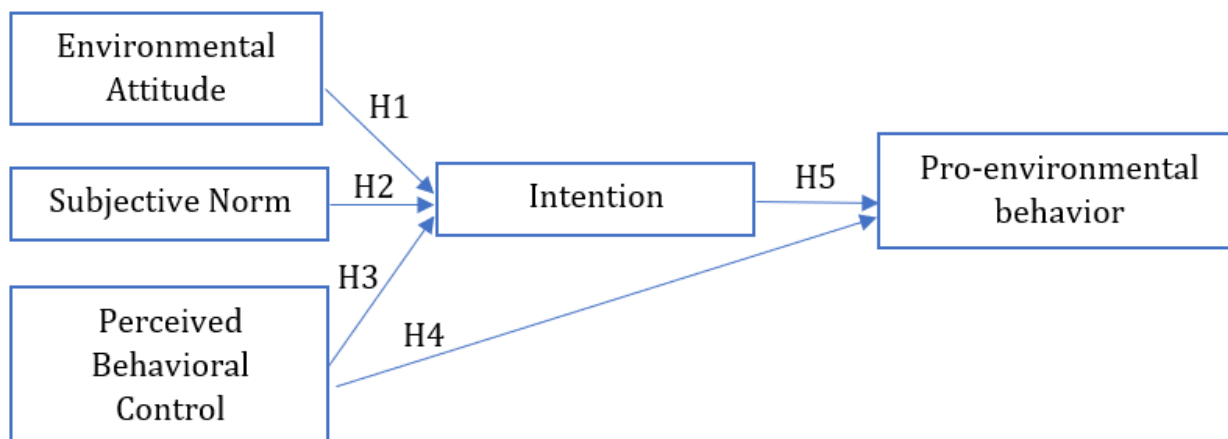
Over the past few decades, environmental degradation has emerged as a serious global issue. Overpopulation, urbanization, industrialization and overconsumption of resources are all possible root causes of environmental changes [1,2]. With the growing population, demand for food, water, energy and housing increases as people have to exploit resources for their survival, posing detrimental effects on the ecological system. It is now evident that climate change is occurring across many countries and millions of people are suffering from the effects of the disastrous event. According to Intergovernmental Panel on Climate Change (IPCC) in 2023, human activities have become the predominant cause of the Earth's warming over the past two centuries, resulting in an average temperature rise of 1.1 °C above pre-industrial levels and leading to more intense and dangerous weather events which cause increased harm to people and the environment [3]. Hence, it is clear that the relationship between humans and the environment is interrelated. People are urged to alter their behavior to minimize negative impacts on the environment.

To encourage environmental behavior, higher education institutions (HEIs) have the responsibility to educate university students on environmental protection and conservation to ensure a sustainable environment for all, since they are the future leaders, policymakers, researchers and professionals [4]. Moreover, young people are the crucial stakeholders because they must deal with all the implications of past and present environmental negligence, and because they act as powerful drivers for behavioral change [5]. Thus, delving deeper into the factors that drive pro-environmental behavior (PEB) among university students becomes a critical element as practical applications in assisting the HEIs to formulate and design effective environmental initiatives to promote behavioral change [6,7]. Furthermore, existing studies have acknowledged that imparting information is insufficient for altering lifestyles and behavioral tendencies [8]. Thus, it is crucial to understand and identify the key beliefs and perspectives that the university students hold to motivate their pro-environmental behavior [9]. To fill this gap, theory of planned behavior (TPB) was used in this study to understand the Universiti Malaya (UM) students' intention to adopt pro-environmental behavior. TPB is the expansion of the theory of reasoned action (TRA) [10]. It asserts that an individual's decision to engage in a particular behavior is driven by logical and reasoned thought processes. According to TPB, one's behavior is directly influenced by intention while intention is affected by three significant factors, which are attitude, subjective norms and perceived behavioral control. Several existing studies have proved that TPB is an extensive and thriving tool to predict and explore the relationship between the main predictors and behavior, especially in the aspect of pro-environmental behavior [6,7,11].

## 2. Materials and methods

### 2.1. Research framework and hypotheses development

Figure 1 illustrates the term's definition and the theoretical framework of TPB in relation to the prediction of pro-environmental behavior among students at UM.



**Figure 1.** Research framework of TPB.

### 2.1.1. Environmental attitude (EA)

Environmental attitude (EA) is explained as the expression of care for the environment or the level of concern regarding environmental issues [9]. In this context, EA refers to the students' subjective tendency to perform actions that aim to protect the environment. To clarify, students will be more likely to possess favorable attitudes towards environmental behavior if they believe that these behaviors result in positive outcomes. Besides, environmental attitude can refer to the individual's subjective tendency towards a specific environmental behavior. Previous findings demonstrate that EA was a significant determinant of pro-environmental behavior [12,13]. Another study also demonstrates that attitude is positively and significantly correlated with the intention to use green products, including recyclable materials, products or services that are environmentally friendly [14]. Thus, this study intends to propose whether:

H1: There is a significant relationship between UM students' environmental attitude and their intention.

### 2.1.2. Subjective norm (SN)

Subjective norm (SN) describes the degree to which an individual is inclined to implement a particular behavior if they are supported or approved by their significant associates or groups, for instance, parents, friends and teachers [15]. In this regard, SN refers to students' intention to perform behavior that improves the environmental conditions to fulfil other's expectations formed by their social circle. Previous research has shown that SN is a major factor in determining the behavioral intention in green purchase behavior [16]. The findings concluded that SN was positively connected with behavioral intention in performing environmental behavior [7,17,18]. Hence, this study proposes to test whether:

H2: There is a significant relationship between subjective norms and intention among UM students.

### 2.1.3. Perceived behavioral control (PBC)

Perceived behavioral control (PBC) can be defined as the perceptions of the people performing a given behavior based on their ability and adequate resources. To clarify, a behavior is more likely to

be performed if sufficient resources and opportunities are available to a person [10,19,20]. In this context, students with abundant resources such as money, time and knowledge tend to exhibit stronger intention to partake in pro-environmental behavior, for instance, participating in recycling activities, using public transport and conserving energy. Several studies have found that PBC exerts a positive influence on individuals' intentions [21–23].

Apart from that, TPB also claims that PBC directly influences one's behavior. Several findings stated that PBC has the greatest influence on pro-environmental behavior [24,25]. Moreover, a previous research revealed a significant and positive association between perceived behavioral control and intention towards students' pro-environmental behavior [7]. Another finding indicated that PBC portrays an essential role in predicting both the intention to buy environmentally friendly goods and actual green behavior [26]. Thus, research hypotheses are postulated as below:

H3: There is a significant relationship between perceived behavioral control and intention among UM students.

H4: There is a significant relationship between perceived behavioral control and pro-environmental behavior.

#### 2.1.4. Intention

Intention is referred to one's willingness and readiness to execute a certain behavior [27]. Generally, a behavior is more likely to be performed if an individual's intention to act is strong. In TPB, intention is a crucial element in determining one's behavior [10,28]. An earlier study conducted has indicated a strong correlation between an individual's intention and their plastic waste segregation behavior among young people [18]. In addition, it is reported that intention is positively correlated with recycling behavior [29]. Therefore, the following research hypothesis is formulated:

H5: There is a significant relationship between UM students' intention and pro-environmental behavior.

#### 2.2. *Improvements and limitations of the theory of planned behavior (TPB)*

The theory of planned behavior (TPB) used in this study is widely used to understand and predict human behavior [28], including inclination towards protecting the environment. TPB model can be an effective tool for understanding and predicting pro-environmental behavior among university students. This information could later be used to develop strategies to promote pro-environmental behavior among students. Over the years, some researchers have improved the TPB model by incorporating new variables such as habit and moral obligation [30]. On the other hand, some advanced TPB have also been developed for a specific type of behavior [16] and tested on various populations [31]. However, some known limitations have also been identified in this study. First, the study only focused on students at one public research university. Future studies could be done to collect data from students from different types of universities including public, teaching and private universities to improve the generalizability of the findings. Second, this study only focused on a few key variables. Future studies should include additional variables as suggested above to gain a better understanding of the pro-environmental behavior. Finally, this study only focuses on using the TPB model. Future studies could use other theories, such as the value-belief-norm theory and the self-congruity theory, to develop a more comprehensive understanding of pro-environmental behavior.

### 2.3. Design and sample size

To identify the ideal sample population size, the Raosoft sample calculator with a margin error of 5% and confidence level of 95% is used [32]. It is a software that calculates the sample size of research or survey. A total of 24872 students enrolled in UM by January 2023, which were comprised of 14564 undergraduate students and 10308 postgraduate students. Referring to the Raosoft sample calculator, a sample size of 379 was determined as the recommended size. For the sampling method, a simple random sampling method was selected to allow every student at UM to have the equal chance of being chosen in answering the questionnaire.

### 2.4. Target population and participant recruitment

In this study, undergraduate and postgraduate students from different faculties in UM are the targeted population. The questionnaire was created using an online form and disseminated to the respondents in the form of an online form and a physical form. The questionnaires were distributed through various online platforms. To receive more responses, questionnaires were then distributed throughout the UM campus, inviting the respondents to scan the provided quick-response code (QR) to complete the questionnaire in physical mode. The collection questionnaires were conducted from March 14 to May 13 in 2023, and a total of 394 valid responses was obtained.

### 2.5. Research instrument

The survey instrument was an adapted questionnaire [7,33,34]. Furthermore, the instrument is composed of six sections: demographic information, environmental attitude, subjective norm, perceived behavioral control, intention and pro-environmental behavior. The final questionnaire comprised of 41 items. The initial section of the questionnaire was composed of six items that inquired about the demographic information, covering aspects such as gender, the year of study, faculty, race, household income and study background. From Section B to Section E, items were assessed using a 5-point Likert-type scale, with response options ranging from “strongly disagree” to “strongly agree” whereas items in Section F were measured with 5-point Likert-type scale from “never” to “always”, to assess the frequency of engaging in pro-environmental behavior among UM students.

### 2.6. Data analysis

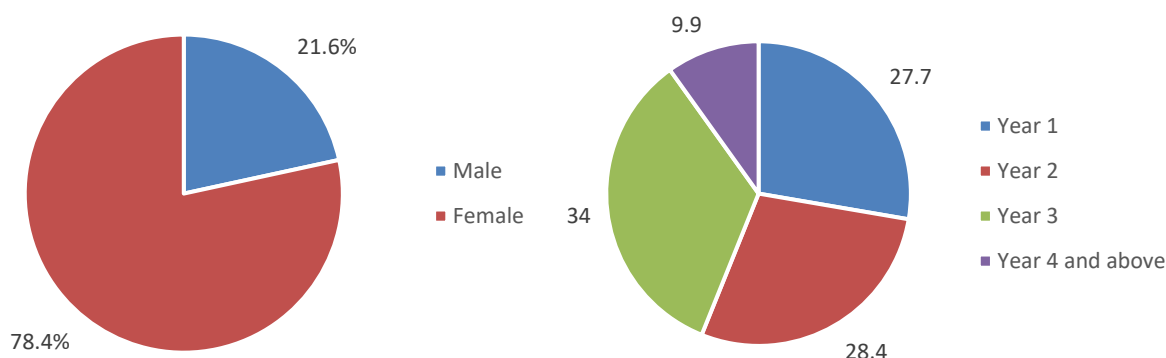
The data was analyzed using SPSS Version 26 software, and the analysis was divided into four sections. The first section included descriptive statistics to provide a comprehensive overview of the respondents' demographic background. The second section examined the relationship between gender and pro-environmental behavior, as well as the relationship between study background and pro-environmental behavior, using an independent sample t-test. In the last part of the statistical analysis, correlation analysis and multiple linear regression tests were conducted. These tests aimed to analyze the correlations and relationships between environmental attitude, subjective norm, perceived behavioral control, intention and pro-environmental behavior.

### 3. Results and discussions

#### 3.1. Descriptive statistics

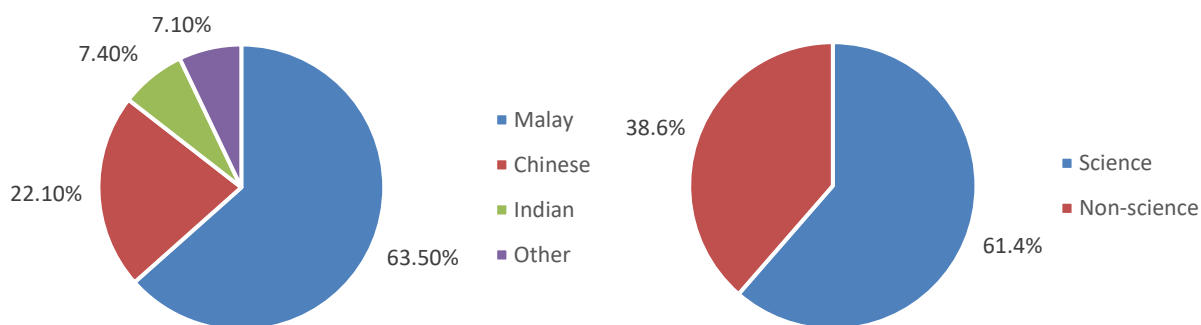
##### 3.1.1. Profile of the respondents

Figure 2 shows that most of the respondents involved in this survey are female (78.4%) compared to male (21.6%). In terms of the year of study, 27.7% respondents are in their first year, 28.4% respondents are in their second year, 34% respondents are in their third year and 9.9% respondents are in their fourth year and above based on Figure 3. Figure 4 denotes that the majority of the participants answering the survey are Malays (63.5%), followed by Chinese (22.1%), Indian (7.4%) and other races (7.1%), including Bumiputera, Korean, German, Bangladeshi and Kenyan. Of 394 respondents, 61.4% respondents originate from the science background while 38.6% respondents are coming from the non-science background in Figure 5.



**Figure 2.** Gender of the respondents.

**Figure 3.** Year of study.



**Figure 4.** Gender of the respondents.

**Figure 5.** Respondents' study background.

### 3.2. Sample T-test analysis

#### 3.2.1. Relationship of pro-environmental behavior towards socio-demographic variables

Table 1 indicates that there was no significant difference between pro-environmental behavior and gender ( $t=-1.883$ ,  $df=390$ ,  $P \geq 0.05$ ). This result aligns with previous studies conducted [11,35]. However, the finding is contrasted with most of the studies [23,31], mentioning that female tend to exhibit stronger environmental attitudes, concerns and behaviors [36,37]. One previous study conducted has reported that no gender differences were observed in performing environmental behaviors at home or outside the home [38]. Therefore, the current results are probably because a majority of the female and male students are not fully portraying the roles assigned to their genders as they are resided with their parents and enrolled in full-time university courses without having careers. The insignificant difference might be due to a change towards encouraging gender equality in recent years and eliminating traditional gender beliefs, leading to wide ranges of pro-environmental behavior.

**Table 1.** Determining the UM students' pro-environmental behavior with gender using independent sample T-test.

		F	Sig.	t	df	Sig. (2-tailed)
Pro-environmental behaviour	Equal variances assumed	0.071	0.790	-1.883	390	0.060
	Equal variances not assumed			-1.889	134.714	0.061

Table 2 reveals the relationship between study background and pro-environmental behavior among students at UM. The findings demonstrate that the pro-environmental behavior and study background indicate no significant difference among students at UM ( $t=-0.634$ ,  $df=390$ ,  $P \geq 0.05$ ). The finding is in agreement a previous study whose results portrayed that there was no significant difference of behavior in minimizing the plastic consumption between science and social sciences courses among Universiti Putra Malaysia (UPM) students [23]. Alternatively, the result contradicted with another previous study which elucidated that significant difference exists between different faculties and behavior where applied science students revealed the highest level of sustainable consumption behavior compared to students from non-science faculties [6]. The result showed that environmental issues have received extensive attention locally and globally as well as increasing environmental awareness level of students regardless of their study background in performing pro-environmental behavior. Another possible reason could be that the students from different academic fields can easily acquire information about environmental concerns via internet or social media which, causing similar levels of pro-environmental behavior among science and non-science students. This could also be due to environmental challenges often requiring interdisciplinary strategies. Thus, science and non-science students have to work together in environmental projects, fostering a common understanding of environmental value and behavior. This collaboration may bridge the gap between science and non-science students in terms of pro-environmental behavior.

**Table 2.** Independent sample T-test for investigating the relationship between study background and pro-environmental behavior.

		F	Sig.	t	df	Sig. (2-tailed)
Pro-environmental behavior	Equal variances assumed	1.037	0.309	-0.634	390	0.526
	Equal variances not assumed			-0.629	309.679	0.530

### 3.3. Factor and reliability analysis

The acceptability of each construct is evaluated by assessing confirmatory factor analysis (CFA), reliability, convergence validity and discriminant validity for the proposed study model. To establish convergent reliability, the factor loading of the indicator, composite reliability (CR) and the average variance extracted (AVE) can be considered [39]. According to the study, a factor loading is considered acceptable when it exceeds 0.5 and it is considered good for one indicator when it is equal to 0.7 and above [39]. It is noted that 30 out of 35 variables were retained after excluding variables with a standardized factor loading of less than 0.5. Based on Table 3, the standardized factor loading for all the variables surpasses the acceptable threshold of 0.5, showing that CFA achieved a satisfactory level of validity. Following the criteria for convergent validity, it is stated that Cronbach's alpha, CR and AVE should be above 0.7, 0.6 and 0.5, respectively [40]. Table 3 shows that the AVE value in our research model is less than 0.5 for four constructs. However, the study also reported that the convergent validity of the construct is acceptable due to the condition that AVE value is less than 0.5, but the composite reliability is higher than 0.6. However, AVE value less than 0.5 is acceptable if composite reliability is higher than 0.6, when the convergent validity of the construct is acceptable [40].

To assess the discriminant validity of the constructs, heterotrait-monotrait (HTMT) ratio of correlation is employed. HTMT value higher than 0.9 indicates a lack of discriminant validity [41]. Table 4 demonstrates that all coefficients of HTMT correlations is less than 0.9, indicating feasible discriminant validity.



**Table 3.** Results of convergent validity of the constructs.

Construct	Items	Mean	SD	SFL	AVE	CR	Cronbach's alpha
Environmental attitude	EA1	4.54	0.850	0.628	0.481	0.866	0.893
	EA2	4.30	0.827	0.720			
	EA3	4.46	0.765	0.758			
	EA4	4.19	0.873	0.713			
	EA5	4.15	0.926	0.640			
	EA6	4.51	0.772	0.772			
	EA7	4.06	0.889	0.607			
Subjective norm	SN1	3.98	0.953	0.675	0.548	0.879	0.902
	SN2	3.91	0.881	0.776			
	SN3	4.03	0.867	0.688			
	SN4	3.81	0.943	0.763			
	SN5	3.56	1.020	0.808			
	SN6	3.80	0.914	0.720			
Perceived behavioral control	PBC1	3.75	0.907	0.690	0.478	0.846	0.871
	PBC2	3.83	0.903	0.621			
	PBC3	3.60	0.942	0.732			
	PBC4	3.78	0.971	0.741			
	PBC5	3.73	0.909	0.730			
	PBC6	4.00	0.829	0.625			
Intention	I1	4.16	0.813	0.574	0.293	0.622	0.864
	I2	3.97	0.909	0.520			
	I3	4.13	0.832	0.542			
	I4	4.19	0.838	0.522			
Pro-environmental behavior	PEB1	4.53	0.823	0.737	0.430	0.839	0.718
	PEB2	4.40	0.963	0.730			
	PEB3	4.33	0.985	0.623			
	PEB4	4.01	1.120	0.503			
	PEB5	3.95	1.042	0.651			
	PEB6	3.75	0.985	0.721			
	PEB7	2.472	1.321	-0.591			

**Table 4.** HTMT correlations.

Construct	EA	SN	PBC	I
EA				
SN	0.653			
PBC	0.667	0.7		
I	0.846	0.673	0.789	
PEB	0.701	0.565	0.609	0.775

### 3.4. Common method bias (CMB) test

To assess the potential presence of CMB issue in our proposed model, the following two methods were applied. First, the variance explained by a single factor of the research model was 39.72%. Thus, the result was aligned with the guidelines which suggested that the ideal proportion of variance explained by a single factor in observed variables through the principal component should be below 50% [42].

Second, variance inflation factor (VIF) is employed to detect multicollinearity among constructs. The VIF values range from 1.000–1.857, demonstrating that no crucial multicollinearity problems in this study [43,44].

### 3.5. Correlation analysis

#### 3.5.1. Pearson correlation

Based on Table 5, the correlational research design is conducted to investigate the correlation between environmental attitude, subjective norm, perceived behavioral control, intention and pro-environmental behavior of students at UM. The findings indicate that all the variables are significantly and positively correlated with one another.

To date, the results indicated that there is a very strong, positive and significant correlation between environmental attitude and intention ( $r=0.741$ ,  $P<0.05$ ). This implies that students who possessed positive environmental attitude tend to have stronger intention to perform pro-environmental behavior, including recycling, minimizing waste and using public transportation. In other words, when environmental attitude increases, intention towards pro-environmental actions also increases and vice versa. Previous research also reported that environmental attitude is significantly correlated with intention to execute pro-environmental behavior [45,46].

Apart from that, the results revealed a very strong, positive and significant correlation exists between perceived behavioral control and intention ( $r=0.741$ ,  $P<0.05$ ), showing that students with more available control elements, encompassing knowledge, ability, time and resources are prone to have stronger intention to carry out pro-environmental behavior. Similar results has been presented [22], suggesting that perceived behavioral control significantly impacts the intention to adopt green information technology (IT) among Malaysian students.

On the contrary, subjective norm and perceived behavioral control indicate a statistically significant but weak positive correlation with pro-environmental behavior ( $r=0.409$ ,  $P<0.05$ ;  $r=0.461$ ,  $P<0.05$ ). In other words, students are inclined to adopt environmentally friendly practices if subjective norm and perceived behavioral control increase. In addition, the findings are in line with another study [47] whose results implied that subjective norm and perceived behavioral control are significantly correlated with pro-environmental behavior among university students in China. The weak correlation between subjective norm and pro-environmental behavior might be because university students typically have a strong sense of independence in making decisions based on their own beliefs, weakening the influence of subjective norm on their behavior. Another plausible reason is that UM is a public university, consisting of many local and international students with different social and cultural backgrounds, leading to a diverse belief system related to pro-environmental behavior causing a weaker effect of subjective norm on pro-environmental behavior. Other than that,

the weak correlation between perceived behavioral control and pro-environmental behavior is probably because students have limited time and energy since they have to commit to their assignments, exams and curricular activities, resulting in a weaker influence of perceived control on pro-environmental behavior. Moreover, subjective norm is strongly and positively correlated with the students' intention ( $r=0.651$ ,  $P<0.05$ ), meaning that as peer pressure increases, intention to opt for pro-environmental behavior also increases among students.

**Table 5.** Results of the relationship of the variables using Pearson correlation.

		1	2	3	4	5
1.Environmental attitude	Pearson correlation Sig. (2-tailed)	1				
2.Subjective norm	Pearson correlation Sig. (2-tailed)	0.576** 0.000	1			
3.Perceived behavioural control	Pearson correlation Sig. (2-tailed)	0.622** 0.000	0.624** 0.000	1		
4. Intention	Pearson correlation Sig. (2-tailed)	0.741** 0.000	0.651** 0.000	0.742** 0.000	1	
5.Pro-environmental behavior	Pearson correlation Sig. (2-tailed)	0.544** 0.000	0.409** 0.000	0.461** 0.000	0.555** 0.000	1

\*\*Correlation is significant at the 0.01 level (2-tailed).

### 3.6. Multiple regression analysis

#### 3.6.1. Multiple linear regression analysis

A multiple regression analysis was conducted to study the relationship between the independent variables and the dependent variable. In the first regression analysis, the predictor variables are attitude, subjective norm and perceived behavioral control while intention serves as the dependent variable. The results of multiple linear regression analysis are presented as shown in Table 5. The constructs of the theory of planned behaviour explained 69% of the variance in intention to perform pro-environmental behavior.

All the variables are significantly influencing the intention of UM students to adopt pro-environmental behavior ( $P<0.05$ ) as presented in Table 6. Thus, H1, H2 and H3 are supported. Similar results have been reported in previous studies [48], highlighting the importance of environmental attitude, subjective norm and perceived behavioral control as key factors driving students' intention to engage in pro-environmental behavior.

Individually, environmental attitude has the largest impact on intention ( $\beta=0.399$ ,  $t=10.678$ ,  $P<0.05$ ), followed by perceived behavioral control ( $\beta=0.378$ ,  $t=9.662$ ,  $P<0.05$ ) and finally subjective norm ( $\beta=0.186$ ,  $t=4.954$ ,  $P<0.05$ ). The conducted research also stated that attitude has the highest impact on the pro-environmental intention of students of Jordanian universities and higher education institutes [48]. Thus, higher education institutions should serve as a crucial platform in fostering students' positive attitude towards the environment through educational and awareness programs to encourage their intentions to actively participate in pro-environmental behaviors. In this context,

discussion, workshop, seminar and campaigns should be conducted regularly so that students are exposed to environmental concerns constantly, which may directly affect their decision towards sustainable lifestyles. Moreover, environmental values can be incorporated into the university and curriculum to enhance students' knowledge and awareness of environmental issue.

Additionally, the intention of UM students to perform pro-environmental behavior is significantly influenced by perceived behavioural control. To elucidate, students presumed that they are able to execute pro-environmental behavior if they possess sufficient opportunities and resources, including environmental knowledge, skills, time and money. The current findings are consistent with another previous study whose results revealed that perceived behavioral control has a substantial impact on the intention among higher education students in Portugal [7].

Furthermore, compared to environmental attitude and perceived behavioral control, subjective norm has the least impact on intention, yet it is significantly associated with students' intention to perform pro-environmental behavior. Despite subjective norms contributing to little impact on intention, students' decision in carrying out pro-environmental behavior can still be affected by the opinions received from their parents, course mates, friends, lecturers and staff. Professors can thus inspire the students' intention in pursuing environmental sustainability and strengthen their beliefs in conducting pro-environmental behavior. Moreover, lecturers and staffs can be the exemplars to involve in environmental programs organized by university or third-party organization, for example, zero-waste campaign, composting programs and tree planting programs to encourage the participation of students.

To conclude, the three independent variables, namely environmental attitude, subjective norm and perceived behavioral control can be utilized as predictors of the intention to conduct pr-environmental behavior among UM students.

**Table 6.** Multiple linear regression analysis results of independent variables and intention.

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	Beta	Std. Error	Beta		
Constant	0.074	0.960		0.077	0.939
Environmental attitude	0.426	0.040	0.399	10.678	0.000
Subjective norm	0.178	0.036	0.186	4.954	0.000
Perceived behavioral control	0.392	0.041	0.378	9.662	0.000

a. Dependent variable: intention

Notes: \* $P < 0.01$ , \*\* $P < 0.05$ , \*\*\* $P < 0.10$

Adjusted R2:0.695, F-statistics=299.198, Sig at 0.000

Table 7 portrays the results of the relationship between two independent variables (intention and perceived behavioral control) and dependent variable (pro-environmental behavior) in the second multiple linear regression analysis. The R2 value of multiple linear regression model implies that all the variables accounted for 31% of the variance in pro-environmental behavior as stated in Table 6.

Specifically, it is observed that perceived behavioral control did not have significant effect on the

pro-environmental behavior among UM students ( $\beta=0.108$ ,  $t=1.719$ ,  $P>0.05$ ). As a result, H4 is not validated. The outcome of the present study contradicts a previous study [49] whose results reported a positive and significant correlation between perceived behavioral control and sustainable behavior among students enrolled in public universities in Malaysia. Meanwhile, another study stated that perceived behavioral control does not significantly affect the pro-environmental behavior among young Irish adults [12]. The disparity persists between an individual's perception of their perceived control and actual control over the condition, causing individual being unable to perform a particular behavior [28]. In this respect, the plausible reason might be that students are facing external constraints which lead them difficult to conduct pro-environmental behavior, for instance, lack of recycling bins around the campus, long waiting times, inefficient public transportation and financial problems. Furthermore, other variables such as values, motivation and knowledge can also become major factors in determining the pro-environmental behavior [50,51]. If their beliefs and motivations are not in line with the pro-environmental actions, they might also fail to transform their intention into actual pro-environmental behavior even if they possessed high perceived behavioral control.

On the other side, the students' intention is significant associated with pro-environmental behavior ( $\beta=0.475$ ,  $t=7.587$ ,  $P<0.05$ ). Hence, H5 is supported. To date, intention is the significant predictor of pro-environmental behavior among UM students. The finding is congruent with several previous conducted studies [7,49,50,51]. In addition, an individual's behavior can be determined by their intention [52]. Since intention encapsulates the motivational factors that affect behavior, it plays a central role in predicting the actual behavior that individuals exhibit. Consequently, students are prone to overcome obstacles and difficulties in practicing pro-environmental behavior when their intention increases. Table 8 summarizes the findings based on the hypotheses made in this study.

**Table 7.** Multiple linear regression analysis results of independent variables and pro-environmental behavior.

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	Beta	Std. Error			
Constant	14.652	0.997		14.696	0.000
Intention	.370	.049	.475	7.587	0.000
Perceived behavioral control	.087	.051	.108	1.719	0.086

a. Dependent variable: pro-environmental behavior.

Notes: \* $P<0.01$ , \*\* $P<0.05$ , \*\*\* $P<0.10$ .

Adjusted  $R^2$ :0.310, F-statistics=88.872, Sig at 0.000.

**Table 8.** Summary results of the hypotheses.

	Hypotheses	Results
H1	There is a significant relationship between UM students' environmental attitude and their intention	Supported
H2	There is a significant relationship between subjective norms and intention among UM students	Supported
H3	There is a significant relationship between perceived behavioral control and intention among UM students	Supported
H4	There is a significant relationship between perceived behavioral control and pro-environmental behavior	Not supported
H5	There is a significant relationship between intention and pro-environmental behavior	Supported

#### 4. Conclusions

To sum up, this study suggests that TPB can be an applicable model to investigate the pro-environmental behavior among UM students. The findings showed that gender and pro-environmental behavior showed no significant difference, as well as study background and pro-environmental behavior. When conducting Pearson correlations, it was observed that all variables exhibit positive and significant correlations with each other. Also, environmental attitude, subjective norm and perceived behavioral control are the precursors of intention to engage in pro-environmental behavior among UM students. However, it should be noted that while intention was found to have a positive influence on pro-environmental behavior in this study, perceived behavioral control did not emerge as a determinant of such behavior.

The research is anticipated to offer valuable information to the higher education institutions for designing effective strategies, especially among students as they play a crucial role in developing a sustainable future. Moreover, this research can help to further improve environmental projects and programs at the university level by recognizing the potential aspects that can increase pro-environmental behavior among students. Alternatively, some limitations and deficiencies are identified so that future studies can be done to ameliorate the current study. The study only focuses on students in UM which may refine the study structure due to limitation of geographic coverage. Therefore, future studies can collect samples from different universities to enhance the generalization of the results. Also, different stakeholders, including lecturers and staffs can be included to provide holistic view on pro-environmental behavior. Moreover, additional variables, including knowledge, moral obligation and self-identity can be introduced into the model for greater comprehension of pro-environmental behavior among students since this study only focused on the fundamental variables included in the TPB model. Finally, future research can be considered to include other theories, such as value believe norm and self-congruity theory into the TPB model to have a comprehensive understanding of pro-environmental behavior among students, allowing the higher education institutions to develop customized environmental programs and initiatives that resonate with student motivations and interests in performing pro-environmental behavior in their daily lives.

## Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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## Conflict of interest

The authors declare that there are no conflicts of interest in this research work.

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