WASTE SORTING BEHAVIOR AMONG UNIVERSITY STUDENTS: A STEP TOWARDS GREEN URBAN DEVELOPMENT

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Abstract: ***Rapid urbanization and population growth in Ho Chi Minh City have intensified pressure on municipal solid waste management, making waste sorting at source essential for sustainable urban development. Although environmental awareness is relatively high, waste-sorting behavior among university students remains limited. This study investigates the determinants of waste-sorting behavior among university students in Ho Chi Minh City using an extended Theory of planned behavior (TPB). Environmental awareness, perceived behavioral control, and personal moral norms are examined as key factors influencing intention, which in turn drives actual waste-sorting behavior. Data from 478 valid responses were analyzed using SmartPLS. The findings reveal that environmental awareness, perceived behavioral control, and personal moral norms significantly influence students' intention and waste-sorting behavior, providing theoretical and practical implications for promoting sustainable practices in universities.***

• Keywords: *waste sorting behavior, students, Ho Chi Minh City.*

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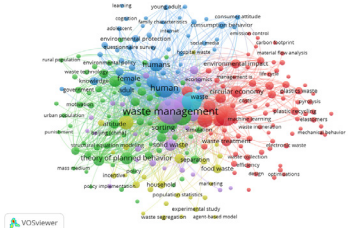
1. Introduction

Previous international studies show that students' waste sorting behavior is influenced by environmental awareness and perceived behavioral control, while inadequate infrastructure and inconvenience remain major barriers (Dong Wang et al., 2022). Personal moral norms and social norms have also been found to play a significant role in encouraging actual waste sorting behavior in educational settings (Jingjie Wang, 2023). Evidence from the UAE further suggests that transforming positive attitudes into real waste sorting behavior largely depends on individuals perceived behavioral control and personal norms (Waxin et al., 2025).

In Vietnam, students' waste sorting behavior is strongly influenced by environmental awareness, personal moral norms, and institutional support, with sustainable education playing a fundamental role (Bang Nguyen Viet et al., 2025). Perceived behavioral control has been shown to directly affect students' actual waste sorting behavior (Vu Thi Thanh Binh et al., 2025). In addition, attitudes, social influence, and the availability of infrastructure contribute to differences in students' participation in waste sorting activities (Hau Van Pham et al., 2020).

Due to the limited number of in-depth studies focusing specifically on university students in Ho Chi Minh City, further research on this topic remains necessary to strengthen the theoretical foundation and to propose practical implications that are better suited to the local context.

Figure 1: Bibliometric analysis of studies related to waste sorting behavior



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Research on waste sorting emphasizes waste management as a nexus between human behavior, attitude, and the theory of planned behavior, shaping students' sorting and separation of solid waste in higher education (Waxin et al., 2025). As shown in Figure 1, key terms such as waste management, human, environmental impact, and circular economy are strongly interconnected, highlighting the behavioral and environmental dimensions of waste-related studies. In university settings, waste sorting is also closely linked to sustainability education and circular economic development goals (Bang et al., 2025).

2. Theoretical Framework and Research Model

2.1 Theoretical Framework

Waste Sorting Behavior: Waste sorting behavior refers to intentional actions to separate waste at the source for recycling and effective treatment. Influenced by behavioral intention, personal moral norms, and perceived behavioral control under the extended TPB, this behavior among students also depends on convenience and supporting infrastructure. This

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highlights the persistent gap between environmental awareness and actual practice (Waxin et al., 2025).

The Theory of Planned Behavior: The Theory of Planned Behavior (TPB) proposed by Ajzen (1991) suggests that human behavior is mainly driven by behavioral intentions. This intention is shaped by attitudes toward behavior, subjective norms, and perceived behavioral control, which can also directly influence behavior. TPB has been widely applied to explain environmental behaviors, including waste sorting.

Norm Activation Theory: Schwartz's Norm Activation Theory (1977) argues that environmental behavior is driven by personal moral norms, or an individual's sense of moral obligation toward society. These norms are activated when people are aware of the consequences of their actions and feel personally responsible. Once activated, personal norms encourage behaviors such as waste sorting.

2.2 Hypotheses and Research Model

Infrastructure: Infrastructure refers to the availability and convenience of waste-sorting facilities on campus, which help reduce practical barriers to waste separation. Adequate infrastructure enables students to perform waste sorting more easily and supports actual behavior (Vu et al., 2025). Accordingly, the following hypothesis is formulated:

H1: Infrastructure positively influences students' actual waste-sorting behavior.

Environmental awareness: Environmental awareness reflects students' understanding of the negative impacts of waste and the benefits of waste sorting. Higher environmental awareness encourages positive attitudes and strengthens students' motivation and intention to engage in waste sorting (Dong Wang et al., 2022). Accordingly, the following hypothesis is formulated:

H2: Environmental awareness positively influences students' intention to perform waste sorting.

Perceived behavioral control: Perceived behavioral control reflects students' beliefs about their ability and available conditions to sort waste. When waste sorting is perceived as easy and manageable, students' intention to engage in this behavior increases significantly (Waxin et al., 2025). Accordingly, the following hypothesis is formulated:

H3: Perceived behavioral control positively influences students' intention to perform waste sorting.

Personal moral norms: Personal moral norms reflect students' sense of moral obligation and responsibility toward the environment. When students view waste sorting as the morally right thing to do, their intention to engage in this behavior increases. Research indicates that personal moral norms have a significant and positive effect on waste sorting intention, highlighting the role of internal moral motivation in shaping behavioral intention (Waxin et al., 2025). Accordingly, the following hypothesis is formulated:

H4: Personal moral norms positively influence students' intention to perform waste sorting.

Intention to sort waste: Waste sorting intention reflects students' readiness to engage in this behavior. The stronger the intention, the more likely students are to actually sort their waste. Studies show that intention has a direct and positive effect on waste sorting behavior, confirming its key role in turning awareness into real action (Bang Nguyen Viet et al., 2025). Accordingly, the following hypothesis is formulated:

H5: Students' intention positively influences their actual waste-sorting behavior.

3. Research Methods

This study adopts a convenience sampling approach, with the sample size determined based on the guidelines of Tabachnick and Fidell (2013). A survey was conducted with 480 respondents in Ho Chi Minh City who were concerned with factors influencing waste sorting behavior; after data cleaning, 478 valid responses were retained for analysis. The data were analyzed using SmartPLS, including tests of Cronbach's alpha for reliability, convergent and discriminant validity, structural model evaluation, multicollinearity assessment, adjusted R^2, and effect size f^2 to assess the influence of each variable and identify potential missing key factors in the model.

4. Research Results

4.1. Cronbach's Alpha analysis results

Scale reliability was assessed using Cronbach's Alpha, and the results show that all constructs meet the required reliability level (Cronbach's Alpha ≥ 0,7). In addition, the average variance extracted (AVE) values are all ≥ 0,50, indicating good convergent validity of the measurement scales (Chin, 1998).

Table 4.1: Table of Cronbach's Alpha Reliability Results

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
EA	0,909	0,912	0,936	0,784
IF	0,887	0,892	0,922	0,746
ISW	0,916	0,917	0,941	0,798
PBC	0,886	0,888	0,921	0,745
PMN	0,897	0,901	0,928	0,765
WSB	0,919	0,920	0,942	0,804

4.2. Convergent Validity Assessment

Table 4.2: Table of Convergent Validity Assessment Results

	EA	IF	ISW	PBC	PMN	WSB
EA1	0,897					
EA2	0,885					
EA3	0,878					
EA4	0,882					

	EA	IF	ISW	PBC	PMN	WSB
IF1		0,846				
IF2		0,870				
IF3		0,876				
IF4		0,863				
ISW1			0,901			
ISW2			0,868			
ISW3			0,910			
ISW4			0,895			
PBC1				0,860		
PBC2				0,891		
PBC3				0,868		
PBC4				0,833		
PMN1					0,811	
PMN2					0,871	
PMN3					0,916	
PMN4					0,896	
WSB1						0,892
WSB2						0,876
WSB3						0,907
SB4						0,911

Convergent validity reflects the degree to which observed variables within the same construct are highly correlated (Bagozzi, Yi, & Phillips, 1991). When assessing convergent validity, researchers typically examine the outer loadings of each indicator as well as the average variance extracted (AVE). According to common guidelines, indicators should have outer loadings of at least ≥ 0,7 to be considered acceptable. The results obtained from SmartPLS show that all indicators have loadings greater than 0,7; therefore, they are retained and the measurement scales demonstrate adequate convergent validity.

4.3 .Discriminant Validity Assessment

Table 4.3: Discriminant Validity Assessment Using the Heterotrait-Monotrait Ratio (HTMT) Matrix

	EA	IF	ISW	PBC	PMN	WSB
EA						
IF	0,714					
ISW	0,803	0,698				
PBC	0,842	0,737	0,856			
PMN	0,813	0,730	0,899	0,898		
WSB	0,658	0,720	0,866	0,831	0,826	

According to Henseler et al. (2015), the Heterotrait–Monotrait ratio (HTMT) is proposed as a reliable criterion for assessing discriminant validity among constructs, with an acceptable threshold of below 0,90. The results presented in Table 4.3 show that all HTMT values are lower than 0,90, indicating that the measurement scales in the research model satisfy the requirements for discriminant validity.

According to the criterion proposed by Fornell and Larcker (1981), discriminant validity is established when the square root of the AVE for each latent construct is greater than its correlations with any other construct in the model. The results shown in the table indicate that the diagonal values (i.e., the square roots of AVE) are higher than the other correlation coefficients in the same column, suggesting that the measurement scales meet the discriminant validity requirement under this criterion.

Table 4.4: Discriminant Validity Assessment Using the Fornell–Larcker Criterion

	EA	IF	ISW	PBC	PMN	WSB
EA	0,886					
IF	0,649	0,864				
ISW	0,735	0,635	0,894			
PBC	0,760	0,658	0,771	0,863		
PMN	0,734	0,657	0,815	0,800	0,875	
WSB	0,604	0,650	0,797	0,750	0,752	0,896

4.4. Structural model assessment

Table 4.5: Results of the structural model assessment

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
EA ISW	0,192	0,193	0,052	3,710	0,000
IF ISW	0,068	0,070	0,044	1,553	0,121
ISW WSB	0,797	0,796	0,026	30,127	0,000
PBC ISW	0,214	0,213	0,055	3,909	0,000
PMN ISW	0,458	0,457	0,064	7,196	0,000

The path coefficients range [-1;1]. Table 4.5 shows that all coefficients fall within the acceptable range, are positive, and are close to 1, indicating positive relationships among the variables in the model. To test statistical significance, the study employs the bootstrapping. Coefficients are considered significant when $t > 1,96$ (corresponding to $p < 0,05$). The results indicate that, except for the relationship between IF and ISW with $p = 0,121 > 0,05$, which is not statistically significant, all other relationships reach statistical significance ($p < 0,05$). This suggests that IF does not have a significant effect on ISW in this study.

4.5. Reassessment of the PLS-SEM model

Multicollinearity assessment

The model was re-estimated using the PLS-SEM approach to ensure the reliability and explanatory power of the variables. The multicollinearity assessment shows that all VIF values fall within a safe range (1,000–3,503), well below the commonly accepted threshold of 5. This indicates that there are no serious multicollinearity issues among the independent variables in the model.

Table 4.6: Multicollinearity test results (VIF)

	VIF
EA ISW	2,793
IF ISW	2,034
ISW WSB	1,000
PBC ISW	3,503
PMN ISW	3,243

4.6. Adjusted R^2 assessment

The R^2 coefficient measures the model's predictive power and reflects the combined effect of exogenous variables on endogenous variables (Hair et al., 2016). R^2 ranges from [0;1], and higher values indicate stronger predictive ability. In behavioral or exploratory studies, an R^2 value of 0,20 is generally considered acceptable (Hair et al., 2017). Therefore, the findings support the relationship between Intention to Sort Waste (ISW) and Waste-Sorting Behavior (WSB) in the proposed theoretical model.

Table 4.7: Adjusted coefficient of determination

	R Square	R Square Adjusted
ISW	0,723	0,721
WSB	0,635	0,634

4.7. Assessment of the effect size f²

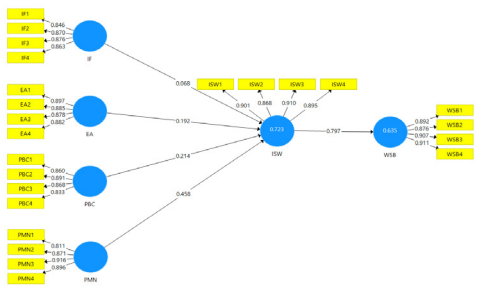
The f² index is used to assess the magnitude of the impact of an independent variable on a dependent variable, with reference thresholds of 0,35 (strong), 0,15 (moderate), and 0,02 (weak) (Cohen, 1988). The results indicate that Personal Moral Norm (PMN) has a moderate effect on Intention to Sort Waste (ISW), with f² = 0,234, while Environmental Awareness (EA) and Perceived Behavioral Control (PBC) show weaker effects (f² values of 0,048 and 0,047, respectively). This suggests that PMN plays a more important role in explaining variations in waste sorting intentions.

However, the relationship between IF and ISW is not statistically significant (p = 0,121 > 0,05, Table 4.5). The effect size f² of IF on ISW is 0,008, indicating a very weak influence. Therefore, the IF variable is excluded from the final research model.

Table 4.8: Evaluation of the impact coefficient f²

	f square
EA ISW	0,048
IF ISW	0,008
ISW WSB	1,740
PBC ISW	0,047
PMN ISW	0,234

Overall, the research results indicate that Personal Moral Norm (PMN), Environmental Awareness (EA), and Perceived Behavioral Control (PBC) all have a significant influence on Intention to Sort Waste (ISW), with all relationships reaching statistical significance (p < 0,05). Among these factors, PMN has the strongest effect on ISW, with a standardized beta coefficient of 0,458, showing that it is the most important factor explaining changes in students' waste sorting intentions. This is followed by the effects of PBC (β = 0,214) and EA (β = 0,192), both of which show moderate and positive influences on ISW. In contrast, IF has a very weak standardized beta coefficient of 0,068 and therefore is excluded from the model. The final research model is presented as follows:



Interpretation: IF-Infrastructure, EA-Environmental Awareness; PBC-Perceived Behavioral Control; PMN-Personal Moral Norm; ISW-Intention to Sort Waste; WSB-Waste-sorting Behavior

5. Conclusions and Managerial Implications

This study examines the factors influencing students' waste sorting behavior in Ho Chi Minh City based on an extended Theory of Planned Behavior (TPB) model. The results show that Personal Moral Norms (PMN) have the strongest effect on students' intention to sort waste (β = 0,458), followed by Perceived Behavioral Control (PBC) (β = 0,214) and Environmental Awareness (EA) (β = 0,192), with all of these relationships being statistically significant. In contrast, Infrastructure (IF) shows a very weak effect (β = 0,068) and is not statistically significant and therefore is excluded from the final research model.

In addition, Intention to Sort Waste (ISW) is identified as a strong predictor of students' actual waste sorting behavior (WSB), with a high standardized beta coefficient (β = 0,797). This finding highlights the central role of intention in translating awareness, attitudes, and motivation into concrete actions, and further supports the applicability of the Theory of Planned Behavior in studying environmental behavior among students in Vietnam.

Based on these findings, the study suggests that promoting waste sorting behavior in university settings should prioritize strengthening students' personal moral norms, while also improve environmental awareness and enhance their perceived ability to control the behavior through appropriate educational, communication, and behavioral guidance activities. These implications provide useful insights for educational institutions and policymakers in designing policies and programs that encourage sustainable waste sorting behavior.

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