# Factors Influencing Municipal Solid Waste Sorting Behavioral Intention: A Study Among Pupils in Hanoi Urban Areas ★

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**Abstract.** With significant economic growth in Hanoi's urban districts, solid waste generation skyrockets, they were negatively impacting the environment and human health. Waste classification is a required answer to this problem and is used in many nations. Numerous publications have been written on the importance of source-based garbage categorization and sorting. The uniqueness of this study is to uncover elements that influence students' intentions toward municipal solid waste sorting based on the theory of planned behaviour. A structural equation model was validated using 170 samples from Hanoi students (SEM). The data showed that students' intentions to sort waste were positively influenced by attitude and subjective norm, but not by perceived behavioural control. This study's findings may help governments, schools, and environmental organizations encourage students to engage in MSWS.

**Keywords:** Theory of Planned Behavior, Pro-Environment, Municipal Solid Waste Sorting, Hanoi urban pupils.

## 1 Introduction

In recent years, municipal solid waste (MSW) disposal has drawn the attention of urban areas in Vietnam, particularly Hanoi, one of the major cities with a high population density. However, dealing with MSW remains a significant concern and a great challenge for the city. An example is a rise due to landfill overflow in Nam Son, Xuan Son, becoming more and more severe and being on alert for the solid waste issue [1]. Therefore, sorting waste is a critical component in reducing the amount of MSW generated in this scenario.

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Municipal solid waste sorting (MSWS) is critical for the human living environment and physical health since residential garbage comprises a significant amount of hazardous waste and corrosive compounds that endanger human health indirectly by polluting land, water, and air. Numerous researches have examined individual behaviour and intention toward MSWS; however, these studies have primarily focused on groups of ordinary populations [2, 3], and few have attempted to analyze young people's intention toward MSWS precisely. As the future society's masters, well-educated young people are the most critical group, and their behavioural intentions are essential to the future living environment's survival. Furthermore, creating MSWS habits takes time, regardless of age or purpose to sort rubbish; thuơs, we should focus on raising MSWS awareness among the younger generation.

As a result, the research will apply multiple-choice surveys to assess students' attitudes about environmental issues, specifically garbage classification. The primary survey subjects were students from Hanoi's urban districts (12 districts total). From 6 to 18 years old, children may develop their behaviours, and Hanoi's unsettling pollution will somehow affect them. Therefore, the best way to assist people in creating a habit of long-term trash classification and disseminating it to the community is to understand their behaviour on this subject.

## 2 Literature review

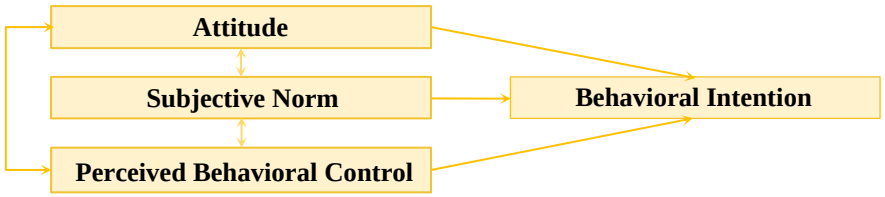
The Theory of Planned Behavior (TPB) [4] assumes that behaviour may be predicted or explained by the intention to conduct it (Fishbein and Ajzen, 1975) [5]. TPB is well defined and indicated by several publications, studies, and reviews [6, 7]. If the person accurately evaluates their amount of control, Ajzen (1991) [4] suggests that the behavioural control element directly influences their BI.

TPB has been widely employed in research since its inception and is regularly used to analyze pro-environmental behaviour [8-10]. Studies on waste classification systems [11, 12], procedures [13], waste classification technology [14], and waste sorting behaviour select the TPB model have recently been conducted. Over time, this theory can be used to analyze and forecast individual social behaviour. Fan, Yang, and Shen (2018) [15] used the Theory of Planned Behavior to build a "motivation-intention-behaviour" theoretical model. According to the research, general and specialized environmental motives influence behavioural intentions. This study adds motivation, background, and habit factors to understanding household solid waste categorization determinants and improves TPB.

Also, based on TPB and earlier studies, [16] determined the elements that affect people's behavioural intents in classifying municipal solid trash in Bau Bang District (Binh Duong Province, Vietnam). The findings reveal that attitude, subjective norms, and perceived behavioural control favourably influence people's intention and behaviour to sort municipal solid waste (MSW). The study made policy recommendations to encourage people in the study region to sort their waste on this premise.

According to TPB, individual behaviour is primarily driven by intention, which is affected by three aspects: attitude (ATT), subjective norm (SN), and perceived

behavioural control (PC). That means the more positive the ATT and SN, the more significant influence on PC and the stronger affect individual behavioural intention. Figure 1 displays the theoretical model.




Source: Ajzen, 1991

**Fig 1.** Theory of Planned Behavior (simplified)

**Attitude.** To express a positive or negative opinion towards a specific action [17]. Many researchers have established the impact and prediction of AT on BI [18]. Most research shows that those with a positive AT toward action has a stable BI [19]. This study specifies attitude as students' cognizance and biases of behaviour toward MSWS and conversely. Hypothesis H1 - AT relates positively to MSWS BI.

**Subjective Norm.** SN mentions societal variables influencing an individual's conduct [20]. For example, the government can commence this influence by enacting environmental legislation, or the family and school can educate pupils. It can also be caused by social aspects like family and friends who act as essential decision-making references. In this scenario, Vietnamese society leans towards collectivism [21]. The more students know about MSWS, the more likely they are to attend [22]. Therefore, the following hypothesis is proposed: Hypothesis H2 - SN relates positively to MSWS BI.

**Perceived behavioral control.** PC is the expectation of a person doing a specific controlled behaviour [4]. Ajzen (1991) [4] defines perceived behavioural control as many aspects that constrain or enhance conduct. Students in MSWS control their behaviour based on perceived barriers to or facilitators of waste classification. Students who are confident in their garbage classification skills are more likely to participate in waste separation [23]. Since that is the case, the following hypothesis is proposed: Hypothesis H3 - PC relates positively to MSWS BI.

# 3 Methodology

## 3.1 Measures and Data Collection

The research uses surveys to collect relevant data. Survey questions were developed through the understanding of TPB [4] based on a 5 point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

Online surveys were utilized to assess students' attitudes toward MSWS and pro-environmental conduct in general. Due to the complexity and severity of the COVID-19 outbreak, online questionnaires were created to enable the authors to communicate with them. Although 181 surveys were gathered, only 170 could be evaluated.

## 3.2 Research Method and Statistical Analysis

Relationship among AT, SN, PC and BI was verified with structural equation modeling (SEM) by using AMOS 20.0.

The steps below are evaluated using SPSS 20. The first was to use descriptive statistics to look at the participants' demographics and determine their means and standard deviations for each factor. Second, Cronbach's alpha was used to assess the model's reliability (CA). Exploratory factor analysis (EFA) is used to determine the relationship between observed variables and baseline factors [24]. The Principal Axis Factoring extraction method was used in EFA, while in Promax, the Kaiser Normalization rotation approach was used. A prior theoretical model underpins a set of observations, and AMOS 20.0 was used to extract confirmatory factor analysis (CFA) [24]. Fourth, assess the model's reliability (CR) and convergent validity (AVE); standardized regression weight data were used to determine each factor's CR and AVE. In the following step, the model was tested through the recommended threshold of SEM included: $\chi 2/df$ (the ratio of chi-square to the degree of freedom), CFI > 0.9 (comparative fit index), GFI (goodness-of-fit index), RMSEA (root mean square error of approximation) and TLI (Tucker-Lewis index). Then, the relationships among the five factors were validated, and the report of the hypotheses testing findings was delivered.

# 4 Findings: Data Analysis and Result

## 4.1 Measurement Model: Reliability and Validity

To confirm the convergent validity of the data, the study used EFA and CFA. According to the EFA results, there were no eliminated variables because their factor loadings were higher than 0.50 [25] and ranged from 0.619 to 0.913. Then, the remaining variables were tested by CFA. The average variance extracted (AVE) was scaled from 0.531 to 0.618, higher than the recommended benchmark point of 0.50 [38]. Therefore, the study has solid convergent validity of measurement items.

CA was conducted to examine the internal items' consistency of each construct [44]. The results show that CA varied from 0.847 to 0.884, demonstrated exemplary reliability (.80 or greater) [26]. Furthermore, CR ranged from 0.847 to 0.880 and was

higher than 0.7 and AVE. Therefore, the constructs' reliability was confirmed.

**Table 2.** Reliability and convergent validity test results.

| Construct | Items | Mean | S.D | Factor loading | CA | CR |
|---|---|---|---|---|---|---|
| AT | AT1 | 3.48 | 0.858 | 0.619 | 0.884 | 0.880 |
| | AT2 | 4.00 | 1.026 | 0.762 | | |
| | AT3 | 3.82 | 0.983 | 0.770 | | |
| | AT4 | 3.76 | 1.073 | 0.789 | | |
| | AT5 | 3.84 | 0.875 | 0.735 | | |
| | AT6 | 4.04 | 1.048 | 0.821 | | |
| SN | SN1 | 2.85 | 1.236 | 0.683 | 0.847 | 0.865 |
| | SN2 | 2.69 | 1.163 | 0.913 | | |
| | SN3 | 2.94 | 1.118 | 0.713 | | |
| | SN4 | 2.62 | 1.131 | 0.704 | | |
| PC | PC1 | 3.42 | 1.124 | 0.748 | 0.854 | 0.847 |
| | PC2 | 3.29 | 1.106 | 0.806 | | |
| | PC3 | 3.39 | 1.079 | 0.817 | | |
| | PC4 | 3.09 | 1.135 | 0.657 | | |
| | PC5 | 2.95 | 1.132 | 0.663 | | |
| BI | BI1 | 3.04 | 1.181 | 0.674 | 0.879 | 0.876 |
| | BI2 | 3.01 | 1.164 | 0.788 | | |
| | BI3 | 3.35 | 1.232 | 0.814 | | |
| | BI4 | 3.46 | 1.142 | 0.695 | | |
| | BI5 | 2.88 | 1.014 | 0.816 | | |

Source: Compiled results from SPSS 20 software

### 4.2 Structural Model Testing

The structural model was set up by applying AMOS 20.0. The result showed an acceptable model fit through these values $\chi 2 = 278.962$, $\chi 2/df = 1.743$, CFI = 0.932, GFI = 0.867, RMSEA = 0.066 and TLI = 0.919. Every statistic was in the suggested limitation, indicating a good model fit of the advised model to the data [26-29]. Measurement of model fit indices is described in table 3.

**Table 3.** Measurement of model fit indices.

| Indicators | Threshold | Results | Model Judgment |
|---|---|---|---|
| $\chi 2/df$ | <3 good; <5 sometimes permissible | 1.743 | Good |

| | | | |
|---|---|---|---|
| CFI | >0.95 great; >0.9 traditional; >0.8 sometimes permissible | 0.932 | Traditional |
| GFI | >0.95 great; >0.9 traditional; >0.8 sometimes permissible | 0.867 | Sometimes permissible |
| RMSEA | <0.06 good fit; 0.06-0.08 acceptable fit; 0.08-0.1 mediocre fit; >=0.1 poor fit | 0.066 | Acceptable fit |
| TLI | >= 0.9 good | 0.919 | Good |

Source: Compiled results from AMOS 20.0 software

### 4.3 Hypothesis Testing

The standardized path coefficients of AT and SN indicated that AT ($\beta = 0.305$, $p < 0.001$) and SN ($\beta = 0.531$, $p < 0.001$) affect the separation intention of MSW positively and significantly. It is explained by standardized path coefficient (β) indices in Table 5, meaning a unit increase in AT raised the pupils' MSWS intention by 0.305 units. A unit increase in SN raised the pupils' MSWS intention by 0.531 units. Nevertheless, PC ($\beta = -0.029$, $p = 0.631$) did not positively affect on BI. The result supported hypotheses H1 and H2 while rejecting H3. Table 4 and figure 2 show the result details of the hypothesis test.

**Table 4.** Standardized regression weights of path analysis.

| Hypothesis | Path Correlation | Standardized Path Coefficient (β) | *p* | Results |
|---|---|---|---|---|
| H1 | AT → BI | 0.305 | *** | Supported |
| H2 | SN → BI | 0.531 | *** | Supported |
| H3 | PC → BI | -0.029 | 0.631 | Not Supported |

Note: a *** means $p < 0.001$.

Source: Compiled results from AMOS 20.0 software

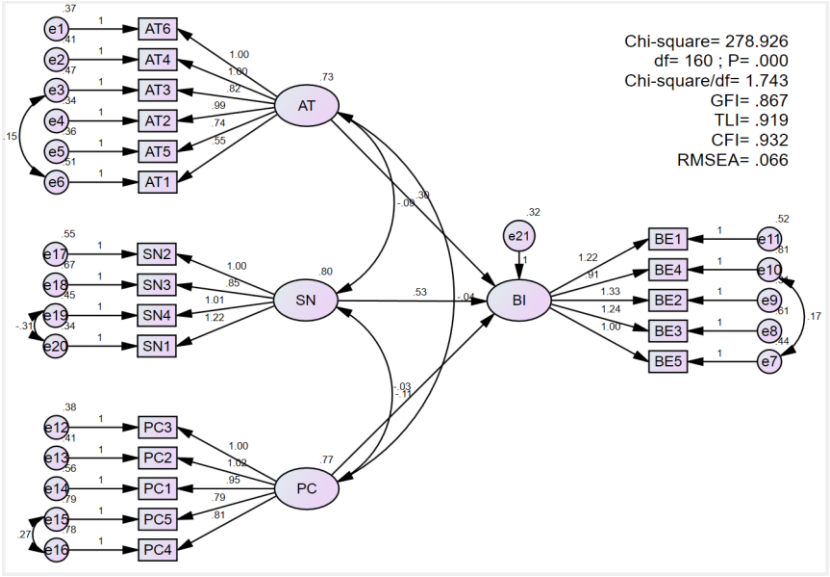



**Fig 2.** SEM model

Source: AMOS 20.0 software

# 5 Conclusion and Implications

## 5.1 Conclusion

The authors used the TPB to examine factors impacting students' behavioural intentions in MSWS in Hanoi. Among the three model constructs, perceived behavioural control was insignificant, but attitude and subjective norm were. These findings can help governments, schools, and environmental organizations inspire MSWS participants. Specifically, all possible measures are enforcing regulations, disseminating MSWS information, delivering MSWS lectures alongside theoretical classes, simplifying trash classification, and increasing waste-collecting infrastructure.

## 5.2 Implication

**AT and Its Implications.** The findings indicated that AT impacted pupils' behavioural intention toward MSWS according to p-value <0.001. Besides, standardized path coefficient equal to 0.305, thus AT had impact on BI. As can be observed, students' recognition of waste categorization is critical to improving students' waste classification intention. According to the survey results, most students are pleased about waste sorting. Generation Z may have more significant opportunities to interact with information. Especially current environmental movements like reducing plastic straw use and the trash cleaning challenge [30, 31]. They are interested in MSWS because

they believe waste classification can help clean up the environment.

**SN and Its Implications.** SN had the most impact on students' waste classification intentions. BI influenced more than AT, with a p-value of 0.001 and a normalized path coefficient of 0.531. Due to their ages, external social pressure has a significant impact on students' intentions. At this stage, intent and behaviour are formed by emulating the surrounding people's behaviour and are easily influenced by external stimuli [32]. For example, involving family and friends in MSW classification increases collectivism [33]. However, the poll shows that the percentage of family and friends sorting rubbish is low, lowering the pupils' intention.

To increase the students' awareness, the classification of MSW can be integrated into the educational content. In addition, the government should enforce related legislation, policies and disseminate MSWS information across the society to make it compulsory for citizens.

**PC and Its Implications**. In this study, PC was not a significant determinant of the pupils' BI. However, the finding indicates that students are quite confused in their participation in garbage classification, and their intention has not significantly improved. The reason may be that even though the city has made specific efforts in educating pupils on how to classify waste [34, 35], such action has not been widely disseminated. Given the above finding, it can be implied that further education for the pupils is necessary to identify their ability to classify waste and improve public accessibility and convenience in MSWS to allow them to feel easier in achieving the classification of waste.

## References

1. VnExpress, https://vnexpress.net/infographics/hien-trang-xu-ly-rac-thai-sinh-hoat-o-viet-nam-3950706.html, last accessed 2021/03/21
2. Karim Ghani, W. A. W. A., Rusli, I. F., Biak, D. R. A., Idris, A.: An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. Waste Management 33(5), 1276–1281 (2013)
3. Alhassan, H., Kwakwa, P. A., Owusu-Sekyere, E.: Households' source separation behaviour and solid waste disposal options in Ghana's Millennium City. Journal of Environmental Management 259, 110055 (2020)
4. Ajzen, I.: The Theory of Planned Behavior. 1st edn. Academic Press, New York, USA (1991)
5. Fishbein, M., Ajzen, I.: Belief, attitude, intention and behavior: An introduction to theory and research. Reading, MA: Addison Wesley (1975)
6. Armitage, C. J., Conner, M.: Efficacy of the Theory of Planned Behaviour: A meta-analytic review. British Journal of Social Psychology 40(4), 471–499 (2001)
7. Zhang, L., Chen, L., Wu, Z., Zhang, S., Song, H. Investigating Young Consumers' Purchasing Intention of Green Housing in China. Sustainability 10(4), 1044 (2018)
8. Yadav, R., Pathak, G. S.: Determinants of Consumers' Green Purchase Behavior in a Developing Nation: Applying and Extending the Theory of Planned Behavior. Ecological Economics, 134, 114–12 (2017)
9. Wan, C., Shen, G. Q., Choi, S.: Experiential and instrumental attitudes: Interaction effect

of attitude and subjective norm on recycling intention. Journal of Environmental Psychology, 50, 69–79 (2017)
10. Shen, L., Si, H., Yu, L., Si, H.: Factors Influencing Young People's Intention toward Municipal Solid Waste Sorting. International Journal of Environmental Research and Public Health 16(10), 1708 (2019)
11. Zheng, Y., Bai, J., Xu, J., Li, X., Zhang, Y.: A discrimination model in waste plastics sorting using NIR hyperspectral imaging system. Waste Management 72, 87–98 (2018)
12. Zhang, J., Hu, Q., Qu, Y., Dai, Y., He, Y., Wang, C.-H., Tong, Y. W.: Integrating food waste sorting system with anaerobic digestion and gasification for hydrogen and methane co-production. Applied Energy 257, 113988 (2020)
13. Robert, G., Marcin, P., Marek, M.: Analysis of Picked up Fraction Changes on the Process of Manual Waste Sorting. Procedia Engineering 178, 349–358 (2017)
14. Vegas, I., Broos, K., Nielsen, P., Lambertz, O., Lisbona, A.: Upgrading the quality of mixed recycled aggregates from construction and demolition waste by using near-infrared sorting technology. Construction and Building Materials 75, 121–128 (2015)
15. Fan, B., Yang, W., Shen, X.: A comparison study of "motivation–intention–behavior" model on household solid waste sorting in China and Singapore. Journal of Cleaner Production (2018)
16. Nguyen, T. H.: Nghiên cứu các yếu tố ảnh hưởng đến hành vi dự định của người dân trong hoạt động phân loại chất thải rắn sinh hoạt tại huyện Bàu Bàng, tỉnh Bình Dương. UEH Digital Repository, 05-63 (2019)
17. Ajzen, I., Fishbein, M.: Attitudes and the Attitude-Behavior Relation: Reasoned and Automatic Processes. European Review of Social Psychology 11(1), 1–33 (2000)
18. Yazdanpanah, M., Forouzani, M.: Application of the Theory of Planned Behaviour to predict Iranian students' intention to purchase organic food. Journal of Cleaner Production 107, 342–352 (2015)
19. Felixdóttir, S.S.: The role of materialistic and environmental values in predicting daily proenvironmental behavior and ethical consumption among young Icelanders. Háskólaprent, Reykjavík, Iceland (2017)
20. McEachan, R. R. C., Conner, M., Taylor, N. J., Lawton, R. J.: Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: a meta-analysis. Health Psychology Review 5(2), 97–144 (2011)
21. Hofstede Insights, https://www.hofstede-insights.com/country/vietnam/, last accessed 2021/03/29
22. Ru, X., Wang, S., Yan, S. Exploring the effects of normative factors and perceived behavioral control on individual's energy-saving intention: An empirical study in eastern China. Resources, Conservation and Recycling 134, 91–99 (2018)
23. Ma, J., Hipel, K. W., Hanson, M. L., Cai, X., Liu, Y.: An analysis of influencing factors on municipal solid waste source-separated collection behavior in Guilin, China by Using the Theory of Planned Behavior. Sustainable Cities and Society 37, 336–343 (2018)
24. MBA Bách Khoa, http://phantichspss.com/co-so-ly-thuyet-cua-mo-hinh-mang-sem-phan-4.html, last accessed 2021/03/17
25. Fornell, C., Larcker, D. F.: Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of Marketing Research 18(1), 39–50 (1981)
26. Hair, J.F., Black, W., Babin, B.J., Anderson, R.E.: Multivariate Data Analysis: A Global Perspective. Pearson 7 (2010)
27. Jöreskog, K.G.: A General Approach to Confirmatory Factor Analysis. Psychometrika 34(2). 183-202 (1969)
28. Bagozzi, R. P.: Attitudes, intentions, and behavior: A test of some key hypotheses. Journal of Personality and Social Psychology 41(4), 607–627 (1981)
29. Brown, M. W., Cudeck, R.: Alternative Ways of Assessing Model Fit. In K. A. Bollen, &

J. S. Long (Eds.), Testing Structural Equation Models, 136-162. Newbury Park, CA Sage (1993)
30. Dân Trí, https://dantri.com.vn/suc-manh-so/trao-luu-thu-thach-don-rac-dang-lan-truyen-manh-me-tren-cong-dong-mang-20190313183732087.htm, last accessed 2021/03/15
31. Tuổi trẻ Online. https://tuoitre.vn/trao-luu-khong-dung-ong-hut-nhua-cua-gioi-tre-viet-20180326090849606.htm, last accessed 2021/03/18
32. Facts for Life global. http://www.factsforlifeglobal.org/03/4.html, last accessed 2021/03/15
33. Ekasari, A.: Pengaruh Drive For Environmental Responsibility, Collectivism Dan Subjective Norm Terhadap Behavioral Intention Penggunaan Reusable Bag. Jurnal Manajemen dan Pemasaran Jasa 11(2), 201-216 (2018)
34. Vietnam Integration Magazine, https://vietnamhoinhap.vn/article/day-tre-noi-khong-voi-rac-thai-nhua-va-phan-loai-rac-thai-trong-truong-hoc---n-23900, last accessed 2021/04/21
35. GreenHub, https://greenhub.org.vn/vi/giao-duc-moi-truong-tu-kiem-toan-rac-thai-nhung-dau-hieu-dang-mung-tai-truong-pho-thong-dan-toc-noi-tru-tinh-phu-yen/, last accessed 2021/04/21