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Predictors of Students' Proper Waste Disposal Behavior in School Environment: a Partial Least Squares Structural Equation Modeling Approach

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A B S T R A C T

It is evident from various reports and statistics that there is a significant gap between the desired environmental state and the current situation, primarily due to improper waste disposal. This study used a predictive-correlational design and structural equation modeling to examine the predictors of proper waste disposal behavior. The research instrument was validated and used to survey 293 high school students across three public schools in Nueva Ecija, Philippines. Using WarpPLS 8.0, the results revealed that (1) accessibility of trash bins, perceived consequences, environmental concern, and perceived behavioral control predict proper waste disposal behavior, and (2) environmental concern and perceived behavioral control sequentially mediate the effect of perceived behavioral control on proper disposal behavior. This study proposes a structural model with meaningful predictive accuracy that can help educational institutions design effective waste management programs empowering education to promote eco-friendly behavior. Future studies may be conducted to test the revised model presented in this study.

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INTRODUCTION

The United Nations has a vision for a better world, encapsulated in the Sustainable Development Goals (SDGs) aimed at transforming our planet. Among these goals, two stand out for their critical focus on enhancing the health of our planet and the quality of life for its people: SDG 11: Sustainable Cities and Communities, and SDG 3: Good Health and Well-being.

SDG 11 is dedicated to making cities and human settlements inclusive, safe, resilient, and sustainable. Specifically, Target 11.6 aims to reduce the negative environmental impact of cities on a per capita basis by improving waste management and other measures. Meanwhile, SDG 3 aims to ensure healthy lives and promote well-being for all in all ages. This goal includes Target 3.9, which seeks to reduce the number of deaths and illnesses from hazardous chemicals and pollution. Together, these goals emphasize the vital need to tackle global and local environmental challenges, including within educational institutions.

Statistics on global waste generation underscored the urgency of these issues. According to the World Bank's "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050" report, without urgent action, global waste will increase by 70 percent on current levels by 2050 (Kaza et al., 2018). This is further emphasized by Alvares (2023), who notes that more than two billion metric tons of municipal solid waste are generated worldwide every year, a figure expected to rise significantly by 2050.

In the local context, the Philippines is facing a major challenge concerning plastic waste management, as highlighted by recent studies and reports. Meijer et al. (2021) have pointed out that in 2019, the country had approximately 4.03 million tons of mismanaged plastic waste. Moreover, if no interventions are taken, mismanaged plastic waste could increase to 9 million metric tons by 2040 and 11 million metric tons by 2060 (Schachter & Karasik, 2022).

As reported by The Philippine Star (2023), the country produces 163 million plastic sachet packets, 48 million shopping bags, and 45 million thin-film bags every day. Schachter and Karasik (2022) have reported that 20% of these items leak into the environment. In 2023, Cariaso reported that 35% of them are leaked into the open environment and oceans, indicating an increase of 15% in just one year.

The problem arises globally and locally as revealed by statistics, which show the gap between the desired environmental state and the current state of waste management practices. However, the plastic pollution problem cannot be solved just by cleaning up the environment, it is better to solve the main cause including improper waste disposal practices. Hence, addressing this gap requires an understanding of the factors affecting waste disposal behavior, particularly in key settings such as schools where environmental habits are formed and reinforced. Thus, the purpose of this study is to identify and analyze the factors that predict proper waste disposal behavior in schools, and to develop a structural model to guide effective waste management practices.

Proper waste disposal is a critical aspect of maintaining a clean and healthy school environment. Understanding the predictors of students' proper waste disposal behavior is essential for developing effective strategies to promote sustainable waste management practices. This theoretical review aims to synthesize existing research on the factors influencing students' proper waste disposal behavior, focusing on a Partial Least Squares Structural Equation Modeling (PLS-SEM) approach.

Waste disposal practices in schools are influenced by a variety of factors, including environmental knowledge, attitudes, social norms, and behavioral control. Studies have shown that students' understanding of the consequences of improper waste disposal and their involvement in environmental education programs can significantly impact their waste management behaviors

THEORETICAL REVIEW

Proper Waste Disposal Behavior

Proper waste disposal behavior, within the context of this study, refers to the consistent and responsible actions taken by individuals to dispose of waste appropriately. Proper waste disposal is crucial for environmental sustainability and public health, as inadequate practices lead to pollution, health risks, and negative impacts on communities (Abubakar et al., 2022). Previous studies have indicated that several factors are related to proper waste disposal behavior, including perceived consequences, accessibility of trash bins, environmental concerns, and perceived behavioral control.

Perceived Consequences

In the context of this study, perceived consequences refer to an individual's awareness of the potential negative outcomes or impacts associated with improper waste disposal practices. A study conducted by Sharma et al. (2023) revealed that perceived consequences influence proper waste disposal behavior, as shown in the study that 71% of respondents are aware of adverse impacts tend to have better waste management practices. On the other hand, a lack of awareness about health risks from improper waste disposal hinders responsible waste management practices (Kaoje et al., 2017). Moreover, several studies also suggest that perceived consequences significantly affect individuals' waste disposal behavior (Janmaimool, 2017; Foon et al., 2020).

Previous research also suggests that an increase in awareness of proper waste disposal methods leads to greater concern for the environment, making individuals more environmentally conscious choices in waste management practices (Michael et al., 2019).

Accessibility of Trash Bins

Accessibility of trash bins refers to the ease with which individuals can locate and utilize those within a given environment. This affects waste disposal behavior, as their presence create a sense of convenience and adherence to proper disposal policies. Research has shown that the proximity and

accessibility of trash bins play a critical role in encouraging proper waste disposal practices and reducing littering (Tahar & Azmira, 2017).

In addition, studies have indicated that making recycling bins more immediately accessible at the point of behavioral decision can increase utilization (Rosenthal & Linder, 2021), and enhancing accessibility would likely encourage the behavior (Zhang et al., 2016). Furthermore, modifying the abundance and location of trash bins can influence waste collection, as decreasing disposal efforts by increasing convenience may change behavior (Robinson, 2023).

Environmental Concern

Environmental concern, in the context of this study, refers to being environmentally conscious and expressing concern about environmental issues. Studies have indicated that increasing knowledge about environmental ethics can improve behavior in managing waste (Zulfa et al., 2021), suggesting that environmental concern can influence waste management behavior. Wu et al. (2022) found that environmental concern affects individuals' waste management practices, and Lou & Li (2022) reported a positive correlation between environmental concern and public pro-environmental behavior, indicating a significant impact on waste disposal behavior. Additionally, beliefs and values regarding the environment have been shown to significantly predict ecologically responsible behavior, with higher environmental concern correlating with increased engagement in environmental protection activities (Miguens et al., 2014).

Environmental concern can indirectly affect proper waste disposal behavior through Perceived Behavioral Control, considering that environmental concern can influence an individual's attitudes and beliefs about their ability to control their behavior related to waste disposal. For example, if an individual is concerned about the environment, they may be more likely to believe that they can properly dispose of waste, leading to a stronger perception of behavioral control. This, in turn, can lead to a greater likelihood of engaging in proper waste disposal behavior. This relationship is supported by several studies (Jekria & Daud, 2016; Wu et al., 2022).

Perceived Behavioral Control

The Theory of Planned Behavior (TPB), is defined as "a psychological theory that links beliefs to behavior," (Bošnjak, Ajzen, & Schmidt, 2020). Individuals' behaviors are influenced by control beliefs, which include their perceptions of how challenging a task is and their confidence in their abilities to perform it effectively (e.g., "waste separation is easy for me;" Ajzen, 2005).

Perceived behavioral control does affect proper waste disposal behavior. Studies have shown that perceived behavioral control, which refers to an individual's belief in their skills and abilities to perform a specific behavior, is a significant factor influencing waste disposal behavior (Cheng, 2020; Rahmania, 2023; Romo et al., 2019; Wang et al., 2020;). For instance, in a study focusing on dog owners' behaviors related to pet waste disposal, perceived behavioral control was found to be the construct most significantly correlated with

behavioral intent regarding the dog's proper waste disposal (Romo et al., 2019). This indicates that individuals who feel confident in their ability to dispose waste properly are more likely to engage in appropriate waste disposal practices.

Research Hypotheses and Framework

Previous researches suggest that the availability and accessibility of trash bins, individuals' awareness of the consequences of improper waste disposal, their concern for the environment, and their perceived ability to control waste disposal actions are all factors related to proper waste disposal behavior. Thus, it can be hypothesized that:

H1. Accessibility of trash bins affects proper waste disposal behavior.
H2. Perceived consequences affect proper waste disposal behavior.
H3. Environmental concerns affect proper waste disposal behavior.
H4. Perceived behavioral control affects proper waste disposal behavior.

Previous studies showed that when a person becomes more aware of the potential consequences of improper waste disposal methods, they tend to be more environmentally conscious. Moreover, people who are already environmentally conscious are more likely to believe that they can dispose of waste properly. Therefore, it can be hypothesized that:

H5. Perceived consequences affect environmental concerns.
H6. Environmental concerns affect perceived behavioral control.

Moreover, this study also investigated the indirect effects of these variables on proper waste disposal behavior. Hence, it can be hypothesized that:

H7. Environmental concern mediates the effect of perceived consequences on proper waste disposal behavior.
H8. Perceived behavioral control mediates the effect of environmental concern on proper waste disposal behavior.
H9. Environmental concern and perceived behavioral control sequentially mediate the effect of perceived consequences on proper waste disposal behavior.

Figure 1 presents the proposed research model based on the identified research hypotheses.

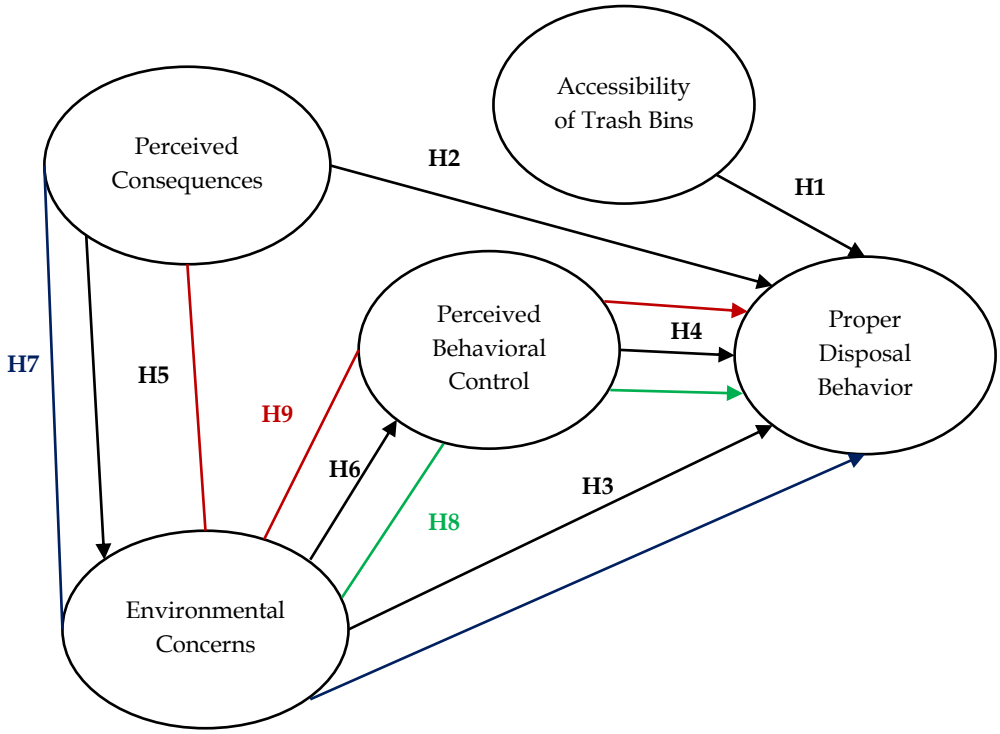


Figure 1. Proposed Research Model

METHODOLOGY

Participants of the Study

The study included 293 students from three public high schools in Nueva Ecija, Philippines. The inverse square root and gamma-exponential methods were used to estimate the sample size sufficiency (Kock & Hadaya, 2016). Using WarpPLS version 8.0, the following parameters were set: a minimum absolute significant path coefficient of 0.12, a significance level of 0.05, and a power level of 0.67. The inverse square root method suggested a sample size of 302, while the gamma-exponential method recommended a sample size of 291 (see Figure 2). The actual sample size of 293 students fell within this range.

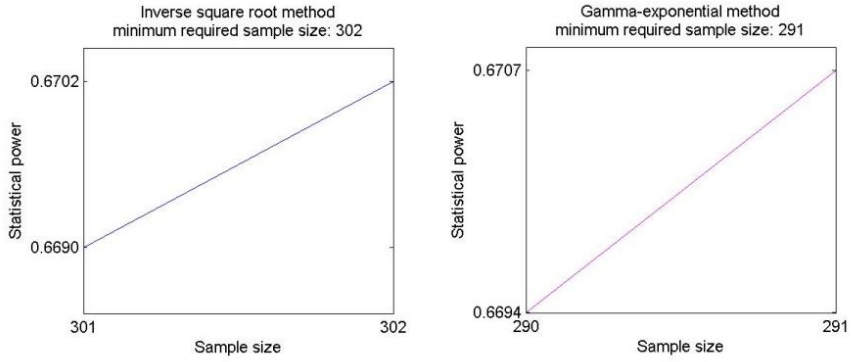


Figure 2. The Results of Inverse Square Root and Gamma-Exponential Methods

Research Instrument

This study used a survey questionnaire as the research tool. To ensure that the tool produces results aligned with the research objective, the researchers conducted a literature review to understand the constructs essential for the instrument for the development of the research tool.

The questionnaire consisted of two parts: the demographic profile of the respondents, and the items for the four-construct in this study - Accessibility of Trash Bins, Perceived Consequences, Environmental Concerns, Perceived Behavioral Control, and Proper Disposal Behavior.

Reliability and Validity Measurements

The evaluation of the outer model involved a test of the validity and reliability of the constructs. Reliability tests assess the consistency of the research instrument, with an instrument deemed reliable if the measures or items for each latent variable are interpreted consistently across different participants (Kock, 2017). In this study, reliability was measured using Cronbach's Alpha (CA) and Composite Reliability (CR), with an acceptable threshold set at 0.7 or higher (Fornell & Larcker, 1981; Kock & Lynn, 2012).

Validity measurements were conducted to assess both convergent and discriminant validity, which determine the extent to which an instrument measures its intended constructs (Tavakol & Dennick, 2011). Convergent validity is achieved when the items associated with each latent variable are understood by respondents as intended by the instrument's designers (Kock, 2017). This was evaluated using item loading and Average Variance Extracted (AVE). For good convergent validity, item loading should have p-values of 0.05 or less and values of 0.5 or higher (Hair et al., 2009), while AVE values should be ≥0.5 or greater (Kock & Lynn, 2012).

Table 1 presents each latent variable's CA and CR coefficients, item loadings, and AVE. All values meet or exceed the required thresholds, indicating that the constructs are reliable and valid.

Table 1. Convergent Validity and Reliability Measures

Construct	No. of items	Item Loading	AVE	CA	CR
Accessibility of trash bins	5	0.729 -0.784	0.565	0.807	0.866
Perceived consequences	4	0.805-0.850	0.691	0.851	0.899
Environmental concern	4	0.854-0.879	0.746	0.887	0.922
Perceived behavioral concern	3	0.831-0.840	0.698	0.783	0.874
Proper Disposal Behavior	4	0.703-0.821	0.612	0.787	0.863

All item loadings are significant at 0.001 (p<.001). AVE = average variance extracted; CR =composite reliability; CA = Cronbach's alpha

Discriminant validity is achieved when respondents clearly distinguish between items of different latent variables and do not confuse them with items from other constructs (Kock, 2017). To assess this, the Average Variance Extracted (AVE) square root for each latent construct must be greater than the correlations involving that construct. In other words, the diagonal values in the

matrix should exceed the off-diagonal values in the same row (Kock, 2017; Fornell & Larcker, 1981).

Table 2 shows that each latent variable's AVE square root exceeds the correlations with other variables, which implies good discriminant validity.

Table 2. Discriminant Validity using Fornell and Larcker Criterion

	ATB	PC	EC	PBC	PDB
Accessibility of Trash Bins (ATB)	**0.752**				
Perceived Consequences (PC)	0.581	**0.831**			
Environmental Concerns (EC)	0.595	0.719	**0.864**		
Perceived Behavioral Control (PBC)	0.557	0.644	0.729	**0.835**	
Proper Disposal behavior (PDB)	0.484	0.453	0.586	0.505	**0.782**

Diagonal elements are the square root of AVE of constructs, whereas the off-diagonal elements are the correlation between constructs.

Data Analysis

This study used a predictive-correlational design to verify if accessibility to trash bins, perceived consequences, environmental concern, and perceived behavioral control predict students' proper waste disposal. The analysis was conducted using Partial Least SquaresStructural Equation Modeling (PLS-SEM) which involves three steps: model specification, outer model evaluation, and inner model evaluation (Hair et al., 2014).

In the model specification phase, a logical path model was developed. The outer model evaluation assessed the reliability and validity of the constructs, while the inner model evaluation analyzed the structural paths, effect sizes, collinearity, coefficient of determination, and predictive relevance of the model (Hair et al., 2016). Additionally, mediation analysis was performed to explore the indirect effects among the variables.

Model Fit and Quality Indices

The assessment of the model fit and quality indices involves several key criteria. The coefficients for the Average Path Coefficient (APC), Average R-Squared (ARS), and Average Adjusted R-Squared (AARS) should have p-values ≤0.05 (Kock, 2011). Additionally, the Average Block Variance Inflation Factor (ABVIF) and Average Full Collinearity VIF (AFCVIF) should be equal to or less than 3.3 (Kock & Lynn, 2012). The Tenenhaus Goodness of Fit (GoF) index measures the explanatory power of the structural model, with values indicating small (≥ 0.1), medium (≥ 0.25), and large (≥ 0.36) explanatory power (Wetzels et al., 2009).

Table 3 presents the model fit and quality indices of the PLS-Structural Model. The results indicate that the coefficients for APC, ARS, and AARS have p-values less than 0.001, and both ABVIF and AFCVIF are below 3.3, confirming that the model fits the data. Additionally, the Tenenhaus GoF is 0.561, indicating that the structural model has a large explanatory power.

Table 3. Model Fit and Quality Indices

Indices	Coefficients
APC	0.365, P<0.001
ARS	0.476, P<0.001
AARS	0.472, P<0.001
ABVIF	2.322
AFCVIF	2.247
Tenenhaus GoF	0.561

RESULTS

Figure 3 depicts the PLS path model, showing Beta coefficients (β) as the path coefficients of the model. As can be seen, the beta coefficient between accessibility of trash bins and proper disposal behavior (β=0.19, p<.01), behavioral control and proper disposal behavior (β=0.12, p=.02), environmental concern and proper disposal behavior (β=0.40, p<.01), perceived consequence and environmental concern (β=0.72, p<.01) are significant and positive while the beta coefficient of perceived consequences and proper disposal behavior was not significant (β=-0.03, p=.33).

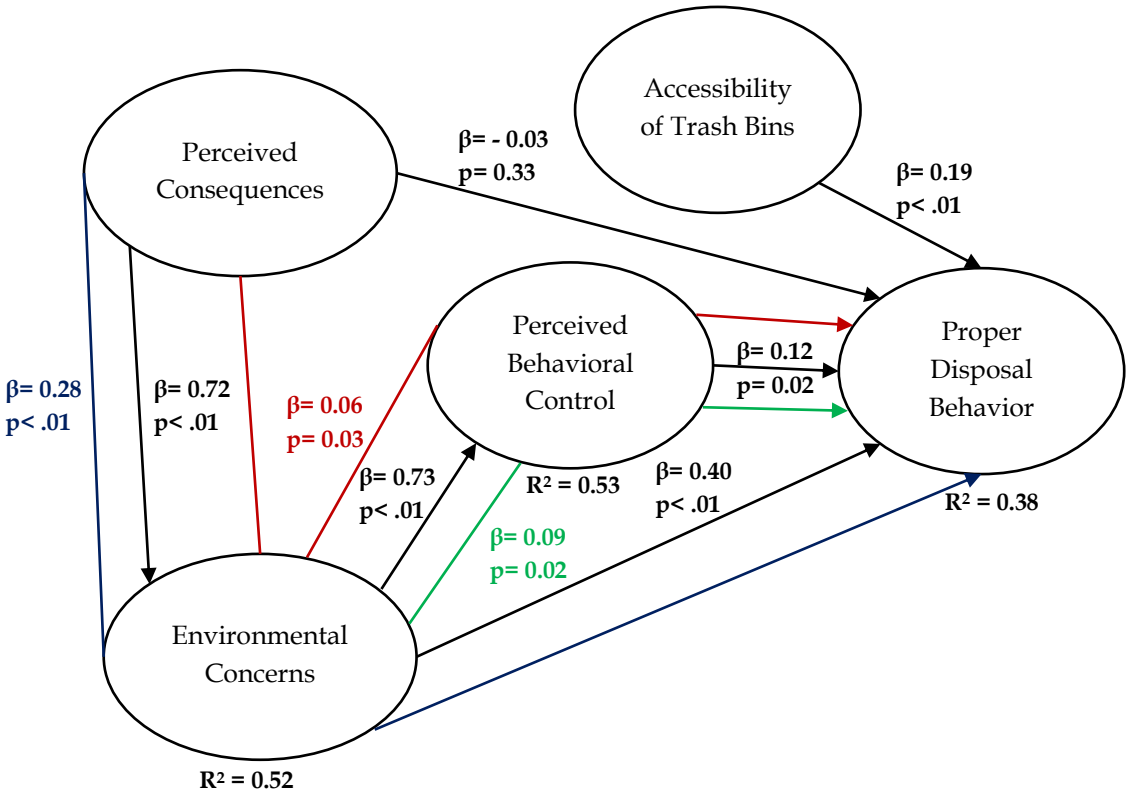


Figure 3. Proposed Research Model with Parameter Estimates

Direct and Indirect Effects

Table 4 presents the direct and indirect effects of the PLS path model. Analysis of the data indicates that accessibility to trash bins positively affects proper disposal behavior (β=0.19, p<0.001) with a small to medium effect size (Cohen's f^2 =0.09); environmental concern positively affects proper disposal behavior (β=0.40, p<0.001) with a medium to large effect size (Cohen's f^2 =0.23); perceived behavioral control positively affect proper disposal behavior (β=0.12, p=0.02) with a small to medium effect size (Cohen's f^2 =0.06); perceived consequences positively affects environmental concern (β=0.72, p<0.001) with a large effect size (Cohen's f^2 =0.52); and environmental concern positively affects perceived behavioral control (β=0.73, p<0.001) with a large effect size (Cohen's f^2 =0.52). Therefore, hypotheses H1, H3, H4, H5, H6 are supported. On the other hand, perceived consequences do not affect proper disposal behavior (β=-0.03, p=0.33). Hence, H2 is not supported.

The analysis also indicates that the indirect effect of perceived consequences on proper disposal behavior with environmental concern as the mediator is statistically significant (β=0.28, p<0.001) with a small to medium effect size (Cohen's f^2 =0.13). Additionally, the indirect effect of environmental concern on proper disposal behavior with perceived behavioral control as a mediator is statistically significant (β=0.09, p=0.02), with a small effect size (Cohen's f^2 =0.05). Furthermore, there is a sequential mediation effect, where environmental concern and perceived behavioral control sequentially mediate the relationship between perceived consequences and proper disposal behavior (β=0.06, p=0.03), with a small effect size (Cohen's f^2 =0.03). Therefore, the results support hypotheses H7, H8, and H9.

Table 4. Direct and Indirect Effects

		β	**SE**	**p-value**	f^2
Direct Effects					
H1.	ATB → PDB	0.19	0.06	<0.001	0.09
H2.	PC → PDB	-0.03	0.06	0.33	0.01
H3.	EC → PDB	0.40	0.06	<0.001	0.23
H4.	PBC → PDB	0.12	0.06	0.02	0.06
H5.	PC → EC	0.72	0.05	<0.001	0.52
H6.	EC → PBC	0.73	0.05	<0.001	0.53
Indirect Effects					
H7.	PC → EC → PDB	0.28	0.04	<0.001	0.13
H8.	EC → PBC → PDB	0.09	0.04	0.02	0.05
H9.	PC → EC → PBC → PDB	0.06	0.03	0.03	0.03

Legend: ATB = Accessibility of Trash Bins, EC = Environmental Concerns, PBC = Perceived Behavioral Control, PC = Perceived Consequences, PDB = Proper Disposal Behavior, f^2 is Cohen's (1988) effect size: 0.02=small, 0.15=medium, 0.35=large.

The evaluation of the structural model includes the assessment of full collinearity, coefficient of determination (R^2), and predictive relevance (Q^2). Kock & Lynn (2012) introduced the full collinearity test to assess both vertical

and lateral collinearity, considering the model free of common method bias if all full collinearity Variance Inflation Factors (VIFs) are equal to or below 3.3. The R^2 coefficient represents the percentage of variance in the outcome variable explained by the predictor variables hypothesized to affect it (Kock, 2017). On the other hand, the Q^2 coefficient measures the predictive accuracy of the PLS path model which values greater than zero are meaningful (Hair et al., 2018).

Table 5 presents the coefficients of full collinearity VIFs for the variables in this study. As shown, the full collinearity VIFs of accessibility of trash bins, perceived consequences, environmental concerns, perceived behavioral control, and proper disposal behavior range from 1.607 to 3.139, all of which are lower than 3.3. Hence, the outer model has no vertical and lateral collinearity. Additionally, environmental concerns and perceived behavioral control explain 51.7% and 53.2% of the variance, respectively. The predictors, accessibility to trash bins, perceived behavioral control, and environmental concern, explain 37.8% of the variance in proper disposal behavior. Moreover, the Q^2 coefficient for environmental concerns is 0.517, 0.532 for perceived behavioral control, and 0.380 for proper disposal behavior. This indicates that the predictive accuracy for environmental concerns, perceived behavioral control, and proper disposal behavior are meaningful.

Table 5. Collinearity Assessment, Coefficient of Determination, and Predictive Relevance

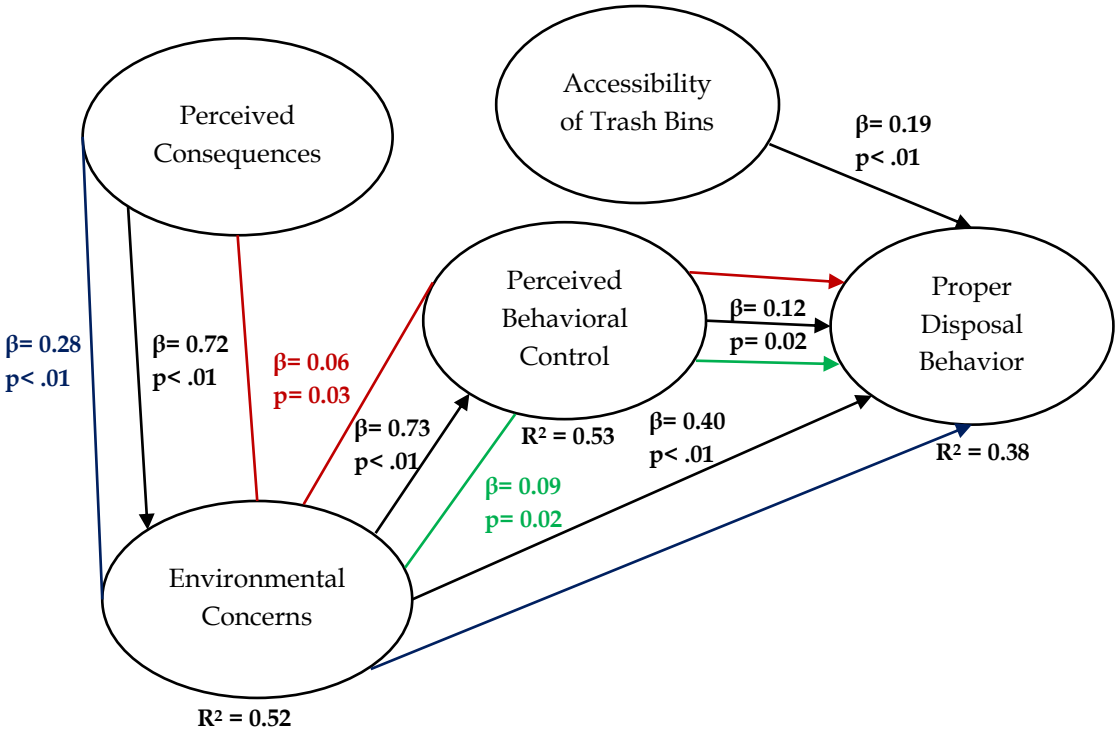
Constructs	Full Collinearity VIF	R^2	Q^2
Accessibility of Trash Bins	1.781		
Perceived Consequences	2.338		
Environmental Concerns	3.139	0.517	0.517
Perceived Behavioral Control	2.370	0.532	0.532
Proper Disposal behavior	1.607	0.378	0.380

Q^2 values of 0, 0.25, and 0.50 represent small, medium, and large predictive accuracy, respectively (Hair et al., 2018)

Revised Model

Figure 4 illustrates the revised PLS path model with the insignificant path removed. As can be seen, Beta coefficients (β) for the paths between accessibility of trash bins and proper disposal behavior ($\beta=0.19$, $p<0.01$); perceived behavioral control and proper disposal behavior ($\beta=0.12$, $p=0.02$); environmental concern and proper disposal behavior ($\beta=0.39$, $p<0.01$); perceived consequences and environmental concerns ($\beta=0.72$, $p<0.01$); and environmental concerns and perceived behavioral control ($\beta=0.73$, $p<0.02$) are significant and positive. This implies that there are significant positive relationships between accessibility of trash bins and proper disposal behavior; perceived behavioral control and proper disposal behavior; environmental

concern and proper disposal behavior; perceived consequences and environmental concerns; and environmental concerns and perceived behavioral



control.

Figure 4. The Predictors of Proper Disposal Behavior Model with Parameter Estimates

DISCUSSION

The present study confirmed that accessibility to trash bins significantly and positively affects proper disposal behavior, indicating that when trash bins are more accessible, students are more likely to dispose of waste properly. This finding is consistent with the previous researches, which have shown that the proximity and accessibility of trash bins enhance adherence to proper disposal practices (Tahar & Azmira, 2017; Rosenthal & Linder, 2021; Zhang et al., 2016). The current study also confirmed that environmental concerns significantly and positively affect proper disposal behavior, implying that students who are more concerned about the environment are likely to engage more actively in proper waste disposal. This aligns with the findings from other studies that link environmental concern to improved waste disposal actions (Wu et al., 2022; Lou & Li, 2022; Miguens et al., 2014). Additionally, the present study found that perceived behavioral control significantly and positively affects proper disposal behavior indicating that students who believe they can dispose of waste properly are more likely to do so. This is supported by earlier studies that have identified perceived behavioral control as a key predictor of waste disposal behavior (Cheng, 2020; Rahmania, 2023; Romo et al., 2019).

The study found that the perceived consequences of improper waste disposal do not directly influence the behavior of properly disposing of waste. Instead, these perceived consequences indirectly impact behavior through their influence on the level of concern for the environment. This implies that when students become more aware of the negative consequences that can result from improper waste disposal, they become more concerned about the environment. As a result, this care increases their likelihood of disposing of waste properly.

Additionally, the study acquired that there is a significant indirect effect of environmental concern on proper waste disposal behavior. The perceived behavioral control mediated this effect, which means that when students care about the environment, it affects their beliefs about how they can control their actions related to waste disposal. Consequently, this encourages them to engage in proper waste disposal.

Lastly, this research obtained that environmental concern and perceived behavioral control sequentially mediate the effect of perceived consequences on proper disposal behavior. This means that simply knowing the negative effects of improper waste disposal is not enough to change people's behavior directly. Instead, this knowledge first increases their concern for the environment, then when the students become more concerned about environmental issues, they start to believe more strongly that they can make a difference through their actions which consequently encourages them to engage in proper waste disposal practices.

CONCLUSIONS AND RECOMMENDATIONS

This study used a predictive-correlational design and structural equation modeling to explore predictors of proper waste disposal behavior, and developed a structural model. The developed research instrument was used to survey 293 high school students from three public schools in Nueva Ecija, Philippines. WarpPLS 8.0 was used to perform Partial Least Squares-Structural Equation Modeling (PLS-SEM). Analyses of validity and reliability were performed to ensure the suitability of the research instrument for this study.

The results showed that accessibility of trash bins, perceived consequences, environmental concern, and perceived behavioral control predict proper waste disposal behavior. Moreover, the research model was able to predict the effects of these factors on proper disposal behavior with medium to large predictive accuracy. A revised model was formulated based on parameter estimates.

Based on the results, schools can increase the accessibility of trash bins by adding more bins, placing them in high-traffic areas, and ensuring their visibility. They can integrate environmental education into the curriculum to raise awareness about proper waste disposal, incorporating lessons on environmental impact, recycling, and sustainability. Organizing eco-friendly activities, such as recycling drives, clean-up events, and sustainability workshops, can help turn awareness into practical actions. Along with these, policymakers, environmental organizations, and educational institutions may use the research model as a

conceptual basis for developing action plans aiming to reduce mismanaged waste and protect the environment**.**

FURTHER STUDY

The findings of this study can be used as a foundation for future research on waste disposal behaviour. While the study identified significant predictors, there may still be other factors that require investigation. Future studies could test the revised model in different educational settings or geographical areas to assess its applicability and robustness.

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