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# Factors Influencing Recycling Behaviour of University Students in Vietnam: The Moderating Role of Wish-Cycling

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**Abstract:** Pollution and environmental concerns are threatening sustainable growth worldwide. Based on Social Learning Theory, this study examines the factors influencing university students' recycling behaviour. A mixed-methods approach was applied, including qualitative research with 12 participants, and quantitative survey of 545 Vietnamese university students analyzed using PLS-SEM. Findings show pro-environmental behaviour, self-efficacy, and social influence influences recycling behaviour, while environmental knowledge and self-efficacy enhance pro-environmental behaviour. Additionally, results show wish-cycling negatively affects the relationship between pro-environmental behaviour and recycling behaviour, a role previously unexplored in the literature. The research extends the environmental behaviour framework and provides policy implications for improving recycling perceptions.

**Keywords:** Pro-environmental behaviour; Recycling behaviour; Self-efficacy; Social influence; Wish-cycling

## 1. Introduction

In the 21st century, environmental conditions have worsened rapidly, driven mainly by excessive $CO_2$ emissions, the sharp growth of plastic production, and poor waste management practices[1)]. Vietnam, in particular, has become one of the top ten countries contributing the most plastic waste to the ocean, with an estimated 28,000 tons released annually[2)]. This shows that plastic has become a "new entity" with negative impacts on the planet, so urgent and comprehensive measures are needed to control and minimize the adverse consequences[3)]. The main causes of the current alarming state of the environment are population growth, rapid urbanization, and rising living standards, which have led to a significant increase in urban solid waste[4)]. Additionally, per capita greenhouse gas emissions increased by 8.3% from 1990 to 2022[5)] . Given this context, recycling behaviour is seen as a practical solution to help reduce environmental damage[6)].

Recycling is a voluntary behaviour that includes sorting, cleaning, and sometimes even transporting recyclable waste to a processing facility[7)]. In other words, recycling is the process of collecting and processing materials that were once considered waste, then converting them into new products, contributing to a reduction in resource waste[8)]. This behaviour contributes to environmental protection by reducing greenhouse gas emissions and energy consumption[9)]. Recycling participation at the individual level has a strong impact on promoting environmental sustainability[10)].

According to social learning theory, people learn behaviour by observing and imitating others, and they are influenced by the outcomes of those behaviours. Besides, this process also depends on their belief in their own abilities and the interaction between the individual, behaviour, and environment[11)]. Existing studies have identified social influence, environmental knowledge, and self-efficacy beliefs as major determinants of recycling behaviour[12-14)], with the especial focusing on consumers in Chinese and the USA[13)] and Indonesia[14)]. Nevertheless, research has only modestly examined how self-efficacy beliefs indirectly shape recycling behaviour through pro-environmental actions.

Furthermore, wish-cycling refers to discarding items of uncertain recyclability into recycling bins under the assumption that the system will manage them

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appropriately[15]. This practice challenges the recycling system because it leads to contamination[16], raises recycling costs[17], and can damage processing machinery[18]. Moreover, wish-cycling has the potential to disrupt the relationship between pro-environmental behaviour and recycling behaviour. If wish-cycling is widespread, pro-environmental behaviour motivated actions may inadvertently result in practices that contaminate recyclables. So far, the moderating effect of wish-cycling in this relationship has not been explored.

Notably, university students are often regarded as a group with high environmental consciousness and an important influence on sustainable behaviour[19]. Based on Social Learning Theory, this study examines whether wish-cycling plays a moderating role in the relationship between pro-environmental behaviour and recycling behaviour. Accordingly, wish-cycling is proposed as a potential moderator that could address gaps in both theory and practical approaches to waste management. The study therefore considers how environmental knowledge, pro-environmental behaviour, social influence, and wish-cycling shape students' recycling behaviour. The anticipated results aim to offer useful guidance for universities and businesses in crafting communication and educational initiatives that strengthen recycling effectiveness.

## 2. Literature Review

### 2.1. Social Learning Theory

Albert Bandura's Social Learning Theory[11] highlights that people acquire new behaviours through observing and imitating others, while also considering the outcomes of those behaviours to shape their learning and future choices. Human behaviour is formed from the continuous interaction of three factors: personal cognition, specific behaviour, and the surrounding environment[20]. Personal perception includes beliefs, expectations, values, and emotions. In particular, self-efficacy means believing in one's own ability to act, and it plays an important role in shaping behaviour. Moreover, people learn by paying attention, remembering, imitating, and receiving reinforcement. As a result, these steps make it easier to repeat what they observe. In addition, the environment provides role models and also affects personal choices. According to Social Learning Theory, people learn by observing and imitating those they admire, and then they apply this knowledge in real-life situations. Consequently, learning is not passive but active, as people reshape their thinking and behaviour through their experiences[21]. Finally, the environment strongly shapes both perception and behaviour, which makes the learning process more natural and flexible[22,23].

### 2.2. Recycling Behaviour

Recycling behaviour (RB) is a type of pro-environmental behaviour. It includes activities such as sorting, storing, or doing basic processing, and transporting recyclable waste to the correct collection points[24]. According to Lau et al.[25], recycling is one of the essential solutions to reduce plastic waste. Due to the serious negative impacts of plastic waste, recycling plays a critical role in reducing energy consumption, limiting toxic emissions and greenhouse gases, and decreasing the need to produce new plastic and the amount of plastic waste released into the environment[26]. Therefore, recent research has shifted from emphasizing only the importance of recycling to also clarifying proper recycling methods.

Previous studies have found that recycling behaviour is influenced by many personal and social factors, such as personal norms, social norms[27,28], environmental knowledge, attitudes and personality characteristics [29], household roles, sociodemographic and psychographic characteristics[30]. While Gamba and Oskamp[31] demonstrate that recylcing knowledge and specific attitudinal measures are significant predictors of self-reported recycling behaviour, a recent study has examined socioeconomic factors associated with recycling behaviour and waste generation in a diverse university population in the United Arab Emirates[32]. However, most of these studies focus on each factor separately and rarely examine them together, especially the factors with strong theoretical meaning, including social influence, environmental knowledge, pro-environmental behaviour, self-efficacy, and the moderating role of "wish-cycling" among Vietnamese students. Most current research also overlooks the role of wish-cycling - putting trash into the recycling bin with the hope that it will be recycled, even though the action does not follow the correct guidelines. Although wish-cycling is frequently mentioned in practical reports as a factor that disrupts recycling systems, it is still rarely studied as a moderating variable that may change the influence of psychosocial factors on recycling behaviour.

In Vietnam, source-based waste classification is still inconsistent, which makes wish-cycling very common and reduces the quality of recyclable materials. This highlights the need for research into proper recycling behaviour. Therefore, this study focuses on university students in Vietnam in the context of increasing urban waste pressure and an inefficient source-separated waste system, which leads to low-quality recyclable materials. Studying this group, who have a high level of education is important for understanding the gap between high environmental awareness and the practical skills required. The findings of this study will provide scientific foundations for management policies and educational campaigns to guide effective practical solutions and ensure clean material sources for a circular economy.

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## 2.3. Pro-environmental Behaviour

Pro-environmental behaviour (PB) is commonly practiced through habits like reusing products, making sustainable choices, and recycling materials[33,34]. The common purpose of these actions is to ease the burden on the environment and conserve resources[35]. Of these, recycling is especially important because it helps us to use old materials again by sorting and processing them, thereby giving them new life instead of being discarded[36]. When an individual develops environmental awareness and habits, they often tend to take more concrete actions, such as sorting trash or recycling. People act in eco-friendly ways because they realize pollution is a serious problem and want to limit the damage. For example, a student who usually carries a personal water bottle may recycle a plastic one by putting it in a recycling bin instead of throwing it away. Due to the lack of extensive research in this field, the study suggests the following hypothesis:

*H1: Pro-environmental behaviour has a positive impact on recycling behaviour.*

## 2.4. Environmental Knowledge

Environmental knowledge (EK) is not only about knowing the state of the environment, its principles, and how ecosystems interact, but also about understanding key ideas and symbols connected to the environment[37,38]. Geiger et al.[39] observed that people who are more knowledgeable about the environment usually recycle more, though the effect is not very strong. In daily life, this kind of knowledge can shape how people respond to waste and make decisions about sustainable actions. For instance, someone who realizes that plastic waste harms the ocean and endangers marine animals is more likely to recycle a plastic bottle rather than throw it away with other trash. However, the link between environmental knowledge and recycling behaviour has not been firmly established across different contexts. Therefore, this study proposes:

*H2: Environmental knowledge has a positive effect on recycling behaviour.*

According to Pagiaslis and Krontalis[40], environmental knowledge can be defined as awareness of global and local challenges, including climate change, declining resources, and the ecological effects of production and consumption. Han[41] states that this knowledge goes beyond recognizing concepts, as it also includes understanding harmful behaviours and directing actions toward sustainable solutions. Therefore, environmental knowledge becomes an important foundation for pro-environmental behaviour, which are actions aimed at minimizing negative impacts and protecting ecosystems, such as energy conservation, recycling, or participating in community activities[42]. Many studies confirm the strong link between environmental knowledge and pro-environmental behaviour. According to Kim et al.[43], people with higher levels of environmental knowledge tend to adopt and encourage green behaviours in their daily lives. In addition, Amoah and Addoah[44] emphasize the role of knowledge as a key predictor in developing countries. Additionally, Hines et al.[45] also emphasized that full access to knowledge helps individuals clearly understand the consequences of their actions and form the motivation to protect the environment. Therefore, environmental knowledge acts as a foundation that shapes green awareness and behaviour. From this perspective, the study puts forward the following hypothesis:

*H3: Environmental knowledge has a positive effect on pro-environmental behaviour.*

## 2.5. Self-efficacy

Schwoerer et al.[46] suggested that an individual's sense of self-confidence in completing a specific task effectively indicates their perceived capability. In social learning theory, this factor plays an important role because it directly influences how people choose behaviours and maintain those behaviours during the learning and adaptation process[21]. Social learning theory is the process of mutual interaction between people, behaviour, and the surrounding environment[47]. Bandura[48] emphasized that strong self-efficacy enables individuals to excel in their tasks and remain committed to their goals despite challenges. In the context of environmental sustainability, pro-environmental actions represent individuals' attempts to reduce their negative impact on nature and support the restoration of ecological systems[49]. Specifically, students are a group with great potential for accessing new knowledge and generating initiatives that help change environmental behaviours[50]. According to Shafiei and Maleksaeidi[51], increasing self-efficacy beliefs in students is one of the determining factors in encouraging pro-environmental behaviour. Additionally, self-efficacy simultaneously impacts both directly and indirectly to promote pro-environmental behaviour by reinforcing feelings of pride[52]. When students have confidence in their abilities, that will motivate them to maintain environmentally friendly behaviours. After efforts of exploration and research, a proposal was put forward that:

*H4: Self-efficacy has a positive impact on pro-environmental behaviour.*

## 2.6. Social Influence

Social influence (SI) refers to the way people change their behaviour, attitudes, or beliefs due to the presence or opinions of others[53]. Venkatesh et al.[54] explain that this concept shows how much individuals feel the impact of social groups on their decisions and behaviour. This influence happens through processes such as following norms, agreeing with the group, or feeling pressure from others. Schwab and et al.[55] research shows that recycling habits are often formed from group influence, even if family or friends outside the group do not support it. Based

on social learning theory, students observe and imitate the behaviour of others, thereby forming their perception of the value and benefits of green actions. Simiyu et al.[56] assert that social influence and behavioural norms are strong predictors of environmental behaviour, while Han and Xu[57] emphasize that information and recycling behaviour from family and friends increase participation. Blose et al.[12] add that social relationships not only encourage short-term recycling but also contribute to the formation of sustainable habits. Thus, social influence plays an important role in encouraging and maintaining pro-environmental behaviour. Therefore, the authors propose the hypothesis:

*H5: Social influence has a positive impact on pro-environmental behaviour.*

Social influence refers to the impact of direct relationships (such as friends, family, and community) or social media relationships on an individual's thoughts, feelings, attitudes, and behaviours[58,59]. Bandura's social learning theory[11] suggests that people are shaped by observing and copying the actions of others, acquiring knowledge through the behaviours demonstrated by role models. According to Blose et al.[12], social influence is a significant driving factor for recycling behaviour among university students in the US and China. Social influence plays a vital role in promoting recycling by fostering shared learning among people. Proper recycling gradually becomes a common practice. This inspires individuals to adopt the behaviour, resulting in the formation of lasting eco-friendly habits within the community. For instance, a group of friends regularly engages in recycling behaviour and shares knowledge about proper recycling through conversations or social media, which helps other members of the group imitate their recycling actions. After a period of research and surveys, the authors found that there were still some aspects that needed further investigation. Therefore, the proposal is made that:

*H6: Social influence has a positive impact on recycling behaviour.*

### 2.7. Wish-cycling

According to Cognitive Dissonance Theory, individuals may recycle uncertain items to reduce the discomfort caused by recyclability uncertainty[60]. Moreover, Moral Licensing Theory suggests that prior environmentally friendly actions may lead individuals to behave less carefully in later environmental decisions[61]. These tendencies may increase the likelihood of wish-cycling, where individuals place items with uncertain recyclability into recycling bins. This behaviour may reduce recycling accuracy and weaken the positive effect of pro-environmental behaviour on recycling behaviour. Therefore, wish-cycling is expected to negatively moderate the relationship between pro-environmental behaviour and recycling behaviour. Therefore, the following hypothesis is formulated:

*H7: Wish-cycling has a negative impact on the relationship between pro-environmental behaviour and recycling behaviour.*

Based on Social learning theory and the hyphotheses, the conceptual model is proposed as Figure 1.

## 3. Materials and Methods

This study employed a combination of qualitative and quantitative methods to identify the relationships between variables and further explore the factors influencing recycling behaviour. The study followed a sequential design in which the qualitative phase preceded the quantitative phase. Findings from expert and student consultations were used to evaluate the translated measurement scales, identify wording issues, and improve the clarity of questionnaire items. The revised scales were subsequently employed in the quantitative survey to test the proposed model and hypotheses. For the qualitative approach, the research team sent consultation letters to 12 individuals, including 5 experts and 7 students via email and conducted direct or online interviews through Google Meet.

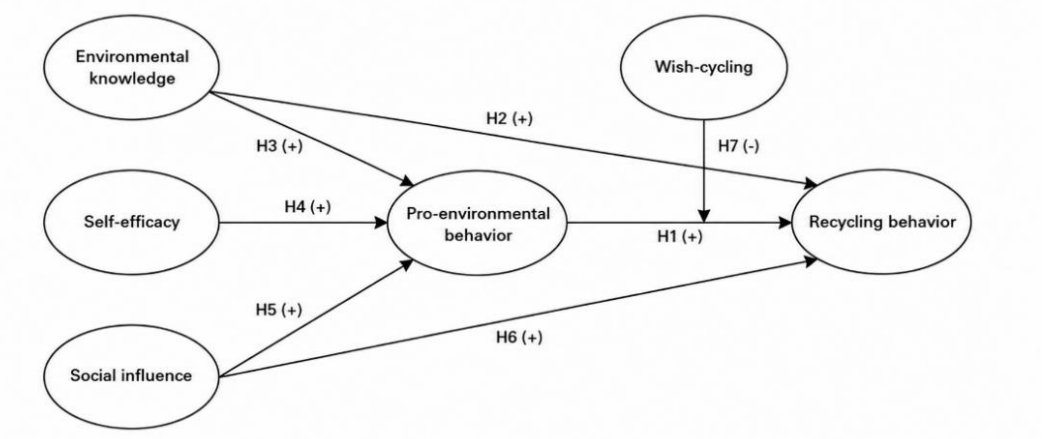



**Fig. 1:** Conceptual framework

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The purpose of this method was to consult experts and students in order to confirm the clarity of the questionnaire after it was translated from English into Vietnamese, thereby refining the measurement scales. The questions were adjusted to fit the Vietnamese context. Feedback from experts and students indicated that the conceptual meaning of all constructs was generally retained after translation. However, several items required minor wording adjustments to improve readability and ensure consistency with Vietnamese language usage.

For the quantitative approach, a convenience sampling method was applied, and data were collected through Google Forms distributed in Vietnamese student communities on social media. Convenience sampling helps save costs, time, and is easy to implement[62]. The questionnaire is designed in two parts. In the first part, survey respondents will be asked to provide demographic information, such as gender "What's your gender?" (male = 1 and female = 2); year of study "What year are you a student" (first year = 1, 2nd year = 2, 3rd year = 3, 4th = 4, 5th and higher = 5); city "What city are you currently living and studying in?" (Ho Chi Minh city = 1, Ha Noi = 2, Hue = 3, other = 4). The second part includes 26 items that were used to measure six constructs. The questionnaire was designed based on the qualitative results and research constructs, using a 5-point Likert scale, where 1 indicates "Strongly disagree" and 5 indicates "Strongly agree" [63]. The observed variables measuring recycling behaviour were selected, adapted, and formulated from the scale of Ali et al.[64]. The scale for pro-environmental behaviour was selected and developed from the study of Sun[65]. Environmental knowledge was measured using observed variables selected from the scale of Lee[66]. The observed variables measuring self-efficacy were adopted from Chen et al.[67]. The social influence scale was developed from Rehman and Dost[68]. Finally, the concept of "wish-cycling" was measured by observed variables selected from the study of Sløgedal and Starling[69].

From October to November 2025 was the period of data collection, also associated with a time when the environment is under severe pressure due to increasing plastic waste and greenhouse gas emissions, with Vietnam being among the countries that discharge the most plastic waste into the oceans. Recycling is considered an important solution; however, in practice, its effectiveness remains limited because of the phenomenon of "wish-cycling," in which people mistakenly put non-recyclable items into recycling bins. Therefore, this survey period is particularly necessary to examine the factors affecting recycling behaviour and to clarify the moderating role of wish-cycling in the Vietnamese context.

In this study, data were analyzed using PLS-SEM with SmartPLS, including the steps of assessing the measurement model, evaluating the structural model, and testing research hypotheses. The analysis steps were proposed and presented by Hair et al.[70,71]. The PLS-SEM method offers several significant advantages, such as not requiring data to follow a normal distribution, handling small sample sizes effectively, and being suitable for complex models with many latent variables and indicators[72]. It also allows the assessment of both reflective and formative constructs[73,74].

## 4. Result and Discussion

According to Munerah et al.[75], the outer loadings in the measurement model should be equal to or greater than 0.708. Table 1 shows that the outer loadings of the constructs environmental knowledge (EK), pro-environmental behaviour (PB), recycling behaviour (RB), self-efficacy (SE), social influence (SI), and wish-cycling (WC) meet the required standard with loadings above 0.708.

Next, reliability was measured by using Cronbach's alpha (CA) and Composite Reliability (CR). As shown in Table 1, the Cronbach's alpha values range from 0.713 to 0.866 and all exceed the required standard of 0.7[76]. Similarly, the Composite Reliability values range from 0.834 to 0.897 and are all above the acceptable level of 0.7[76]. These results indicate that the measurement scales demonstrate adequate reliability.

Convergent validity is achieved when the Average Variance Extracted (AVE) is 0.5 or higher[77]. The results in Table 1 also show that all AVE values exceed this benchmark, with the lowest value being 0.555 for the self-efficacy construct. This finding confirms that the measurement model satisfies the requirement for convergent validity.

**Table 1:** Data validity

| | Cronbach's Alpha (CA) | Composite Reliability (CR) | Average Variance Extracted (AVE) | Outer loading |
|---|---|---|---|---|
| EK | 0.734 | 0.834 | 0.557 | 0.725-0.770 |
| PB | 0.781 | 0.859 | 0.604 | 0.761-0.803 |
| RB | 0.713 | 0.839 | 0.636 | 0.774-0.816 |
| SE | 0.866 | 0.897 | 0.555 | 0.719-0.773 |
| SI | 0.827 | 0.878 | 0.592 | 0.719-0.831 |
| WC | 0.802 | 0.882 | 0.713 | 0.822-0.856 |

*Source: Authors' works*

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The study continues to examine discriminant validity using the Heterotrait–Monotrait Ratio of Correlations (HTMT). The HTMT matrix is used to assess whether the constructs are empirically distinct. As reported in Table 2, all HTMT values are less than or equal to 1, following the criterion suggested by Henseler et al.[78]. However, the HTMT values between environmental knowledge and pro-environmental behaviour (0.997), as well as between social influence and recycling behaviour (0.996), were extremely high and approached the critical threshold of 1. These results suggest potential conceptual overlap between the respective constructs and indicate that discriminant validity should be interpreted with caution. Although the constructs were retained because they represent theoretically distinct concepts that have been widely recognized in prior environmental behaviour research, the high HTMT values may reflect the close relationship among environmental knowledge, pro-environmental behaviour, social influence, and recycling practices within the Vietnamese university context. Therefore, this issue should be considered a methodological limitation of the study. Future research is encouraged to further refine the measurement scales and validate the constructs across different samples and settings to improve discriminant validity and better distinguish between related environmental concepts.

The assessment of the structural model begins with an examination of multicollinearity. The results presented in Table 3 indicate that the maximum VIF value is 2.025, which is below the threshold of 3 suggested by Hair et al.[79]. This result confirms that multicollinearity does not affect the proposed research model.

The explanatory power of the model is also supported by the coefficient of determination, as all $R^2$ values exceed 0.1[71]. In particular, the $R^2$ value for pro environmental behaviour is 0.621 and the $R^2$ value for recycling behaviour is 0.679. These findings indicate that the independent variables account for 62.1% of the variance in pro environmental behaviour and 67.9% of the variance in recycling behaviour.

Furthermore, the results in Table 3 show that the $Q^2$ values of all endogenous constructs are greater than zero and therefore statistically meaningful[80]. This evidence suggests that the research model demonstrates adequate predictive relevance.

Finally, the results of the path coefficient analysis show that the hypotheses are generally supported at the 95% significance level because most p values are below 0.05, as presented in Table 4. In contrast, hypotheses H2 and H5 are rejected since their p-values exceed the acceptable level.

**Table 2:** Heterotrait-Monotrait Ratio (HTMT)

| | EK | PB | RB | SE | SI | WC |
|---|---|---|---|---|---|---|
| EK | | | | | | |
| PB | 0.997 | | | | | |
| RB | 0.883 | 0.856 | | | | |
| SE | 0.902 | 0.839 | 0.947 | | | |
| SI | 0.823 | 0.727 | 0.996 | 0.836 | | |
| WC | 0.725 | 0.637 | 0.769 | 0.733 | 0.610 | |

*Source: Authors' works*

**Table 3:** Multicollinearity, coefficient of determination ($R^2$) and the out-of-sample predictive power ($Q^2$)

| Concept | VIF | $R^2$ | $Q^2$ |
|---|---|---|---|
| RB | 1.321 - 1.471 | 0.679 | 0.369 |
| PB | 1.468 - 1.626 | 0.621 | 0.423 |
| EK | 1.358 - 1.473 | | |
| SE | 1.632 - 1.859 | | |
| SI | 1.515 - 2.025 | | |
| WC | 1.547 - 1.950 | | |

*EK: Environmental knowledge; PB: Pro-environmental behaviour; RB: Recycling behaviour; SE: Self-efficacy; SI: Social influence; WC: Wish-cycling, Source: Authors' works*

**Table 4:** Hypothesis testing

| Hypothesis | Relationship | ß | t value | p value | Conclusion |
|---|---|---|---|---|---|
| H1 | PB → RB | 0.135 | 0.065 | 0.020 | Accepted |
| H2 | EK → RB | -0.001 | 1.632 | 0.980 | Rejected |
| H3 | EK → PB | 0.517 | 8.631 | 0.000 | Accepted |
| H4 | SE → PB | 0.285 | 4.879 | 0.000 | Accepted |
| H5 | SI → PB | 0.053 | 2.800 | 0.188 | Rejected |
| H6 | SI → RB | 0.532 | 9.025 | 0.000 | Accepted |
| H7 | PB*WC → RB | -0.082 | 2.101 | 0.018 | Accepted |

*Source: Authors' works*

The qualitative findings provided preliminary evidence regarding the suitability of the measurement scales for the Vietnamese context. Experts and students generally agreed that the translated scales retained the conceptual meanings of the original constructs and were appropriate for assessing recycling-related behaviours among Vietnamese students. However, several items required minor wording modifications to improve clarity and reduce potential misunderstandings among respondents. These findings suggest that although the original scales were developed in different contexts, their underlying concepts remain relevant and applicable to Vietnamese students after careful adaptation and refinement. The qualitative phase therefore contributed to strengthening the content validity of the measurement instrument used in the subsequent quantitative analysis.

The research results show that pro-environmental behaviour and social influence both have a positive impact on university students' recycling behaviour. This result supports the initially proposed hypotheses H1 and H6. In particular, social influence was identified as the strongest factor affecting recycling behaviour (ß = 0.532). This finding is completely consistent with previous studies[12,57]. Recycling often takes place in shared areas such as universities, dormitories, or centralized waste collection points. When individuals see that those around them are engaging in recycling behaviour, they tend to observe and imitate this behaviour. According to Blose et al.[12], social influence through friends and peers serves as a positive driver that significantly promotes recycling behaviour among university students in both the United States and China. In addition, social influence within close relationships such as family and friends plays a key role in promoting significant changes in individuals' recycling and environmental protection behaviours[57]. Bandura's social learning theory[11] also confirms that individuals form behaviours by observing the models around them. However, the impact of pro-environmental behaviour on recycling behaviour has not been addressed in previous studies, so this can be considered a novelty value in this study. When students engage in environmental protection actions such as reducing plastic use, saving electricity and water, and using electric vehicles, they are often individuals with a green lifestyle. Therefore, this encourages them to engage in recycling behaviour to affirm their personal lifestyle. This finding suggests that recycling behaviour is not merely a waste management activity but also a reflection of broader environmental values and lifestyles. Students who consistently engage in environmentally responsible behaviours are more likely to incorporate recycling into their daily routines. Therefore, promoting general pro-environmental behaviours may indirectly strengthen recycling behaviour among university students.

In addition, this study indicates that environmental knowledge and self-efficacy have a positive impact on pro-environmental behaviour. These findings are consistent with the initially proposed hypotheses H3 and H4 and further support previous studies. The studies by Simiyu et al.[56] and Pothitou et al.[81] demonstrates that individuals with higher levels of environmental and energy knowledge tend to engage more in pro-environmental behaviour. Additionally, the research findings also support Huang[82] and Chen et al.[83] with the evidence that self-efficacy may postively influence pro-environment behaviour. Another perspective by Kollmuss and Agyeman[84] suggests that environmental knowledge only indirectly influences pro-environmental behaviour through mediating factors such as attitudes, motivation, and situational conditions, rather than having a direct effect. This difference may stem from the research context and the characteristics of the survey sample. One possible explanation is that environmental knowledge helps students better understand the consequences of environmental degradation and the benefits of sustainable practices. As a result, they may become more motivated to adopt environmentally responsible behaviours. This finding highlights the importance of environmental education in fostering pro-environmental behaviour among young people.

Furthermore, the results highlight the potential mediating role of pro-environmental behaviour, which emerged as an additional finding of this study. Specifically, while environmental knowledge significantly predicts pro-environmental behaviour, its direct relationship with recycling behaviour is not significant. Although mediation analysis was not formally conducted, this structural pattern suggests that pro-environmental behaviour may serve as an important behavioural pathway through which environmental knowledge influences recycling behaviour. In addition, self-efficacy is not only one of the three psychological factors that significantly influence pro-environmental behaviour, but also plays a crucial psychological mechanism in transforming initial interventions or efforts into actual behaviour[52,82,83]. Therefore, environmental knowledge alone may be insufficient to directly trigger specific recycling actions unless it is first translated into broader environmentally responsible behaviours supported by individuals' confidence in their ability to act.

On the other hand, the study shows that environmental knowledge does not influence recycling behaviour. The main reason for this is that environmental education in Vietnamese universities often focuses heavily on theoretical subjects and general environmental science, with limited emphasis on developing practical recycling skills. In addition, contextual and infrastructural barriers also play an important role. If sorting bins are unclear, instructions are not specific, or the collection and treatment systems are not synchronized, students may find it difficult to recycle properly even if they possess sufficient

knowledge. This explains why many people clearly understand the issue of urban waste, yet their actual behaviour does not correspond accordingly[30]. Moreover, the analysis results demonstrate that social influence does not affect pro-environmental behaviour. This finding completely rejects the initially proposed hypothesis H5. This study is entirely inconsistent with the findings of Simiyu et al.[56] and Ly[85] that social influence has a positive effect on pro-environmental behaviour. However, in reality, Vietnamese students today tend to value individuality and independence in their views and actions. They engage in pro-environmental behaviour only when they find personal meaning in it and believe that they are capable of doing so, rather than acting under peer pressure. The most important finding of this study is the negative moderating effect of wish-cycling on the relationship between pro-environmental behaviour and recycling behaviour, with ß and P-value of -0.082 and 0.018, respectively. This finding further supports the initially proposed hypothesis H7. Notably, through the literature review, the authors found that no previous studies have examined the moderating role of wish-cycling in the relationship between pro-environmental behaviour and recycling behaviour. Therefore, this result represents an important and novel theoretical contribution. Wish-cycling refers to individuals disposing of waste into recycling bins based on the belief that it will be recycled, which unintentionally causes contamination and reduces the effectiveness of environmental protection efforts. Although this action stems from good intentions, it creates an illusion of contribution, leading students to believe that they are optimizing environmental protection while in fact increasing the rate of recycling contamination. According to Vayona et al.[86], this phenomenon arises when individuals rely on symbols or labels promoted as environmentally friendly without carefully verifying the actual recyclability of the products. At the level of individual cognition, the findings of this study are also consistent with the argument of Dreijerink et al.[87], who suggests that individuals tend to rationalize environmentally suboptimal behaviours in order to maintain a self-image of being environmentally responsible. In Vietnam, many students have the habit of putting all types of plastic, food-contaminated paper, or uncleaned milk cartons into recycling bins in the hope that they will be recycled. This misconception not only reduces the positive impact of a pro-environmental lifestyle but also places reverse pressure on the recycling system. The negative moderating effect suggests that wish-cycling weakens the positive relationship between pro-environmental behaviour and recycling behaviour. Students with strong pro-environmental behaviour may still place uncertain items into recycling bins, reducing recycling accuracy. However, the effect is relatively weak ($\beta$ = -0.082). This may be because many university students still have environmental awareness and are willing to recycle, so wish-cycling only partially weakens the positive relationship between pro-environmental behaviour and recycling behaviour.

In addition, the study reports that the HTMT index between pro-environmental behaviour and environmental knowledge reached 0.997. According to the HTMT criterion, this value suggests potential conceptual overlap between these two constructs in the survey sample. This may reflect the close relationship between environmental understanding and pro-environmental behaviour among university students. It may also indicate that the current measurement scales require further refinement in the Vietnamese research context. To explain this, the results suggest that Vietnamese students tend to acquire environmental knowledge and environmental protection behaviours in an integrated manner through educational programs. This finding suggests that future research should further refine the measurement scales to strengthen discriminant validity and better distinguish between awareness and actual recycling practices.

## 5. Conclusions

This study investigates the factors influencing students' recycling behaviour based on Social Learning Theory amid escalating environmental challenges. Based on the proposed research model, the empirical findings offer a comprehensive perspective on the mechanisms underlying the formation and transformation of recycling behaviour within the university context. The qualitative consultation supported the suitability of the translated measurement scales for the Vietnamese context. Although two proposed hypotheses were not supported in the quantitative analysis, these unexpected results provide additional insights by suggesting that relationships commonly reported in previous studies may not operate uniformly across contexts. Consequently, the study highlights the importance of contextual factors in understanding recycling behaviour among university students.

The results indicate that environmental knowledge and self-efficacy function as critical antecedents of pro-environmental behaviour, which subsequently promotes recycling behaviour. Additionally, social influence exerts a significant and direct effect on students' recycling behaviour, reflecting the importance of social norms and interpersonal interactions in shaping environmentally responsible actions. Notably, the findings indicate that environmental knowledge has no direct effect on recycling behaviour and influences it only indirectly through pro-environmental behaviour. This result highlights the limited capacity of knowledge on its own to translate environmental awareness into concrete behavioural outcomes.

A key contribution of this study lies in the incorporation of

wish-cycling as a moderating variable within the recycling behaviour framework. The findings demonstrate that misconceptions regarding recycling practices weaken the positive relationship between pro-environmental behaviour and recycling behaviour.

From a practical implication, the findings suggest that environmental education and communication initiatives should move beyond enhancing general environmental awareness. These initiatives should therefore focus on providing clear, specific, and context-sensitive guidance on proper recycling practices. Furthermore, leveraging social influence through the establishment of shared norms and community-based initiatives within university contexts may enhance the effectiveness and sustainability of recycling behaviour interventions. Although the study has analyzed and identified factors influencing recycling behaviour, several limitations remain and should be considered. Regarding sample size, the study relied on a relatively small convenience sample of Vietnamese university students, which may limit the generalizability of the findings. Moreover, the research primarily examined the roles of environmental knowledge, self-efficacy, and social influence in relation to pro-environmental behaviour and recycling behaviour. Other relevant factors were not included in the research model. These factors include personal norms, environmental concern, and convenience in performing recycling behaviour. In addition, the study was conducted solely within Vietnam. Therefore, extending the research to other countries may yield more diverse findings. Furthermore, the current research model focuses only on testing the direct relationships among variables and does not examine the roles of mediating variables or differences across demographic groups, such as gender. In addition, the relatively high HTMT values observed between certain constructs suggest potential conceptual overlap, indicating the need for further refinement and improvement of the measurement scales. Therefore, future studies should further refine the measurement scales, expand the research scope to different contexts and populations, and examine mediating mechanisms as well as demographic factors to provide a deeper understanding of the formation and maintenance of sustainable recycling behaviour and the role of wish-cycling in this process.

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