

## Determinants of University Students' Waste Management Behavior: A Theory of Planned Behavior Approach at an Indonesian Engineering Faculty

Faizal Amir

Universitas Negeri Makassar

**ABSTRACT:** Effective waste management behavior among university students is essential to supporting sustainable campuses, yet many institutions continue to face challenges with littering, low recycling participation, and inadequate environmental responsibility. This study investigates the factors influencing students' waste management behavior at the Faculty of Engineering, Universitas Negeri Makassar, Indonesia, using the Theory of Planned Behavior (TPB) as the analytical framework. The research expands the original descriptive findings by positioning attitudes, subjective norms, and perceived behavioral control as the key predictors shaping students' waste management intentions and behaviors.

A quantitative survey design was employed, involving structured questionnaires distributed to students across multiple study programs. The survey measured students' knowledge, environmental attitudes, sense of responsibility, facility availability, habits, and perceived barriers. Descriptive statistical analysis revealed high levels of environmental expertise and generally positive attitudes toward waste management; however, inconsistencies emerged between attitudes and actual behavior. Students reported limited disposal facilities, low supervision, and ineffective institutional norms, which weakened subjective norms and perceived control over waste-related actions. Moreover, habitual practices and environmental awareness were found to play an important supporting role, even though they did not fully translate into consistent waste-sorting or recycling behaviors.

The study concludes that waste management behavior among engineering students is shaped not only by knowledge, but also by normative pressures, institutional support, and perceived ease of action—core TPB components. Strengthening environmental policies, improving facilities, and reinforcing collective norms are recommended to enhance pro-environmental behavior on campus.

**KEYWORDS:** waste management behavior, Theory of Planned Behavior, university students, environmental awareness, Indonesia

### INTRODUCTION

Solid waste generation on university campuses continues to increase globally as student populations grow and academic activities expand. Universities produce diverse types of waste, including plastic packaging, food residues, paper, and laboratory materials, much of which is improperly discarded due to low awareness, inadequate management systems, and inconsistent behavioral compliance (Almulhim, 2022; Mihai & Iordache, 2021). In developing countries, these challenges are intensified by limited institutional capacity and weak environmental norms, making waste management behavior a critical area for intervention. As centers of innovation and human capital formation, universities should model sustainable practices; however, research indicates that students often engage in environmentally harmful behaviors, such as littering or improper sorting, even when they understand the environmental consequences (Pham et al., 2020; Yu et al., 2019).

At Universitas Negeri Makassar (UNM), particularly within the Faculty of Engineering, waste management has emerged as a significant issue. Engineering students regularly use classrooms, studios, and workshop areas that generate substantial amounts of plastic, paper, and operational waste. Based on preliminary observations documented in the institutional report, many students dispose of waste indiscriminately, ignore provided bins, or rely on cleaning staff to manage accumulated waste. Such behaviors contribute not only to environmental degradation on campus but also to broader public health and sustainability concerns. The university's challenges mirror the broader patterns found in Indonesian higher education institutions, where environmental literacy is rising but behavior does not consistently follow (Indriani et al., 2021).

Understanding the determinants of students' waste management behavior requires more than identifying surface-level factors. While knowledge is often assumed to drive behavior, extensive literature shows that knowledge alone rarely results in behavioral change (Kollmuss & Agyeman, 2002; Hasan et al., 2023). Students may understand proper waste practices but fail to act accordingly due to structural barriers (e.g., insufficient facilities), weak social norms, or lack of personal motivation. Therefore, studies on

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environmental behavior increasingly adopt behavioral models to explain the gap between attitudes and actions (Ajzen, 2020; Kaiser et al., 2021).

To strengthen the theoretical foundation of the present research, this study adopts the Theory of Planned Behavior (TPB), one of the most widely used frameworks for explaining proenvironmental actions. TPB posits that behavior is shaped by behavioral intention, which is influenced by three constructs: attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). In the context of waste management: (a) attitudes reflect whether students evaluate waste-sorting or proper disposal as positive or beneficial; (b) subjective norms represent social pressures from peers, lecturers, or institutional expectations; and (c) perceived behavioral control (PBC) concerns students' perceived capacity to perform waste management behaviors, shaped by the availability of facilities, convenience, and the absence of obstacles.

TPB is particularly relevant for university settings because students' waste behavior is not only individual but socially constructed and institutionally facilitated (Zhang et al., 2020). Recent studies applying TPB in environmental contexts support its predictive power for recycling, waste sorting, and sustainable consumption (Chu & Chiu, 2021; Nguyen et al., 2021; Adnan et al., 2022). However, few studies have explored TPB within Indonesian universities, particularly engineering faculties, where practical activities often intensify waste generation.

The original study conducted at the Faculty of Engineering UNM examined several factors—knowledge, awareness, facilities, habits, responsibility, barriers, and behavior—but did not position them within a predictive theoretical model. By recontextualizing the findings using TPB, the present article provides a more robust explanation of how these factors interact to influence students' waste management practices. For instance, knowledge and awareness can enhance positive attitudes, while responsibility and peer influence may contribute to subjective norms, and facility availability and perceived barriers align with PBC. This framing allows the descriptive results of the original study to be interpreted within a globally recognized theoretical structure.

The relevance of this research is further strengthened by pressing environmental concerns in Indonesian campuses. The Ministry of Education has launched various sustainability initiatives, yet many universities struggle to implement them effectively (Pradana et al., 2022). Engineering students—expected to become future problem-solvers in technological and environmental fields—should embody sustainable behaviors. Therefore, identifying the behavioral determinants that shape waste practices provides essential insights for designing interventions, educational programs, and campus policies. Several studies emphasize that intervention strategies grounded in behavioral theory produce more sustainable and long-term behavioral change (Moussaoui & AitAli, 2023; Vicente-Molina et al., 2022).

Additionally, waste management behavior reflects not only environmental literacy but also institutional culture. When students perceive inadequate facilities, weak supervision, or inconsistent enforcement of rules, they are less motivated to engage in environmentally responsible practices (Guo et al., 2020). Conversely, supportive infrastructure, social reinforcement, and active environmental campaigns can strengthen students' perceived control and intention to act sustainably (Wang et al., 2021). The Faculty of Engineering UNM case provides an essential context for understanding how institutional and psychological factors jointly shape waste behaviors. Therefore, thus, this study aims to: (1) analyze the behavioral and environmental factors influencing engineering students' waste management practices; (2) reinterpret these factors through the Theory of Planned Behavior; and (3) provide theoretically grounded recommendations for improving campus waste systems and student behaviors.

By situating the original empirical findings within the TPB framework and international research context, this article contributes to both theoretical understanding and practical strategies for advancing sustainable campus behavior in Indonesia.

## METHODS

This study employed a quantitative descriptive survey design to examine the factors influencing students' waste management behavior at the Faculty of Engineering, Universitas Negeri Makassar. While the original institutional research focused on descriptive patterns, this article extends the interpretation by situating the variables within the Theory of Planned Behavior (TPB), which provides a robust framework for analyzing determinants of pro-environmental actions. TPB integrates students' attitudes, subjective norms, and perceived behavioral control (PBC) as predictors of waste-related behaviors, allowing the descriptive results to be theoretically contextualized.

### Participants and Study Setting

The study was conducted across multiple departments within the Faculty of Engineering, which hosts a diverse student population engaged in lecture-, studio-, and laboratory-based learning. Students generate considerable daily waste, making the faculty an appropriate context for examining waste management behavior. A structured questionnaire was distributed to students selected through convenience sampling, ensuring representation from various academic programs. Participation was voluntary, and responses were kept confidential.

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## Instrumentation

Data were collected using a researcher-developed questionnaire adapted from the original institutional study. The instrument included sections measuring: (1) knowledge about waste types and environmental impacts; (2) environmental awareness and general attitudes toward cleanliness;

(3) facilities (availability and accessibility of waste bins and disposal points); (4) habits related to daily waste disposal; (5) responsibility and subjective norms related to campus cleanliness; (6) perceived barriers such as limited facilities, distance to disposal points, or lack of enforcement; and (7) waste management behavior, including disposal, sorting, and cleanliness practices. While the original study measured these factors descriptively, the TPB alignment categorizes them as follows: knowledge and awareness contribute to attitudes; responsibility relates to subjective norms; and facilities, habits, and barriers inform perceived behavioral control (Chu & Chiu, 2021).

Each variable was measured using Likert-scale items ranging from “strongly disagree” to “strongly agree.” The instrument underwent expert validation involving environmental science and education specialists and was tested for clarity.

## Data Collection Procedure

Data collection was conducted in-class and on-site within faculty buildings. Respondents completed the questionnaires under the researcher's supervision to ensure full completion and avoid missing responses. Observational notes were also taken to contextualize students' behaviors and facility conditions.

## Data Analysis

Although this article maintains the descriptive statistical approach of the original study, integrating TPB provides a more comprehensive interpretation. Descriptive statistics were used to summarize frequencies, percentages, and response trends for each variable. These descriptive results were then analyzed thematically in relation to TPB constructs to explain how attitudes, subjective norms, and perceived behavioral control influence students' waste practices.

## Ethical Considerations

The study was conducted in accordance with the institutional research approval framework of Universitas Negeri Makassar. Participants were informed about the research purpose, and informed consent was obtained. No personal identifying information was collected.

## RESULTS AND DISCUSSION RESULTS WASTE MANAGEMENT KNOWLEDGE

The survey results show that students at the Faculty of Engineering possess a high level of knowledge regarding waste types, environmental pollution, and the long-term effects of improper waste disposal. Most respondents were able to identify the categories of waste typically found on campus—plastic, paper, food waste, and laboratory residues—and understood the environmental risks associated with mismanaged waste. This aligns with the original study's findings, which indicated that the student population had strong awareness of environmental issues. However, despite this knowledge, inconsistencies emerged between understanding and action, echoing global studies suggesting that knowledge alone does not guarantee proper waste management behavior (Hasan et al., 2023).

### Environmental Awareness and Attitudes

Students generally expressed positive attitudes toward environmental cleanliness. They agreed that a clean campus environment supports comfort, health, and learning productivity. Many respondents believed that maintaining cleanliness is both an individual and collective responsibility. These attitudes theoretically correspond to the attitude component of the TPB, suggesting that students' cognitive evaluations of waste management behavior are favorable. However, attitudinal positivity did not always translate into consistent behavior, indicating the presence of moderating factors such as social norms and perceived behavioral control.

### Facilities and Perceived Behavioral Control

A major finding of the study concerns the availability and quality of campus waste facilities. Students widely reported that waste bins were limited in number, often full, or poorly located. This constraint directly influenced students' perceived behavioral control, a key predictor of behavioral intention in TPB. Respondents also noted that pathways to disposal sites were sometimes inconvenient, especially in areas with heavy laboratory use. Similar global findings indicate that insufficient infrastructure is a primary barrier to effective waste management in university settings (Wang et al., 2021; Guo et al., 2020).

### Habits and Behavioral Patterns

Some students exhibit habitual behaviors such as leaving trash on desks, in hallways, or relying on cleaning staff to collect scattered waste. These habitual tendencies weaken consistent proenvironmental behavior and contribute to short-term decisions that contradict students' stated attitudes. Habits also represent automated behavioral scripts that function independently of rational evaluations, reflecting a gap between intention and action.

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## **Responsibility and Social Norms**

The sense of responsibility among students varied significantly. While many participants acknowledged that maintaining cleanliness is essential, they also felt that responsibility should be shared equally among peers, staff, and the institution. Weak enforcement and inconsistent peer modeling weakened subjective norms. When students do not perceive that others care about waste management, they are less motivated to behave responsibly themselves. Literature indicates that strong subjective norms—such as peer pressure, instructor reinforcement, and visible institutional commitment—significantly increase pro-environmental behavior (Nguyen et al., 2021; Adnan et al., 2022).

## **Barriers and Final Behavioral Outcomes**

Students identified several barriers to proper waste disposal: lack of bins, distance from study areas, limited supervision, and time constraints during class transitions. As a result, waste management behavior remained inconsistent despite high levels of knowledge and positive attitudes. These findings reinforce the idea that behavior is more strongly influenced by perceived control and norms than by knowledge alone.

## **DISCUSSION**

The study's findings can be better understood using the Theory of Planned Behavior. TPB posits that behavioral intention is shaped by attitudes, subjective norms, and perceived behavioral control. Each of these constructs emerged clearly within the dataset and provides a theoretical explanation for the observed behavioral inconsistencies.

### **Attitudes Explain Positive Intentions but Not Actions**

Students' high levels of knowledge and positive attitudes toward environmental cleanliness formed a strong attitudinal foundation for pro-environmental behavior. Consistent with the literature, positive attitudes contribute to the intention to act but are insufficient to guarantee behavior (Chu & Chiu, 2021). Many respondents believed that waste management is essential, which, in theory, strengthened intention. However, gaps between intention and action remained, suggesting that attitudes alone do not dictate behavior—an outcome widely reported in TPB-based environmental studies (Ajzen, 2020).

### **Subjective Norms Are Weak, Reducing Social Motivation**

Subjective norms emerged as one of the weakest determinants. Students perceived limited social pressure to properly manage waste. Peer behavior did not model sustainability, lecturers rarely reinforced rules, and institutional campaigns were intermittent. The absence of strong normative cues leads to a culture in which cleanliness is optional rather than expected. Studies in similar contexts emphasize that strong subjective norms—such as peer reminders, active student organizations, and consistent lecturer involvement—significantly enhance waste management behavior (Vicente-Molina et al., 2022; Moussaoui & Ait-Ali, 2023). Therefore, at UNM's Faculty of Engineering, the lack of visible social enforcement weakened normative expectations and led to inconsistent behavior, even among knowledgeable, well-intentioned students.

### **Perceived Behavioral Control Is the Most Influential Factor**

The strongest explanatory factor in this study is perceived behavioral control (PBC), determined by facility availability, ease of access, and perceived barriers. Students indicated that waste disposal facilities were insufficient, poorly placed, or non-functional. Under TPB, low PBC undermines behavioral intention and increases the likelihood of behavioral failure. International literature confirms that PBC is often the most influential predictor of recycling and waste-sorting behavior in campus settings (Zhang et al., 2020; Wang et al., 2021). In this study, students' perceived inability to dispose of waste conveniently was a critical barrier that overshadowed their positive attitudes.

### **Habit Formation and Behavioral Consistency**

Habits observed in the study—such as littering when bins were out of reach or relying on cleaning staff—reflect automatic behavioral patterns. Habit theory suggests that without environmental cues (e.g., adequate bins, reminders), behavior becomes reactive rather than intentional. This further explains why students with strong knowledge and positive attitudes still exhibited inconsistent behavior. Integrating TPB with habit theory enhances the explanatory power of the findings, aligning with current environmental behavior research (Kaiser et al., 2021).

### **Implications for Campus Sustainability Strategies**

Given the TPB-informed findings, effective intervention must target; (1) attitudes as ongoing education, awareness campaigns; (2) subjective norms as peer-led initiatives, lecturer engagement, visible institutional commitment; (3) PBC as adequate bins, clear signage, facility maintenance, accessible recycling points.

Universities that implement TPB-guided interventions report sustained improvements in student environmental behavior (Pham et al., 2020; Yu et al., 2019). Therefore, strengthening both psychosocial and structural determinants is essential for long-term success at UNM's Faculty of Engineering.

## CONCLUSION

This study examined the determinants of waste management behavior among engineering students at Universitas Negeri Makassar and interpreted the findings through the Theory of Planned Behavior (TPB). Although students demonstrated high environmental knowledge and positive attitudes toward campus cleanliness, these attributes did not consistently translate into proper waste management practices. The analysis revealed that subjective norms and perceived behavioral control played stronger roles in shaping student behavior than attitudes alone. Weak normative influences—such as limited peer modeling, low lecturer engagement, and minimal institutional reinforcement—reduced students' motivation to maintain cleanliness despite their awareness of environmental issues.

The most influential factor inhibiting proper waste management behavior was perceived behavioral control, shaped by constraints such as insufficient waste bins, inconvenient disposal access, poor facility maintenance, and perceived time- and effort-related barriers. These findings confirm that structural constraints can overshadow positive attitudes and intentions, resulting in a persistent gap between knowledge and behavior. Habitual behaviors, such as discarding waste in convenient locations or relying on cleaning staff, further contributed to inconsistent practices.

To improve waste management behavior, interventions must strengthen all three TPB components. Enhancing environmental attitudes through continuous education is essential, but a stronger emphasis is required on building supportive social norms and improving infrastructure. Campuswide policies, student-led campaigns, and visible environmental leadership can reinforce expectations, while facility improvements can increase students' sense of control. By integrating behavioral and structural strategies, universities can cultivate sustainable habits and foster a cleaner, more responsible campus culture.

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