Journal of Comparative Education Nexus
Vol. 01 No. 02, June 2026, pp.69-81
https://journal.gioedutech.id/index.php/jcen/issue/view/

Beyond Knowledge: Exploring the Attitude–Behavior Gap in Sustainable Waste Management among Indonesian Secondary School Communities

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ABSTRACT

This study examines waste management literacy among secondary school communities in Tangerang City, Indonesia, through the Knowledge–Attitude–Behavior (KAB) framework integrated with the 3R principles (Reduce, Reuse, Recycle). A mixed-methods sequential explanatory design was employed, involving 357 respondents comprising principals, teachers, staff, and students from seven schools situated near the Rawa Kucing Landfill, supported by in-depth follow-up interviews. Quantitative data were analyzed using correlation and multiple regression techniques to determine the relationships between knowledge, attitude, and behavior. The results reveal that knowledge has a significant positive effect on waste management behavior, while attitude unexpectedly shows a negative relationship with behavior, indicating a pronounced attitude–behavior gap. Despite generally positive attitudes toward waste management, these attitudes are not consistently reflected in daily practices. Qualitative findings further identify key barriers at individual, social, and structural levels, including insufficient facilities and established waste-handling habits that limit effective implementation of the 3R system. The study emphasizes the importance of an integrated intervention strategy, including the provision of adequate 3R facilities in schools, teacher role modeling, alignment between municipal waste services and school initiatives, reinforcement from families, and integration of waste management education into the curriculum, to bridge the attitude–behavior gap and promote sustainable waste practices in school environments.

Keywords: Waste management literacy; Knowledge; Attitude; Behavior; School communities

Article history

Received:	*Revised:*	*Accepted:*	*Published:*
Date 17/04/2026	*30/05/2026*	*Date 20/06/2026*	*30/06//2026*

Citation (APA Style): *Sunantri Putri et al. (2026). Beyond Knowledge: Exploring the Attitude–Behavior Gap in Sustainable Waste Management among Indonesian Secondary School Communities*

INTRODUCTION

Waste management has become one of the most pressing environmental challenges threatening the achievement of sustainable development worldwide. According to the World Bank's *What a Waste 2.0* report, global municipal solid waste generation reaches approximately 2.01 billion tons annually, of which nearly 33% is improperly managed, resulting in significant environmental degradation and public health concerns (Kaza et al., 2018). In Indonesia, waste generation was estimated at 65.2 million tons in 2020, with the public sector contributing 50.41% of the total waste produced nationwide (KLHK, 2023; World Bank, 2023). The increasing volume of waste is closely associated with unsustainable consumption patterns, the widespread use of single-use products, and the slow adoption of environmentally friendly practices (Aprilia, 2021; Beylot et al., 2016; Chen et al., 2021; Waluyo & Kharisma, 2023). Despite growing environmental concerns, many individuals continue to perceive waste management as the sole responsibility of governments or external institutions, limiting active community participation in environmental stewardship (Fadhullah et al., 2022; Sahu & Mishra, 2023). Consequently, enhancing waste management literacy has emerged as a critical strategy for fostering environmental awareness and promoting sustainable waste

management practices (Debrah et al., 2021; Stöckert & Bogner, 2020; Zhou et al., 2022).

Waste management literacy extends beyond the acquisition of factual knowledge and encompasses the ability to apply knowledge and skills to real-world environmental challenges, critically evaluate issues, and communicate effective solutions across diverse contexts (OECD, 2010). Within the environmental domain, literacy plays a fundamental role in increasing awareness, strengthening individual responsibility, and encouraging community participation in integrated waste management systems. Previous studies have demonstrated that enhanced waste management literacy can improve both environmental awareness and participation by equipping individuals with the competencies necessary to manage waste effectively (Kundu et al., 2021). Moreover, literacy contributes not only to cognitive understanding but also to the development of attitudes and behaviors that support sustainable waste management practices. As waste management increasingly becomes a behavioral and social challenge, understanding how knowledge is translated into action remains essential for achieving long-term environmental sustainability.

Although waste management literacy has received considerable scholarly attention, existing research has predominantly focused on households and community groups to assess individual awareness and waste management practices (Babaei et al., 2015; Castin et al., 2022; Limon et al., 2020; Ling et al., 2018). Studies have also examined waste management literacy among university students within higher education contexts (Spínola, 2023). However, empirical investigations within school communities remain relatively limited. Existing school-based studies have primarily emphasized environmental education programs and their influence on students' understanding of sustainability issues, while detailed examinations of the relationships among knowledge, attitudes, and behaviors regarding waste management are still scarce (Debrah et al., 2021). This gap is significant because schools represent strategic institutions for cultivating environmental awareness and shaping responsible behaviors among future generations. Strengthening waste management literacy within school communities can contribute to the development of environmentally conscious citizens while providing valuable insights for educational policies and curriculum development aimed at sustainability.

The importance of focusing on school communities is further reinforced by their role in character development and environmental education. Schools are expected to foster environmental awareness and encourage behaviors that contribute to maintaining environmental cleanliness and conservation (Siskayanti & Chastanti, 2022). Such efforts align with the broader principles of sustainable development and environmental stewardship (Pauw et al., 2015). Furthermore, the Sustainable Development Goals (SDGs) emphasize the necessity of equipping learners with the knowledge and skills required to promote sustainable development (O'Flaherty & Liddy, 2018). Formal education therefore serves as a critical mechanism for addressing waste management challenges and embedding sustainable practices among young people (Bonnett, 1999). This educational mandate is also consistent with UNESCO's Decade of Education for Sustainable Development (DESD), which highlights the integration of sustainability principles, including responsible waste management, into educational systems (Pauw et al., 2015).

Understanding how waste management literacy influences behavior requires a robust theoretical framework that captures the interplay between knowledge, attitudes, and actions. The Knowledge–Attitude–Behavior (KAB) model suggests that knowledge shapes attitudes, which subsequently influence behavior (WHO, 2008; Yap et al., 2010). Within the context of sustainable waste management, the model is commonly applied through the 3R principles Reduce, Reuse, and Recycle—which have been widely recognized as effective strategies for minimizing waste generation and promoting resource efficiency (Law et al., 2023). Previous studies generally assume that higher levels of knowledge contribute to more positive attitudes and ultimately lead to environmentally responsible behaviors (Gusti et al., 2015; WHO, 2008). However, emerging evidence suggests that positive attitudes do not always translate into actual waste management practices, indicating the existence of an attitude–behavior gap. This discrepancy raises important questions regarding the factors that hinder the transformation of environmental awareness into meaningful action. Therefore, this study investigates waste management literacy among secondary school communities in Tangerang City, Indonesia, by examining the relationships among knowledge,

attitudes, and behavior through the KAB framework. Specifically, it seeks to move beyond traditional assumptions by exploring the attitude–behavior gap in sustainable waste management and identifying the challenges that prevent environmentally positive attitudes from being translated into consistent waste management behaviors.

METHOD

Research design

This study employed a mixed-methods approach using a sequential explanatory design, which integrates quantitative and qualitative methods in two consecutive phases to provide a comprehensive understanding of waste management literacy among secondary school communities in Tangerang City, Indonesia (Creswell & Poth, 2016). The first phase involved a quantitative assessment of knowledge, attitudes, and behaviors related to sustainable waste management among principals, teachers, students, and administrative staff from seven junior high schools. Prior to the main survey, the research instrument underwent expert validation by three specialists and was pilot-tested with 200 participants from junior high school communities in Tangerang City to ensure its validity and reliability (Naga, 2012). Construct validity was evaluated using Pearson Product–Moment correlation analysis, while instrument reliability was assessed through Cronbach's Alpha coefficients. The quantitative findings were subsequently followed by a qualitative phase aimed at exploring and contextualizing the observed relationships among knowledge, attitudes, and behaviors, particularly the factors contributing to the attitude–behavior gap in waste management practices. This qualitative inquiry provided deeper insights into the social, cultural, and institutional factors influencing waste-related behaviors within school communities. The study was conducted between April and May 2024 in Tangerang City, a strategic research setting due to its status as the eighth-largest waste-producing city in Indonesia and the location of the Rawa Kucing Final Disposal Site in Neglasari District. Furthermore, Tangerang hosts the highest number of Adiwiyata schools in Indonesia, totaling 521 institutions, making it a relevant context for examining sustainability-oriented educational initiatives. The selection of junior high schools was also aligned with the implementation of sustainable living themes within the Strengthening the Pancasila Student Profile project under Indonesia's Merdeka Curriculum, which emphasizes environmental responsibility and sustainable development competencies among students.

Sampling and data collection techniques

The quantitative data were collected using a structured questionnaire administered through Google Forms to assess respondents' knowledge, attitudes, and behaviors regarding the 3R principles (Reduce, Reuse, and Recycle). The instrument consisted of 59 statements measured on a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with items designed to capture different dimensions of waste management literacy. Prior to data collection, the questionnaire underwent content validation to ensure the relevance and clarity of the items. According to data from the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (Dapodik), eleven junior high schools are located near the Rawa Kucing Final Disposal Site in Neglasari District, consisting of one public school and ten private schools, including both Adiwiyata and non-Adiwiyata institutions. The total school community population comprised 3,287 individuals, including 3,060 students, 142 teachers, 74 staff members, and 11 principals. Using the Slovin formula with a 5% margin of error, the required sample size was determined to be 357 participants. To ensure proportional representation of each subgroup, stratified proportional random sampling was employed, resulting in a sample of 332 students, 15 teachers, 8 staff members, and 2 principals who were randomly selected from school-provided participant lists.

To complement the quantitative findings, qualitative data were collected through semi-structured interviews with seven purposively selected informants who possessed direct experience and responsibilities related to waste management within their schools. The interview protocol consisted of guiding questions while allowing flexibility for follow-up inquiries to gain deeper

insights into participants' perspectives and experiences. This approach enabled the exploration of contextual factors that could not be fully captured through the survey, particularly those related to the observed attitude–behavior gap in sustainable waste management practices. All interviews were audio-recorded and transcribed for analysis. To enhance the credibility and trustworthiness of the findings, triangulation of sources and methods was employed. Source triangulation involved comparing information obtained from principals, teachers, and staff members to verify the consistency of findings concerning waste management practices, while methodological triangulation integrated quantitative survey results with qualitative interview data to provide a more comprehensive understanding of waste management literacy among secondary school communities.

Data analysis techniques

Quantitative data were analyzed using correlation and multiple regression analyses to examine the relationships among waste management knowledge, attitudes, and behaviors within secondary school communities. Correlation analysis was conducted to determine the strength and significance of the relationships among the variables (Gravetter & Wallnau, 2017), while multiple regression analysis was employed to assess the partial and simultaneous effects of knowledge and attitudes on behavior (Hair et al., 2019). The analysis was guided by three hypotheses: H1, waste management knowledge significantly influences behavior; H2, attitudes toward waste management significantly influence behavior; and H3, knowledge and attitudes simultaneously have a significant influence on behavior. To complement the quantitative findings, qualitative interview data were analyzed using thematic analysis to identify recurring patterns and contextual factors related to waste management practices (Braun & Clarke, 2006). The integration of quantitative and qualitative findings enabled a deeper understanding of the relationships among knowledge, attitudes, and behaviors, particularly in explaining the attitude–behavior gap in sustainable waste management within school communities (Creswell & Poth, 2016).

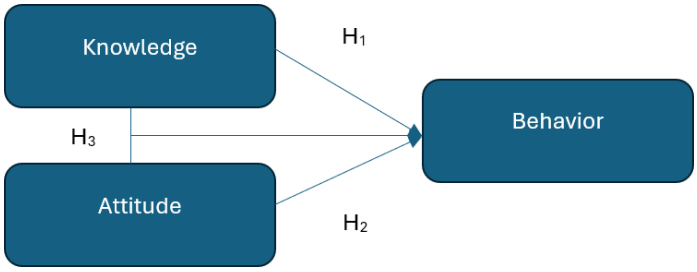

Figure 1. The research hypothesis

Prior to conducting multiple regression analysis, several classical assumption tests are performed to ensure the validity of the model, including linearity testing by examining scatterplots for knowledge and attitude against behavior, normality testing using the Kolmogorov-Smirnov and Shapiro-Wilk tests (Razali & Wah, 2011), homogeneity testing through Levene's Test (Lavene, 1960), and multicollinearity testing (Hair et al., 2019). Once these classical assumptions are validated, multiple regression analysis is conducted, followed by the interpretation of results. Both correlation and multiple regression analyses, along with the assumption tests, are performed using R Studio. For qualitative data, interview recordings are transcribed and analyzed using the Interactive Model developed by Miles, Huberman, and Saldana, which consists of four stages: data collection, data condensation, data display, and conclusion drawing (Miles et al., 2013). Thematic analysis is utilized to identify patterns and themes within the qualitative data (Braun & Clarke, 2006). This structured approach ensures that qualitative data analysis is both systematic and comprehensive, enhancing understanding of the context and factors influencing waste management knowledge, attitudes, and behaviors within school communities. This method enables the researcher to distill complex information into meaningful insights, ensuring that participants' perspectives are accurately captured and interpreted.

FINDINGS AND DISCUSSION

Findings

Profile of respondents

The demographic trends among the 357 respondents reveal a strong predominance of students (93%) primarily under the age of 15 (75.9%), with the majority holding an elementary school education level (93%). Gender representation leans slightly toward females (56.6%), and the highest representation is from Public Junior High School A, followed by various private institutions. This demographic profile underscores the significance of waste management literacy at an early educational stage, highlighting a young, predominantly student-based sample that is essential for fostering foundational attitudes and behaviors toward sustainable waste management practices. Table 1 presents a detailed profile of the 357 respondents, categorized by demographic characteristics and educational levels.

Table 1. Profile of the respondents

Description (n=357)		Frequency (n)	Percentage (%)
Gender	Male	155	43.4
	Female	202	56.6
School	Public Junior High School A	142	39.8
	Private Junior High School A	53	14.8
	Private Junior High School B	43	12
	Private Junior High School C	36	10.1
	Private Junior High School D	29	8.1
	Private Junior High School E	28	7.8
	Private Junior High School F	26	7.3
Role	School Principal	2	0.6
	Teacher	15	4.2
	Staff	8	2.2
	Student	332	93
Age	Under 15 years	271	75.9
	15 - 25 years	67	18.8
	41 - 60 years	11	3.1
	26 - 40 years	8	2.24
Educational Level	Elementary School	332	93
	Junior High School	0	0
	Senior High School	5	1.4
	Bachelor (S1)	19	5.3
	Master (S2)	1	0.3

The validity and reliability test

The validity of the questionnaire was assessed using the Pearson Product-Moment correlation, with a cutoff value of 0.30. Items with correlation coefficients below this threshold were considered invalid and subsequently removed from the analysis. Initially, the questionnaire included 65 statements. Following the validity test, 6 items were identified with correlation values below 0.30 and were excluded, resulting in a final total of 59 valid items. This refinement ensured that only statements with statistically significant relationships to the underlying constructions were retained. The reliability of the data was evaluated using Cronbach's Alpha. The Attitude and Behavior variables demonstrated Cronbach's alpha values above the 0.70 threshold, indicating strong internal reliability. The Knowledge variable showed a Cronbach's alpha of 0.674, which rounds to 0.70, meeting the standard for acceptable reliability. Consequently, all remaining variables met or exceeded the 0.70 threshold, confirming the data's consistency and suitability for further analysis.

Correlation analysis

The degree and direction of the association between knowledge, attitude, and behavior in

waste management within school communities were evaluated using the Pearson correlation coefficient. Coefficients approaching an absolute value of 1 indicate a stronger relationship (Yap et al., 2010). Table 2 reveals a moderately strong positive correlation between knowledge and attitudes toward waste management (r = 0.351, Sig. = 0.000), suggesting that higher levels of knowledge are associated with more positive attitudes. This outcome is consistent with findings from studies in various regions and populations, underscoring a persistent link between environmental knowledge and positive waste management attitudes. For example, Cahyono et al. (2023) found that increased environmental knowledge significantly enhanced student attitudes toward the 3R (Reduce, Reuse, Recycle) approach. Similarly, Benitez (2018) reported a positive correlation between solid waste management knowledge and favorable attitudes among students in the Philippines (Benitez, 2018). In Nigeria, Dung et al. (2017) observed that although students exhibited relatively low waste management knowledge, any increase in knowledge further strengthened their already positive attitudes (Dung et al., 2017).

Additionally, Iyer (2018) identified that greater awareness of e-waste issues in Bengaluru, India, encouraged more responsible attitudes toward e-waste generation (Iyer, 2018). Echoing these findings, Jinn et al. (2023) showed a robust association between 3R knowledge and positive waste management attitudes among Malaysian students (Jinn et al., 2023). However, Suwerda et al. (2018) cautioned that even with adequate knowledge, practical barriers such as limited waste disposal facilities and challenges related to personal motivation can hinder proper waste management practices (Suwerda et al., 2018). Collectively, these studies highlight a reliable trend: as knowledge of waste management principles, such as the 3Rs, grows, attitudes toward waste management tend to improve across diverse cultural and geographical contexts. Nevertheless, addressing practical barriers remains essential to translating positive attitudes into consistent waste management behaviors.

The study identifies a low correlation between environmental knowledge and waste management behavior within school communities in Tangerang (r = 0.081, Sig. = 0.125), suggesting that knowledge alone does not significantly influence behavior. This finding aligns with research by Yusuf and Fajri (2022), which similarly found that environmental knowledge among students at Syiah Kuala University, Indonesia, does not necessarily translate into corresponding waste management actions (Yusuf & Fajri, 2022). In other words, while students may possess solid environmental knowledge, this does not guarantee that they engage in environmentally responsible behaviors. The research also reveals a slightly negative relationship between attitude and behavior (r = -0.115, Sig. = 0.030), suggesting that even when individuals hold positive attitudes, their actual behaviors may not align accordingly. This significant yet unexpected result suggests that additional factors, such as the availability of facilities and prevailing social norms, likely impact waste management practices within the school community. Although increased knowledge may enhance attitudes, it does not automatically translate into improved behaviors, underscoring a gap shaped by external influences. A study conducted across European Union countries by Minelgaitė and Liobikienė (2019) found that while individuals held positive attitudes toward waste management, these attitudes did not necessarily result in behaviors such as waste reduction and recycling (Minelgaitė & Liobikienė, 2019). Notably, only individuals who recognized their personal responsibility in contributing to waste engaged in active waste management practices. Additionally, attitudes toward resource efficiency were found to have no significant impact on waste management behaviors, further reinforcing that awareness alone is insufficient to drive effective action. These studies highlight a critical insight: while environmental knowledge and general attitudes are important, they often do not suffice on their own to instill sustainable waste management behaviors. Cultivating a sense of personal responsibility appears essential for transforming knowledge into meaningful, sustainable action. Table 2 presents the correlation analysis between knowledge, attitude, and behavior regarding waste management within Tangerang school communities.

Table 2. Correlation between knowledge, attitude, and behavior of school communities waste management

	Knowledge	Attitude	Behavior

Knowledge	Pearson Corr.	1	.351*	.081
	Sign. (2-tailed)		18	.125
	N	357	357	357
Attitude	Pearson Corr.	.351*	1	-.115*
	Sign. (2-tailed)	.000		.030
	N	357		357
Behavior	Pearson Corr.	.081	-.115*	1
	Sign. (2-tailed)	.125	.030	
	N	357	357	357

Note: *Correlation is significant at the 0,05 level (2-tailed)

Multiple regression analysis

Multiple regression analysis was utilized to investigate the relationship between a single dependent variable (behavior) and two independent variables (knowledge and attitude) related to waste management within school communities. Prior to conducting multiple regression analysis, classical assumption tests were performed to ensure data suitability. The linearity of data patterns was evaluated using scatterplots for each independent variable (knowledge and attitude) in relation to the dependent variable (behavior). Normal testing conducted using the Kolmogorov-Smirnov and Shapiro-Wilk methods, yielded significance values of 0.071, 0.083, and 0.069, respectively, all exceeding the 0.05 threshold (MoE), confirming a normal distribution for all variables (knowledge, attitude, and behavior). Homogeneity was tested with Levene's test, resulting in a significance value of 0.062, which also exceeded the 0.05 criterion (MoE), thereby meeting the requirement for homogeneity. Additionally, multicollinearity between the independent variables (knowledge and attitude) was assessed, with a tolerance value of 0.877 (> 0.1) and a VIF value of 1.140 (< 10.0), indicating no multicollinearity concerns. Given that all classical assumptions were satisfied, the multiple regression analysis was deemed appropriate for this study. Table 3 presents the Multiple Regression Analysis.

Table 3. Multiple regression analysis

Independent Variables	Number of Items β	Sig.	Hypothesis	Result
Knowledge	0.594	0.014	H1	Significant
Attitude	-0.355	0.004	H2	Significant
F Value	5.496	0.004	H3	Significant
R Square	0.30			

In multiple regression analysis, the simultaneous test, commonly known as the F-test, evaluates whether the combined effect of independent variables (knowledge and attitude) on the dependent variable (behavior) is significant. Table 3 presents the results of the simultaneous test, indicating a significant value of 0.004, which is below the conventional 0.05 threshold. These results suggest that knowledge and attitude jointly exert a significant effect on waste management behavior within school communities in Tangerang City. These findings are supported by previous research. A study conducted in Padang, Indonesia, demonstrated a significant relationship between knowledge about sustainable waste management and the attitudes and behavioral intentions of primary school students (Gusti, 2016).

Similarly, research in Tangerang indicated that energy knowledge and attitudes influenced energy-saving behavior among elementary students (Bahij et al., 2020). However, a study in South Tangerang found no significant relationship between knowledge, attitudes, and waste management practices among housewives (Puji et al., 2020). Additionally, research on primary school children highlighted that although waste management knowledge was generally sufficient, there was a need to encourage the practical application of this knowledge in everyday life (Sulistyawati et al., 2020). These findings suggest that while knowledge and attitudes are crucial factors, other elements such as facilities and practical opportunities may also play an essential role in shaping waste management behaviors in school communities.

The Theory of Planned Behavior supports these findings, positing that behavior is influenced by attitudes, subjective norms, and perceived behavioral control (Ajzen & Schmidt, 2020). In this study's context, while knowledge can enhance attitudes, actual behavior is also shaped by the perceived ability to manage waste effectively and the influence of social norms within the school community. Consequently, the significant impact of both knowledge and attitude highlights the need for a holistic approach in educational interventions, integrating both cognitive understanding and attitudinal shifts to promote effective waste management behaviors.

A partial test was also conducted to explore the individual effects of knowledge and attitude on behavior. As indicated in Table 3, the knowledge variable yielded a t-value of 2.482 with a significance level of 0.014, suggesting that knowledge significantly influences behavior at the 5% significance level ($p < 0.05$). This implies that knowledge has a meaningful impact on behavior. Similarly, for the attitude variable, a t-value of -2.929 and a significance level of 0.004 were observed, indicating a statistically significant influence on behavior at the 5% significance level ($p < 0.05$). However, the influence of attitudes on behavior was negative, revealing a notable attitude-behavior gap, a phenomenon also observed in prior studies (Minelgaitė & Liobikienė, 2019).

Research indicates that while personal attitudes toward waste generation may positively impact waste management behaviors, broader attitudes toward waste management often adversely affect efforts to reduce and recycle waste (Minelgaitė & Liobikienė, 2019). This finding aligns with Blake's (1999) Value-Action Gap, which posits that individuals may hold supportive values or attitudes towards specific actions, yet their behaviors do not consistently reflect these attitudes. Environmental knowledge is essential for shaping attitudes and influencing behavior. Environmental knowledge is critical for forming attitudes and influencing behavior (Dennis V. Madrigal & Enrique G. Oracion, 2017; Raghu & Rodrigues, 2022). However, factors such as subjective norms, perceived behavioral control, and intention also significantly impact waste management practices (Raghu & Rodrigues, 2022). In addition, cultural, social, and political barriers—such as perceptions of responsibility and a lack of trust in waste management authorities—contribute to the gap between attitudes and actions (Fahy, 2005). Despite rising environmental awareness, municipal waste disposal in landfills has increased, emphasizing the need for effective strategies to bridge the attitude-behavior gap in waste management practices (Fahy, 2005).

Moreover, the low R^2 value in the regression model (approximately 30%) indicates that knowledge and attitude account for only a minor portion of the variance in waste management behavior, suggesting that other factors, such as established habits, social pressures, or external conditions, exert a stronger influence. This observation supports Blake's (1999) assertion that external barriers often impede the translation of positive intentions or attitudes into action.

Exploring barriers to bridging the value-action gap in school communities

Blake (1999) identifies various barriers contributing to the Value-Action Gap, including individual, social, and structural obstacles. Within this study's context, the negative influence of attitudes on behavior may reflect the presence of these barriers. For instance, while students and teachers may hold positive attitudes toward waste management, they often encounter practical challenges, such as a lack of concrete knowledge on effective waste management practices despite understanding its importance. Additionally, social barriers, including influences from family, peers, and prevailing norms within the school community, may discourage pro-environmental behavior. If surrounding norms do not support effective waste management, positive attitudes alone are insufficient to drive meaningful action. In interviews, teachers at Public Secondary School A in Tangerang consistently noted the impact of students' backgrounds on their waste management behavior. One teacher articulated this concern, stating:

> *"Most of the students at this school come from families of scavengers, given its location near the Rawa Kucing Landfill. This family background undoubtedly affects their upbringing, mindset, and habits. As a result, I assume that because these students live close to waste, they perceive it as not a significant problem."* (Teacher LQ, Tangerang Public

Secondary School, interviewed on July 23, 2024).

This perspective reflects a consensus among faculty that the socio-economic context and familial influences significantly shape students' perceptions of waste. Addressing these barriers is essential to fostering more effective waste management practices within the school community.

Institutional barriers, such as the lack of adequate waste management facilities, including the absence of separate bins for recycling programs, further impede the alignment of behavior with attitudes toward waste management. Interview findings indicated that several secondary schools in Tangerang City still lack 3R (Reduce, Reuse, Recycle) bins, leading to the continued mixing of waste types despite the school community's commitment to proper waste disposal practices. As Teacher AH from a private secondary school in Tangerang remarked:

> *"We are grateful that students, teachers, and staff at our school already dispose of their waste in designated bins, but unfortunately, we still only have one bin to accommodate all types of waste produced by the school community."* (Teacher AH, a private secondary school in Tangerang, interviewed on May 4, 2024).

This statement reflects the challenges schools face in aligning waste management practices with available infrastructure, underscoring the need for enhanced waste sorting systems to support these efforts. Furthermore, the conventional waste management system operated by the Tangerang local government undermines school waste management initiatives, diminishing their effectiveness. This misalignment has led some schools to express frustration. For example, Private Junior School D and Junior School F in Tangerang have voiced concerns that their commitment to good waste disposal practices—such as sorting organic and inorganic waste and composting on school grounds—often feels "futile" due to ineffective external waste management practices. As a teacher overseeing the Adiwiyata program explained:

> *"Within the school environment, we have managed waste quite well, such as separating organic and inorganic waste and composting on school grounds. However, once the sanitation workers collect the waste, it gets mixed again. This happens because the workers only use one bin, so all types of waste are remixed,"* (Teacher from Private Junior School D, interviewed on May 4, 2024).

This quote illustrates the disconnect between internal school efforts and external waste management systems, a persistent barrier to effective waste management in Tangerang's schools. The finding that attitudes can negatively influence behaviour may also reflect frustration among students and staff regarding their limited ability to implement effective waste management practices due to institutional constraints. Positive attitudes may inversely relate to behaviour when individuals feel their actions lack impact or when external barriers render these actions impractical or challenging.

The limited explanatory power of knowledge and attitudes in predicting waste management behaviour within Tangerang's school communities suggests that additional, more influential factors are at play. This insight has critical implications for environmental education programs, highlighting the insufficiency of focusing solely on knowledge enhancement to achieve sustainable behavioural change. A comprehensive, multifaceted approach is essential, one that includes the provision of appropriate facilities, the establishment of social norms supportive of eco-friendly practices, and the mitigation of logistical barriers faced by students, teachers, and staff. Addressing these institutional and social challenges is crucial to bridging the Value-Action Gap and fostering waste management behaviours that genuinely reflect the environmentally responsible values held by the school community. These findings call for an evolved environmental education framework, one that not only informs but also strategically motivates and facilitates meaningful behavioural shifts.

CONCLUSION

This study underscores a significant relationship between knowledge, attitude, and behavior in waste management within school communities in Tangerang City, revealing that, while knowledge positively influences behavior, attitudes may exert a negative effect, suggesting an attitude-behavior gap. The Value-Action Gap, as conceptualized by Blake (1999), is evident in these communities: although positive attitudes toward waste management are present, translating these attitudes into effective actions is hindered by individual limitations, social influences, and institutional barriers. The lack of adequate waste management infrastructure, such as separate recycling bins, impedes the alignment of actions with attitudes, creating frustration among school community members. Furthermore, conventional waste management systems exacerbate these issues by leading to mixed waste disposal, which reduces motivation to implement the 3R (Reduce, Reuse, Recycle) principles. The low R^2 value indicates that knowledge and attitude together explain only a small portion of the variance in waste management behavior, suggesting that other factors, such as established habits and social pressures, play a substantial role. Consequently, a more comprehensive approach is essential to enhance environmental education, including the provision of adequate facilities and the development of supportive social norms, which are critical to bridging the Value-Action Gap and advancing sustainable waste management practices within schools. Future research should aim to identify factors that contribute to the attitude-behavior gap and evaluate the effectiveness of educational interventions. Additionally, studies should explore the role of community engagement in fostering sustainability within schools and conduct longitudinal analyses to understand the long-term impact of institutional support on waste management behaviors.

ACKNOWLEDGMENT

This research was funded by the Institute of Social Sciences and Humanities at the National Research and Innovation Agency of Indonesia, as part of the *Rumah Program-IPSH* 2024. We express our sincere gratitude for their financial support and dedication to advancing research in the social sciences and humanities, which has been instrumental to the successful completion of this study.

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