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MORALITY BEFORE KNOWLEDGE

The implementation gap in waste management: A study of discrepancies in awareness, attitude, and practice

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ABSTRACT

Background: Proper household waste management is essential to maintain environmental quality, especially in densely populated areas such as student boarding houses. University students, as part of the educated population, play a crucial role in promoting sustainable waste practices. However, the gap between environmental awareness and actual waste management behavior among students remains a significant challenge. **Methods:** This study employed a descriptive quantitative survey approach to analyze the awareness and attitudes of Universitas Negeri Semarang (UNNES) students living in boarding houses toward household waste management. Data were collected through a self-administered online questionnaire distributed to 53 respondents and analyzed using descriptive statistical methods. **Findings:** The results revealed that most respondents demonstrated high awareness of environmental and household waste issues, with more than 80% agreeing or strongly agreeing that waste sorting and recycling are essential. Nevertheless, their active participation in implementing waste management practices was still limited, mainly due to lack of facilities and motivation. **Conclusion:** The findings indicate that while awareness and attitudes are generally positive, the translation of this awareness into consistent waste management behavior remains inadequate. **Novelty/Originality of this article:** This study provides a focused analysis of environmental awareness and attitudes within the context of student boarding life, offering insight into behavioral gaps that can inform targeted environmental education and campus sustainability programs. However, this study is limited by its relatively small sample size and descriptive focus, which may affect the generalization of the findings. Despite this, the results provide practical implications for developing targeted environmental programs and waste management initiatives within university student communities.

KEYWORDS: environmental awareness; student attitudes; household waste management; boarding houses; sustainable behavior; university students.

1. Introduction

Proper management of household waste is essential to maintain environmental health, especially in urban areas with high waste generation. Analyzing UNNES students' awareness and attitudes toward household waste management is crucial, as the growing number of students living in urban areas contributes to increasing household waste generation. Understanding college students' attitudes toward managing household waste provides insight into their practices, which is crucial to encouraging responsible waste management behavior among young adults (Baba-Nalikant et al., 2023). In addition, research by Bashir et al. (2020) showed that high environmental awareness among students contributes to waste reduction and increased recycling practices. Therefore, it is

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important to examine these factors so that we can understand the difference between what is known and what is actually done.

Recent national and regional data further highlight the urgency of this issue. The Ministry of Environment and Forestry reported that Indonesia produces more than 68 million tons of waste annually, with a significant portion coming from household sources (Arisman & Fatimah, 2023). In university cities such as Semarang, the high concentration of student boarding houses contributes to daily waste generation dominated by organic waste, plastic packaging, and paper materials. Although local governments have promoted waste separation policies, implementation at the household level, particularly among students living in boarding houses, remains limited. Similar trends are seen in other Southeast Asian countries, where the rapid growth of the student population intensifies challenges in urban waste management systems (Rashid et al., 2024; Shrestha et al., 2025). These observations indicate that young adults in transitional living arrangements, such as boarding houses, represent a critical demographic for shaping sustainable waste habits.

Previous research shows that university students often have a basic understanding of waste management but lack the motivation to apply this knowledge in their daily lives. For example, research conducted by Chao et al. (2023) found that many college students are aware of the importance of recycling but do not consistently perform recycling behaviors. This inconsistency is especially evident among students living in boarding houses, where limited facilities and lack of motivation can hinder good waste management (Raghu & Rodrigues, 2022). Recent studies have continued to emphasize the importance of students' environmental literacy and pro-environmental behavior, highlighting the role of educational institutions in shaping sustainable lifestyles (Mendes et al., 2025). These findings further support the relevance of examining waste management behavior in university settings. Although similar studies have been conducted to examine the awareness and practices of secondary school students in India, this study focuses on university students living in boarding houses in Indonesia, using the same questionnaire indicators to assess their awareness and attitude toward managing household waste.

This study is conceptually grounded in the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) model, which together explain how environmental awareness and moral values influence behavioral intentions and actions. According to the TPB, attitudes toward a behavior, perceived social pressure (subjective norms), and perceived control shape the likelihood of engaging in that behavior (Kobylińska, 2022). Meanwhile, the VBN framework highlights the role of internalized moral obligations and environmental values in motivating sustainable practices (Al Mamun et al., 2022). Integrating these frameworks allows for a deeper understanding of how cognitive and contextual factors interact to influence waste management behavior among students. By situating this study within these theoretical perspectives, the analysis not only captures descriptive patterns of awareness and attitude but also contributes to broader behavioral and sustainability research in higher education. This study highlights its distinct contribution by emphasizing the context of Indonesian student boarding life, offering a localized insight that complements prior international studies on waste management behavior. According to TPB, individuals are more likely to engage in pro-environmental behavior when they possess favorable attitudes, perceive social support, and believe they have control over their actions (Correia et al., 2022), while the VBN model emphasizes that moral and normative beliefs can further drive responsible environmental behavior (Al Mamun et al., 2022). These frameworks serve as the analytical lens for interpreting students' awareness, attitudes, and practices in household waste management.

Understanding the gap between awareness and actual practice among UNNES students living in boarding houses is important because this group contributes substantially to daily household waste generation in urban areas (Knickmeyer, 2020). This focus also underscores the behavioral significance of student communities as transitional actors between family-based and independent living, which makes their waste practices an important reflection of environmental education outcomes. The main objective of this study is to determine the gap between awareness and actual practice in managing household

waste among UNNES students living in boarding houses. Accordingly, this study seeks to answer the following research question: "How do UNNES students living in boarding houses demonstrate the relationship between their environmental awareness, attitudes, and household waste management practices?"

2. Methods

This study employed a descriptive survey design with a quantitative approach. Data were collected via a self-administered online questionnaire distributed through Google Forms to 53 UNNES students living in boarding houses, selected by purposive sampling. The instrument was designed to find out how the level of awareness and attitude of university students towards household waste management. The survey consisted of closed-ended questions and was administered to 53 respondents, all of whom met specific criteria as UNNES students currently living in boarding houses. The questionnaire consisted of closed-ended items, such as "Yes" or "No" answers, scale choices (e.g. Likert scale: 1 to 5), or multiple choice (Rashid et al., 2024). The sampling method used was purposive sampling, to ensure that only students who fit the research criteria were included in the study.

Before the data collection, the questionnaire items were adapted from previous studies that had been tested for validity and reliability (Raghu & Rodrigues, 2022; Chao et al., 2023). The adapted instrument was reviewed by two environmental and science education lecturers to ensure contextual relevance and content accuracy for UNNES students. As this study adopted an established instrument that had been previously validated, no separate reliability test was conducted; however, expert review was employed to ensure its contextual appropriateness and content validity in the present study. The sample size of 53 respondents was determined based on purposive sampling considerations, emphasizing representativeness of the target population rather than generalization. The data collection process began by distributing the Google Forms survey link through online platforms, such as WhatsApp group chats. Before completing the survey, participants were first asked to confirm that they met the required criteria (i.e. UNNES students living in boarding houses). Once confirmed, they were directed to answer the survey questions, which were structured to gather insights into their daily practices and attitudes regarding household management. The data were then analyzed using descriptive statistical methods to draw conclusions about students' overall awareness and attitudes toward waste management responsibilities. This study employed descriptive statistical analysis, as the main objective was to describe and interpret students' awareness and attitudes rather than to test hypotheses. Inferential or correlation-based analyses were considered beyond the current research scope but are recommended for future studies to enhance generalizability.

The use of online surveys allows for efficient data collection from a sample population and makes it easier for respondents to participate without time and location constraints, thus speeding up the data collection process (Van Quaquebeke et al., 2022; Arndt et al., 2022). In addition, ethical considerations were taken into account throughout the research process. Participation in this study was entirely voluntary, and informed consent was obtained digitally before respondents accessed the questionnaire. The survey did not collect any identifying information, ensuring anonymity and confidentiality of participants' responses. Ethical clearance was granted through consultation with the Faculty of Mathematics and Natural Sciences at Universitas Negeri Semarang, following institutional research ethics guidelines. Furthermore, data integrity was maintained by limiting multiple submissions from the same device and ensuring all responses were complete before analysis. These steps ensured that the study adhered to accepted standards of research ethics and methodological rigor.

3. Results and Discussion

This research focuses on understanding the level of awareness and attitudes of UNNES students living in boarding houses regarding household waste management and broader

environmental issues. As the world faces increasing environmental challenges, particularly around waste disposal and sustainability, it is vital to explore how young adults perceive their role in addressing these issues (Debrah et al., 2021). The study examines their understanding of proper waste disposal practices, their perceptions of responsibility, and their level of engagement in sustainable waste management activities. In doing so, this study highlights both the positive steps taken by the students and areas where further improvement or education may be needed. The results reflect the students' personal beliefs and knowledge regarding household waste, offering insights into their potential role in supporting broader environmental efforts. The results of this study describe the awareness, attitudes, and household waste management practices of UNNES students living in boarding houses.

Table 1. Summary of students' awareness, attitudes, and practices toward household waste management

Variable	Indicators	Mean score	Percentage (Agree/Positive)	Indicators
Awareness	Knowing how to sort waste	4.25	88.7%	High
	Understanding recycling importance	4.18	84.9%	High
Attitude	Willingness to separate organic and inorganic waste	4.12	81.2%	Positive
	Perceiving waste sorting as beneficial	4.05	79.6%	Positive
Practice	Regularly separating waste	3.42	61.0%	Moderate
	Reusing or recycling materials	3.26	55.8%	Moderate

Note: Scores are based on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree)

The table indicates that while students show high levels of awareness and positive attitudes toward household waste management, their actual practices remain moderate. This suggests a clear awareness–behavior gap, consistent with the findings discussed in the following sections. A closer look at the data reveals that although students understand the technical aspects of waste management, such as sorting and recycling, this knowledge is not consistently translated into daily habits. The relatively lower mean scores in the "practice" category suggest that external barriers, such as insufficient access to sorting bins and lack of institutional waste programs, may limit behavioral expression. This finding reinforces the need for an enabling environment that transforms individual awareness into structural participation. Students' willingness to participate in recycling initiatives often depends on the perceived convenience and the level of institutional support available in their environment.

Moreover, the strong awareness levels (mean= 4.25) indicate that cognitive understanding is already well-developed, implying that future interventions should focus on motivational and contextual strategies rather than basic education. The gap between "knowing" and "doing" thus represents a behavioral bottleneck that universities can address through policy integration, peer influence, and experiential learning activities. In addition, promoting behavioral reinforcement, such as recognition systems, visible role models, and feedback mechanisms could enhance commitment to sustainability, as supported by findings from Skeirytė et al. (2022), who noted that continuous reinforcement improves pro-environmental habits among students. This also implies that awareness initiatives should evolve from short-term campaigns into long-term engagement strategies that embed sustainability into students' lifestyles.

Another noteworthy pattern in the data is that respondents generally express positive attitudes even when their practices lag behind. This finding suggests that intention exists

but is not always operationalized, which reflects the classic gap between behavioral intention and actual control described in the Theory of Planned Behavior (Kobylińska, 2022). In this context, UNNES students may feel constrained not by a lack of awareness, but by situational limitations such as inadequate waste bins, lack of incentives, or social indifference toward recycling. Addressing these barriers through structural support and peer-based initiatives could bridge the gap between awareness and sustained behavioral engagement.

Furthermore, the descriptive statistics underscore that environmental awareness is not uniform across all respondents. While the majority express strong agreement with sustainability principles, a smaller proportion demonstrates moderate or uncertain responses, suggesting a partial internalization of environmental values. This highlights the importance of differentiated educational strategies, combining informative, emotional, and participatory learning to reach students with varying levels of environmental commitment (Utaminingsih et al., 2025). Universities can play a transformative role by fostering campus cultures that model and reward sustainable practices.

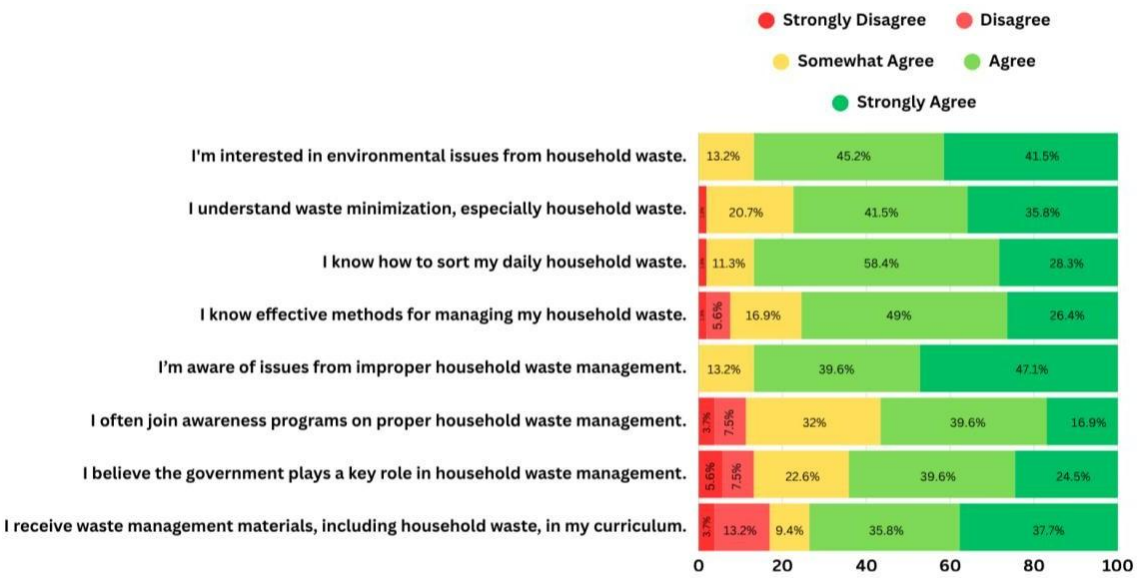

Fig. 1. Student's awareness of household waste management

Figure 1 presents a stacked bar chart illustrating respondents' awareness of environmental issues and household waste management. The responses indicate a strong awareness of environmental issues: 41.5% strongly agree and 45.2% agree that household waste management is a critical concern. This high level of agreement aligns with previous studies, such as those by Skeirytė et al. (2022), which found that young adults, particularly students, tend to be more environmentally conscious due to increasing awareness of climate change and pollution. However, the 13.2% who fairly agree indicates that while there is interest in environmental issues, there may be varying levels of depth in that interest, suggesting that more targeted education or hands-on involvement could strengthen their commitment to environmental sustainability.

For the statement regarding waste minimization principles, 41.5% of respondents agree, and 35.8% strongly agree, but the 1.8% disagreement may indicate persisting misconceptions or lack of effective communication on this topic. This reflects findings from Subri et al. (2025), who emphasize that awareness alone may not lead to action without proper education and community involvement. In terms of waste management practices, 58.4% of respondents agree, and 28.3% strongly agree that they know how to sort household waste, suggesting a strong foundational knowledge. However, the 1.8% disagreement indicates that not all students are equally involved or knowledgeable about practical waste management actions. The discrepancy between awareness and behavioral execution underscores the importance of experiential learning and environmental

immersion. Integrating real-world activities, such as waste audits or zero-waste challenges, could bridge the gap between theoretical understanding and lived practice. This may also indicate that theoretical exposure, such as classroom learning has not been sufficiently translated into experiential engagement, emphasizing the need for applied sustainability programs like waste-to-compost projects, eco-volunteering, or on-campus recycling initiatives.

The fourth statement regarding the knowledge of effective methods to manage household waste shows a notable majority with 49% agreeing and 26.4% strongly agreeing, indicating that most respondents have a solid understanding of proper waste management techniques. This reflects a generally positive trend in awareness and capability regarding sustainable household waste practices. However, the 16.9% who fairly agree may point to a need for further practical education or experience in applying these methods. This suggests that while theoretical knowledge may be present, actual application and hands-on practice in effective waste management could be areas for improvement, aligning with findings from prior research that emphasize the importance of experiential learning in fostering long-term sustainable behaviors (Moyer & Sinclair, 2020).

This finding supports the idea that while theoretical knowledge is established, consistent behavioral application remains limited, an indication of the classic awareness–behavior gap described in behavioral environmental literature (Lim & Weissmann, 2023). Bridging this gap requires transforming awareness into internalized motivation through interactive learning experiences, community-based waste programs, and university-led initiatives that reinforce positive environmental norms among students. Furthermore, creating peer-led initiatives may help normalize sustainable habits, as peer influence is often more effective in shaping daily routines among students than formal instruction (Menon & Suresh, 2020). Beyond individual behavior, these findings also highlight the institutional dimension of environmental responsibility. Universities serve as microcosms of society, and embedding sustainability into their operational, curricular, and cultural frameworks can have a multiplier effect on students' long-term attitudes. Establishing campus-based waste sorting facilities, regular environmental audits, and "green dormitory" programs could provide practical exposure and social reinforcement, thereby strengthening the continuity between awareness and practice. As suggested by Gupta et al. (2024), students who experience visible sustainability infrastructures are more likely to sustain eco-friendly behaviors after graduation.

The awareness of problems arising from improper household waste management is strong among respondents, with 47.1% strongly agreeing and 39.6% agreeing. This suggests a high level of consciousness regarding the environmental risks associated with poor waste disposal practices. However, the 13.2% who fairly agree may indicate that while there is basic awareness, a deeper understanding of the long-term consequences might be lacking. This is consistent with the notion that more comprehensive environmental education and community engagement efforts are necessary to enhance awareness (Menon & Suresh, 2020). In addition, the moderate participation level in environmental awareness programs (39.6% agreeing, 32% fairly agreeing, and 7.5% disagreeing) suggests that the availability and accessibility of such programs remain limited. This indicates an institutional gap in sustainability outreach and student involvement, which could be addressed by integrating environmental education into both curricular and extracurricular activities. One possible explanation for this limited engagement is that environmental programs at the university level often remain event-based and temporary, rather than embedded as a continuous part of campus culture (Gupta et al., 2024). Sustained initiatives, such as semester-long eco-projects, green ambassador programs, or community composting schemes, could foster a more consistent behavioral transformation among students.

Universities could collaborate with local governments to organize campaigns, recycling workshops, and waste segregation drives, ensuring that awareness translates into concrete behavioral practices. Moreover, partnerships with private sectors, such as waste management companies and eco-friendly startups could also expand opportunities for students to engage in practical sustainability projects. These collaborations would not only

strengthen applied learning but also enhance students' employability in the growing green economy sector (Skeirytė et al., 2022).

Overall, students perceive waste management as a shared responsibility between individuals and government authorities, which reflects a balanced awareness of personal and institutional roles. The strong agreement (over 70%) on including environmental management in the curriculum reinforces the need to formalize sustainability education within higher learning institutions. This aligns with Indonesia's National Waste Management Policy (Government Regulation No. 81 of 2012), which emphasizes community-based participation and education as key components of waste reduction strategies (Maskun et al., 2025). Such alignment between student perception and national priorities demonstrates a favorable foundation for policy implementation and behavioral change in the academic community.

This finding also opens the door for universities to act as catalysts in local sustainability networks. By embedding students in community service projects that focus on waste segregation, composting, or clean-up initiatives, higher education institutions can position themselves as active agents of change rather than passive educators. This approach resonates with the Education for Sustainable Development framework, which emphasizes the integration of knowledge, skills, values, and actions for environmental stewardship (Huang et al., 2024). Further studies could examine how practical, hands-on waste management education and experiential learning opportunities can enhance students' commitment to sustainable environmental practices. While this study applied descriptive analysis to portray students' awareness and attitudes, future research could incorporate inferential statistical approaches to further examine the relationships among variables and strengthen the generalizability of the results. This behavioral gap between high awareness and limited implementation reflects the core idea of the Theory of Planned Behavior, which explains that attitudes and awareness alone are insufficient to drive consistent behavior if perceived behavioral control and enabling conditions are weak (Hagger et al., 2022; Simanihuruk & Toni, 2025).

In this study, the lack of waste sorting facilities, limited institutional support, and minimal peer influence may have reduced students' sense of control over their actions. This interpretation aligns with Song et al. (2022), who highlight the role of situational and normative factors in shaping pro-environmental practices among students. Additionally, from a psychological standpoint, this imbalance between intention and behavior may also relate to the "value-action gap," a phenomenon where individuals endorse sustainable values but fail to act upon them consistently (Grunwald et al., 2025). This can occur when external rewards, social reinforcement, or personal efficacy are lacking, reinforcing the need for motivational design in sustainability programs. Encouraging collective accountability, for example, through group-based recycling competitions or dormitory-level sustainability scoring could provide the social cues needed to trigger consistent behavioral change.

These findings are consistent with previous studies indicating that young adults tend to demonstrate strong environmental awareness yet inconsistent behavioral implementation (Bashir et al., 2020; Shutaleva et al., 2021; Skeirytė et al., 2022). However, compared with Chao et al. (2023), who found relatively higher recycling engagement among students with institutional incentives, the present study reveals a more limited behavioral response. This contrast may stem from contextual differences, as UNNES students living in independent boarding houses often rely on self-initiative rather than structured campus waste programs. This context underlines the importance of external facilitation; without consistent cues or reinforcement, environmental awareness remains an abstract principle rather than an actionable habit. Universities should therefore explore hybrid learning models that combine sustainability education with real-life applications, such as integrating waste audits or eco-challenges into coursework.

Furthermore, the findings can be interpreted through the Value-Belief-Norm framework, which emphasizes that pro-environmental actions arise when personal norms are activated by environmental awareness and moral responsibility (Batool et al., 2024).

Although UNNES students show strong awareness, the transition from belief to consistent behavior may require targeted interventions that reinforce social norms and provide tangible opportunities for action. From a theoretical standpoint, this study deepens the application of TPB and VBN models in the context of Indonesian higher education, demonstrating that cognitive awareness must be complemented by social and structural support to produce sustained environmental behavior. Practically, the results highlight that universities play a pivotal role in enabling behavioral consistency, through peer-based waste programs, incentive-driven participation, and experiential learning activities that internalize environmental responsibility as part of campus culture. Embedding sustainability indicators into university performance metrics, such as ranking criteria, accreditation, or community engagement scores could institutionalize these values beyond short-term campaigns.

In addition to cognitive factors, motivational and contextual barriers appear to play a substantial role in shaping students' waste management behavior (Gupta et al., 2024). Empirically, this research underscores that the determinants of sustainable behavior among students are multifaceted, rooted not only in awareness but also in the social, motivational, and infrastructural environment surrounding them. The absence of visible role models, peer encouragement, and university-level reinforcement mechanisms collectively diminishes behavioral control and habit formation. As supported by Bang et al. (2025), sustained environmental behavior arises when individuals perceive tangible feedback and social validation, which suggests that participatory and reward-based approaches could be more effective than passive education campaigns. Programs that celebrate small, measurable achievements, such as "green dorm" competitions or eco-point systems can generate a sense of progress and belonging, gradually transforming sustainability into a shared identity rather than a personal obligation (Bang et al., 2025). Addressing these barriers through motivational interventions and improved campus-community collaboration could transform positive attitudes into habitual, pro-environmental practices (Alalawi & Omar, 2024; Shrestha et al., 2025).

The limitations of this study include the relatively small sample size of respondents, which may not fully represent the broader population of UNNES students, and the reliance on self-reported data, which could introduce bias in terms of overestimating personal awareness or involvement. Another limitation lies in the focus on quantitative descriptive data, which does not capture the nuanced motivations or emotions behind students' behaviors. Future research employing mixed methods, such as interviews or focus group discussions could enrich understanding of the psychological and cultural factors influencing waste management practices. Overall, while respondents demonstrate positive awareness, there remain areas for improvement in engagement and practical understanding. Beyond methodological limitations, it is also essential to acknowledge the influence of sociocultural contexts on environmental behavior (Xia et al., 2021).

In collectivist cultures like Indonesia, social approval and group belonging often shape behavioral norms more strongly than individual conviction. Therefore, peer-driven initiatives and community-based programs could be instrumental in amplifying students' sustainable practices (Xia et al., 2021). Finally, as digital platforms increasingly shape youth behavior, integrating sustainability content into social media campaigns and gamified online learning could significantly broaden engagement among university students. Digital-based environmental communication can foster a sense of immediacy, connectivity, and shared purpose. They are essential ingredients for sustaining behavioral change in modern academic communities.

Figure 2 shows a stacked bar chart of respondents' attitudes toward environmental issues and household waste management. The responses to the statement regarding improper disposal of household waste posing a serious threat to the environment show a high level of concern among UNNES students living in boarding houses. With 62.2% strongly agreeing and 33.9% agreeing, the majority of respondents acknowledge the severe environmental consequences of mismanaging waste. This consensus reflects a growing awareness of global environmental crises, particularly those driven by poor waste

management practices. However, the 1.8% of respondents who fairly agree and the 1.8% who strongly disagree may point to either a lack of direct exposure to the adverse effects of improper waste disposal or differing perceptions of environmental threats.

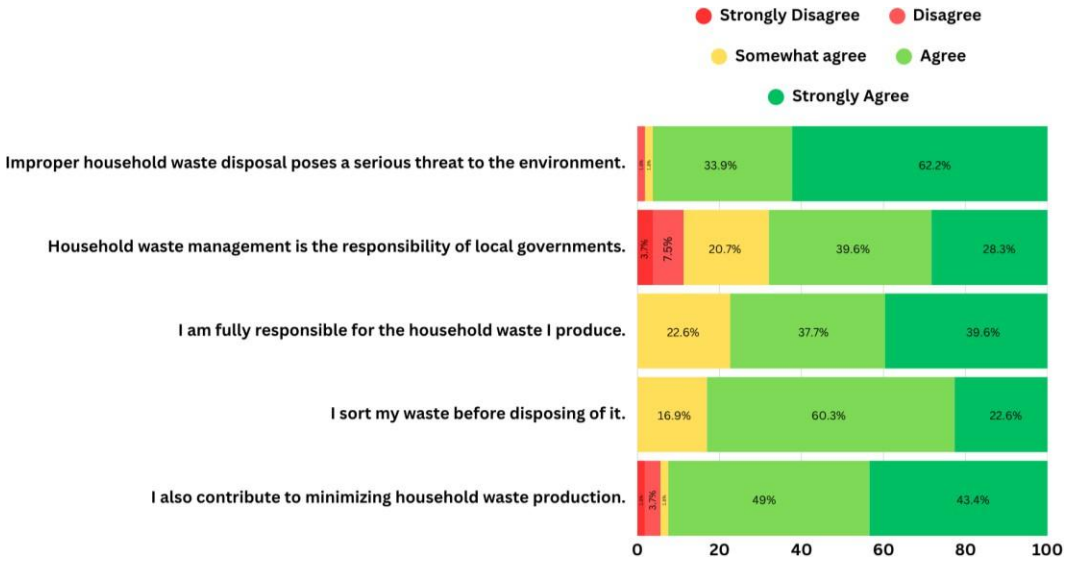

Fig. 2. Student's attitude of household waste management

The data illustrate that students perceive waste mismanagement as a pressing environmental threat, reinforcing the internalization of ecological responsibility as part of their moral framework. This finding supports the notion that attitudes toward environmental issues are not only cognitive but also affective, shaped by emotional awareness of environmental damage (Bashir et al., 2020). In this sense, experiential and project-based learning could further strengthen this emotional connection, enabling students to translate environmental concern into active participation. Such engagement-based approaches have been found to increase the sense of ownership over environmental outcomes, encouraging long-term commitment rather than short-term behavioral changes (Yulianah et al., 2025). Moreover, providing students with real-world contexts, such as visits to waste processing facilities or community recycling centers can bridge the gap between abstract concern and tangible understanding, turning environmental awareness into civic responsibility.

Regarding the responsibility for household waste management, 39.6% agree that it is the responsibility of local governments, with 28.3% strongly agreeing and 20.7% fairly agreeing. These mixed responses indicate that students perceive waste management as a shared responsibility involving both institutional and individual actors. This dual perception reflects the rise of "co-governance" models in environmental policy, where universities, municipalities, and communities share mutual accountability in implementing sustainable practices (Bashir et al., 2020). The recognition of such interdependence demonstrates a mature environmental worldview among students, highlighting their readiness to participate in collective sustainability efforts if institutional mechanisms are available. In the context of Indonesian society, where collective responsibility and community engagement are culturally embedded, this perception aligns well with pro-environmental values that emphasize cooperation and mutual accountability (Prawira et al., 2024). It also mirrors the growing global emphasis on citizen-driven environmental governance, where young people play a pivotal role as change agents in grassroots initiatives (Ispiryan et al., 2024). In this regard, student boarding houses can function as microcosms of sustainable communities, spaces where environmental education is not merely taught, but practiced through daily habits like composting, sorting waste, and energy conservation.

This division of opinion aligns with research that emphasizes the importance of collaborative efforts between government, individuals, and organizations in addressing

environmental challenges (Ispiryan et al., 2024). From a theoretical standpoint, these findings reaffirm the mechanisms described in the TPB and VBN models, where attitudes and moral norms form the foundation of pro-environmental intentions but must be supported by enabling social and institutional structures. These frameworks collectively suggest that awareness and moral norms generate readiness for action, while institutional design determines behavioral persistence. Therefore, to sustain pro-environmental practices, universities must not only cultivate awareness but also provide accessible systems that reinforce environmentally responsible choices, such as separate waste bins, feedback mechanisms, and public recognition programs (Altassan, 2023).

Strengthening these internal and external motivators, through peer networks, recognition programs, and curriculum integration could enhance students' sense of agency and collective responsibility in managing household waste (Raghu & Rodrigues, 2022; Tusyanah et al., 2024; Sokkar, 2024). Furthermore, the data underscore the need to transform positive attitudes into habitual action by embedding environmental values within everyday campus routines and community norms, ensuring that sustainability becomes not only an idea but a lived practice. This transformation can be achieved through consistent messaging, leadership modeling, and institutional accountability. For instance, when student organizations or dorm supervisors actively participate in environmental initiatives, it reinforces behavioral consistency and social legitimacy. In the long term, cultivating a sustainability-oriented campus culture can normalize eco-friendly behaviors, turning waste management from an obligation into an identity-driven habit (Zahran & Aljuhmani, 2025).

The limitations of this study include the relatively narrow focus on students living in boarding houses, which may not represent the broader student population or other living environments. Furthermore, in response to the third statement, 39.6% strongly agree, 37.7% agree, and 22.6% fairly agree that individuals themselves are responsible for managing the household waste they generate. This indicates a strong belief in personal accountability, reflecting an alignment with the principles of environmental stewardship, where individuals take proactive steps in reducing their household waste. The data from the fourth statement on sorting waste before disposal reveals that 60.3% of respondents agree, with 22.6% strongly agreeing, and 16.9% fairly agreeing.

Overall, the responses consistently show that students strongly value waste sorting as a fundamental practice in minimizing environmental impact. This finding reflects the diffusion of pro-environmental values among educated youth and supports the growing culture of ecological responsibility in university communities. Such behaviors indicate that environmental education within higher institutions has begun to influence practical waste management habits, even among students living independently. Sorting waste is often viewed as the foundation for recycling and reducing the amount of non-biodegradable waste, which aligns with broader environmental goals (Kakadellis et al., 2021). This attitude among students reflects growing environmental consciousness and the willingness to engage in practical actions that contribute to sustainable waste management.

In addition, this growing engagement among university students illustrates the potential of higher education institutions as "incubators" of sustainable citizenship. By shaping environmental habits during early adulthood, universities can influence not only individual practices but also the long-term social norms that govern community behavior. Several studies have emphasized that students who develop eco-friendly routines in academic settings tend to carry these habits into their professional and family lives, thereby amplifying societal transformation toward sustainability (Hasan, 2024). This long-term effect positions universities as strategic actors in promoting the transition from environmental awareness to a culture of ecological responsibility. Furthermore, for the fifth statement on contributing to minimizing household waste production, 49% of respondents agree and 43.4% strongly agree, showing a significant commitment to reducing waste at its source. This aligns with waste minimization strategies that prioritize reducing consumption and reusing materials to decrease the overall volume of waste generated. However, 3.7% of respondents express disagreement, which might reflect a lack of awareness or access to

resources that facilitate waste reduction efforts. These results suggest that UNNES students have begun internalizing environmental responsibility as part of their daily decision-making process, though gaps in infrastructure and support still limit full behavioral adoption.

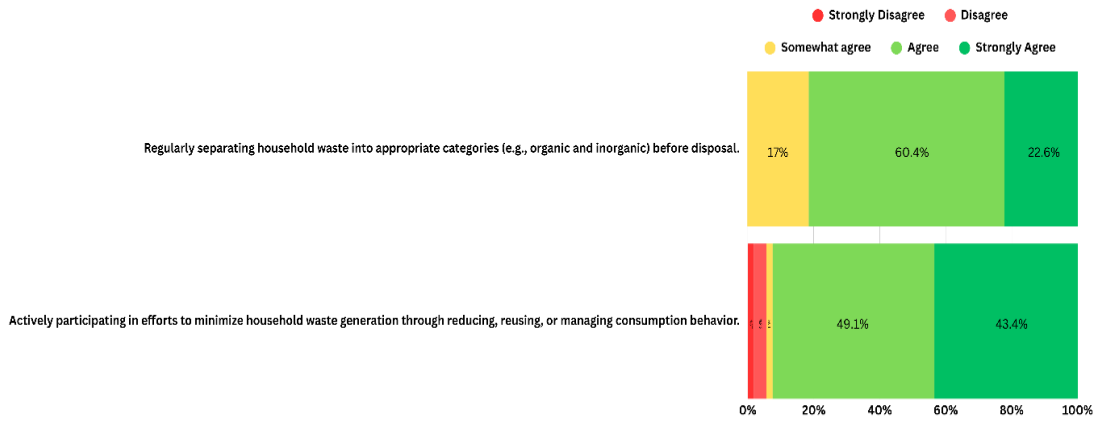

Fig. 3. Students' household waste management practices

Figure 3 presents students' household waste management practices based on two behavioral indicators: waste separation and waste minimization. Regarding waste separation behavior, 60.4% of respondents agreed that they regularly separate household waste prior to disposal, while 22.6% strongly agreed. Meanwhile, 17.0% of students reported fairly agree, indicating that although waste separation is commonly practiced, it has not yet been consistently internalized by all respondents. For waste minimization behavior, the results reveal a more varied pattern. Approximately 49.1% of respondents agreed that they actively participate in minimizing household waste generation, and 43.4% strongly agreed with this statement. Nevertheless, a small proportion of students reported disagreement, indicating that waste reduction practices remain more challenging to maintain consistently compared to waste separation.

Despite relatively high levels of agreement regarding waste separation and waste minimization behaviors, the findings indicate that these practices have not yet been fully internalized as consistent daily routines among students. The higher consistency observed in waste separation compared to waste minimization suggests that behaviors requiring clear procedural guidance and visible infrastructure are more easily adopted than those demanding sustained changes in consumption patterns. This aligns with previous studies reporting that waste separation is often practiced when facilities are available, whereas waste reduction at the source requires stronger self-regulation and institutional support (Raghu & Rodrigues, 2022; Tusyanah et al., 2024). Furthermore, the presence of disagreement responses, particularly in waste minimization, highlights structural and contextual barriers that may inhibit the translation of environmental awareness and positive attitudes into concrete behavioral practices.

In Indonesia's communal context, this sense of individual responsibility is particularly noteworthy, it represents a transition from collective dependence on institutional action to proactive personal engagement. This shift parallels the concept of "environmental citizenship," in which individuals view sustainable living not only as an obligation but also as a contribution to the collective well-being of their community (Kakadellis et al., 2021). This finding resonates strongly with the Indonesian philosophical value of gotong royong—mutual cooperation—which can serve as a culturally embedded driver for sustainability. Integrating this cultural value into environmental education may make sustainability initiatives more relatable and effective, as it connects modern environmental ethics with traditional communal wisdom (Ernawati et al., 2024). Another implication of this result is that sustainable behavior cannot be cultivated through information alone but must be supported by tangible experiences and collective reinforcement. Students who participate

in shared activities, such as community clean-ups or eco-campaigns tend to maintain sustainable behaviors longer because these actions are socially validated. This aligns with the principle of "collective efficacy," which suggests that people act more consistently when they feel part of a supportive group pursuing a common goal (Ernawati et al., 2024). Therefore, universities should emphasize community-based experiential learning to transform abstract knowledge into daily sustainable routines.

Overall, the descriptive results indicate that students with higher environmental awareness tend to exhibit more positive attitudes toward waste management, supporting the notion that cognitive and affective dimensions of environmental responsibility are interconnected. Nevertheless, the persistence of inconsistent behaviors despite favorable attitudes suggests that contextual and structural barriers, such as lack of facilities or institutional encouragement, may play a crucial moderating role (Ahmed et al., 2025). Therefore, bridging the gap between intention and action requires multilevel intervention, one that integrates educational strategies, social reinforcement, and policy-based incentives. This multilevel approach should also involve evaluation mechanisms that monitor behavioral change over time, allowing universities to adjust strategies based on real outcomes rather than assumptions. Continuous assessment of student participation, feedback loops, and policy alignment can make sustainability programs more adaptive and impactful (Hagger et al., 2022).

Embedding sustainability within university life through experiential learning, peer-led initiatives, and visible institutional support can transform waste management from a personal choice into a shared cultural norm. Ultimately, the transformation toward sustainable living within academic communities should be viewed not merely as a matter of environmental compliance but as a fundamental expression of character education, fostering empathy, responsibility, and social integrity among students (Abiddin et al., 2024). By framing sustainability as both an intellectual and moral pursuit, universities can cultivate graduates who embody the values needed to address environmental challenges in their future professional and civic lives.

4. Conclusions

The study concludes that students of UNNES living in boarding houses generally possess a high level of environmental awareness and positive attitudes toward household waste management. However, these attitudes are not consistently translated into active waste management behavior, mainly due to the lack of facilities, limited access to information, and insufficient motivation to participate in waste reduction initiatives. The findings highlight the need for universities and local authorities to collaborate through stronger institutional and educational interventions that align campus sustainability policies with student practices.

Universities could include structured waste management modules in general courses, establish peer-led environmental mentorship programs, and coordinate with local governments to ensure consistent waste collection systems in boarding areas. Such policies and educational collaborations would reinforce pro-environmental habits and foster a culture of shared environmental accountability among students. Moreover, embedding sustainability learning outcomes into university accreditation standards could ensure that environmental responsibility becomes an integral part of the academic system rather than an optional extracurricular activity. This integration would not only enhance institutional accountability but also encourage a long-term cultural shift toward sustainable living.

From a theoretical perspective, the findings reaffirm the complementary roles of the Theory of Planned Behavior and the Value-Belief-Norm framework in explaining the awareness–behavior gap. Cognitive awareness alone is insufficient to drive sustainable action unless supported by perceived control, moral responsibility, and enabling social conditions. By applying these frameworks in the Indonesian higher education context, this study contributes to understanding how environmental awareness interacts with cultural and institutional dynamics in shaping pro-environmental behavior among students.

Future studies should explore intervention-based approaches to evaluate how experiential and digital learning platforms could further improve waste management practices among university students across different living environments. Longitudinal and comparative studies are also needed to assess the persistence of sustainable habits beyond university life and to identify which educational strategies are most effective across various institutional settings. Ultimately, fostering waste-conscious behavior among students is not only an environmental issue but also a matter of character formation, preparing future generations to lead with responsibility, empathy, and ecological integrity.

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Author Contribution
The entire preparation of this study was conducted the main author, encompassing conceptualization, literature review, research implementation, data analysis, and formulation of conclusions. The study was conducted independently by the main author, encompassing conceptualization, literature review, research implementation, data collection, data analysis, and formulation of conclusions. In addition, Stephani Diah Pamelasari provided valuable feedback and constructive input that improved the quality of the manuscript.

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Ethical review and approval were waived for this study because it involved a voluntary, non-invasive online questionnaire that posed no risk to participants' health, safety, or privacy. The research followed the ethical guidelines of Universitas Negeri Semarang (UNNES) for educational research involving human participants.

Informed Consent Statement
Informed consent was obtained from all participants involved in the study. Respondents were informed about the purpose of the research, and their participation was voluntary and anonymous.

Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to privacy considerations, individual survey responses are not publicly shared.

Conflicts of Interest
The author declares no conflict of interest. The study received no external funding, and the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Declaration of Generative AI Use
During the preparation of this work, the author used OpenAI's ChatGPT and Grammarly to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the author reviewed and edited the content as needed and took full responsibility for

the content of the publication.

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