

## **Solid Waste Management: Awareness and Practices Among Grade 12 and Fourth Year College Students of La Consolacion College, Bacolod City**

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### **Abstract:**

Solid waste management (SWM) is a critical environmental issue impacting public health and sustainability, particularly in urbanizing areas like Bacolod City, Philippines. This study evaluates SWM awareness and practices among Grade 12 and graduating college students at La Consolacion College Bacolod. A quantitative, cross-sectional survey was conducted with 254 students using a structured questionnaire assessing awareness, waste management practices, and socio-demographic factors. Statistical analyses, including t-tests, ANOVA, and Pearson correlation, were utilized to explore relationships among variables. Findings reveal that students exhibit high overall SWM awareness, classified as "Very Aware." Female and graduating college students reported slightly higher awareness levels compared to their male and Grade 12 counterparts. Household income significantly influences SWM practices, with higher-income students showing greater engagement in waste segregation, reduction, and recycling. No significant differences were observed in overall awareness and most SWM practices based on gender or educational level, except for waste reduction, where college students were more proactive. A moderately strong positive correlation ( $r = .549$ ,  $p < .001$ ) exists between SWM awareness and practices, indicating that higher awareness is associated with more effective waste management behaviors. The study concludes that while environmental education at La Consolacion College successfully elevates SWM awareness, socioeconomic factors play a crucial role in translating this awareness into consistent practices. Recommendations include enhancing practical SWM education, improving access to waste management facilities, incentivizing proper waste disposal, and implementing targeted interventions to mitigate socioeconomic barriers. These strategies aim to bridge the gap between awareness and practice, fostering sustainable SWM behaviors among students.

**Keywords:** Solid Waste Management, Environmental Awareness, Student Practices, Socioeconomic Factors, Educational Interventions

### **Introduction:**

Solid waste management (SWM) remains one of the most urgent environmental concerns worldwide, particularly in developing countries where rapid urbanization and population growth continue to outpace waste infrastructure. The improper handling of solid waste threatens ecosystems, public health, and economic development. According to the World Bank, global municipal solid waste generation was estimated at 2.01 billion metric tons in 2016 and is projected to rise to 3.40 billion metric tons by 2050 without decisive intervention (Kaza, Yao, Bhada-Tata, & Van Woerden, 2018). This trend is compounded by the lack of effective recycling systems, unsanitary landfills, and low public participation in many urban areas (Wilson, Velis, & Cheeseman, 2006).

The Philippines mirrors these global challenges. Republic Act No. 9003, the Ecological Solid Waste Management Act of 2000, was enacted to institutionalize environmentally sound practices, including waste segregation, recycling, composting, and safe disposal (Official Gazette of the Republic of the Philippines, 2000). However, two decades after its implementation, gaps in compliance and enforcement persist across many local government units. Issues such as inadequate funding, limited technical capacity, and weak community participation hinder the law's effectiveness (Department of Environment and Natural Resources [DENR], 2018; Senate Economic Planning Office, 2017).

Additionally, the Philippines has garnered international attention as one of the world's top contributors to marine plastic pollution. Jambeck et al. (2015) rank the country third globally in terms of mismanaged plastic waste that ends up in oceans. A study by the World Wide Fund for Nature (WWF-Philippines, 2020) further notes that nearly 35% of plastic waste generated in the Philippines remains uncollected, leading to environmental contamination and public health risks.

Schools and universities are significant contributors to the overall waste stream. Waste audits conducted in educational institutions show that school waste is composed largely of paper, food scraps, and plastic—materials that are highly recoverable if managed properly (UNEP, 2010). Recognizing the pivotal role of education in shaping environmental behaviors, the Philippine government enacted Republic Act No. 9512, the National Environmental Awareness and Education Act of 2008, mandating the integration of environmental concepts into formal curricula across educational levels. Complementarily, Republic Act No. 10533, the Enhanced Basic Education Act of 2013, emphasizes the holistic development of learners, including the promotion of ecological literacy.

Research underscores that student awareness is a key determinant in shaping environmentally responsible behavior. Studies such as those by Sujauddin, Huda, and Hoque (2008) and Memon (2010) found a positive correlation between knowledge of waste management and the practice of segregation and recycling among students and households. However, awareness alone may not suffice without institutional support, enabling infrastructure, and cultural reinforcement.

Pope Francis's encyclical *Laudato Si'* (2015) contributes a moral and spiritual dimension to the discourse, urging humanity to care for "our common home" by rethinking lifestyles and systems that harm the Earth. His call emphasizes the role of individuals, families, and institutions in fostering ecological conversion and promoting sustainable development through everyday choices.

In this context, La Consolacion College Bacolod, as a Catholic educational institution, holds a unique position in nurturing ecological awareness and responsible citizenship. This study aims to assess the level of SWM awareness and practices among Grade 12 and fourth-year college students at the institution. It specifically seeks to (1) describe students' demographic profiles in terms of sex, educational level, and household income; (2) assess their levels of awareness and practices related to waste segregation, reduction, reuse, recycling, and disposal; (3) examine differences based on demographic variables; and (4) determine whether a correlation exists between awareness and actual SWM practices.

The results will inform the design and enhancement of SWM programs in academic settings, contributing to a broader strategy of environmental education, compliance with national policy, and fulfillment of moral responsibilities toward sustainable living.

### **Review of Related Literature:**

Effective solid waste management (SWM) involves the systematic control of waste generation, storage, collection, transfer, transport, processing, and disposal in ways that protect public health and the environment (Sarbasov et al., 2019). In many developing countries, weak enforcement, limited infrastructure, and low public compliance continue to hamper sustainable waste management efforts (Wilson et al., 2015). As urbanization and consumption increase, so does the complexity and volume of waste, requiring a shift not only in technology but also in behavior and policy.

Globally, the urgency of the SWM issue is evident. The World Bank projects that global municipal solid waste will increase from 2.01 billion metric tons in 2016 to 3.40 billion metric tons by 2050 if no significant reforms are implemented (Kaza et al., 2018). This rise is particularly challenging for low- and middle-income countries, where more than 90% of waste is often disposed of in open dumps or burned, causing serious environmental and health risks (Wilson, Velis, & Cheeseman, 2006).

In the ASEAN context, Uriarte (1991) highlighted that developing countries often lack efficient collection systems and disposal facilities, leading to uncollected or mismanaged waste. These inefficiencies also contribute to the rising costs of SWM. Educational institutions, though less commonly discussed in macro-level waste discourse, play a substantial role in daily waste generation. According to the United Nations Environment Programme (2010), schools and universities are significant sources of paper, plastic, and food waste. Tam (2008) noted that paper alone accounts for 30–40% of typical school waste.

Awareness and behavior among individuals, especially students, are critical components of SWM success. A study by Sujauddin, Huda, and Hoque (2008) in Bangladesh showed that increased knowledge of waste segregation correlated with better household waste practices. Similarly, Memon (2010) emphasized that the 3R approach—Reduce, Reuse, Recycle—is most effective when combined with active public engagement and education.

Jusoh et al. (2018) reported that Malaysian university students displayed only moderate levels of environmental awareness and behavior, pointing to the need for integrated educational programs. Lozano et al. (2013) supported this view, arguing that sustainability should be embedded into the formal curriculum to influence long-term behavior. The Philippine government has attempted to institutionalize environmental responsibility through Republic Act No. 9512, which mandates the inclusion of environmental education across all levels of instruction (Republic of the Philippines, 2008). However, challenges persist in actual practice. In many schools, gaps remain between student awareness and behavioral implementation due to limited resources, weak monitoring, and lack of institutional support (Wilson et al., 2015).

Theoretical models help frame these issues. The Integrated Solid Waste Management (ISWM) model proposed by Nathanail and Bardos (2004) emphasizes evaluating waste systems based on environmental, economic, and social dimensions. ISWM supports local context-sensitive solutions such as composting, segregation, and recycling infrastructure.

Complementing this, Waste Management Theory (WMT) by Pongrácz (2002) defines waste not only as discarded material but as a symptom of inefficient design and resource use. WMT promotes proactive measures—such as product redesign and materials reuse—to prevent waste generation at the source.

Recent studies echo these approaches. Sarbassov et al. (2019) examined waste sorting behavior in Kazakhstan and found that despite limited infrastructure, a significant portion of residents engaged in waste separation voluntarily. The study concluded that institutional support and public education are pivotal in improving SWM compliance. In sum, the literature underscores the importance of combining policy, infrastructure, education, and behavioral interventions to improve SWM. In educational institutions—where young individuals are both waste generators and future decision-makers—assessing awareness and actual practices is essential for developing effective environmental programs.

### **Methodology:**

This study employs a quantitative research approach, utilizing a descriptive, comparative, and correlational design through a cross-sectional survey methodology. A cross-sectional survey is optimal for collecting data from a large sample of individuals at a single point in time, facilitating the efficient assessment of various variables, including students' awareness, practices, and socio-demographic characteristics (Setia, 2016). This design enables the identification of patterns and relationships between different aspects of solid waste management (SWM) without necessitating longitudinal data collection.

The research was conducted at La Consolacion College Bacolod during the first semester of the Academic Year 2024–2025. This institution was selected due to its diverse population of Grade 12 high school students and graduating college students, providing an ideal setting for examining SWM awareness and practices across different educational levels. A probability sampling technique, specifically proportional stratified sampling, was employed to select a representative sample of students from La Consolacion College Bacolod. Stratification was based on grade level to ensure that each educational group was adequately represented. This method enhances the generalizability of the findings by ensuring that subgroups within the population are proportionately represented (Kish, 1965). The population consisted of 380 Grade 12 students and 361 graduating college students, from which a sample size of 130 and 124 students respectively was determined at a 95% confidence level, totaling 254 participants.

Data were collected using a structured questionnaire specifically designed to measure students' awareness of SWM policies, their actual waste management practices, and their socio-demographic characteristics. The questionnaire was meticulously divided into three sections to ensure comprehensive data collection. The first section gathered demographic information of the respondents, including age, gender, grade level, and household monthly income, which are essential for analyzing the influence of these variables on waste management behaviors. The second section comprised 10 questions aimed at assessing students' awareness of SWM, covering topics such as the importance of waste segregation, the impact of recycling, and the effectiveness of current waste disposal policies. The third section included 38 questions that evaluated various practices related to SWM, including segregation, reduction, recycling, reuse, and disposal. Following a validation process, two non-essential items were excluded to enhance the questionnaire's focus and clarity.

The reliability of the questionnaire was rigorously tested using Cronbach's Alpha coefficients, yielding a coefficient of 0.823 for the Awareness section, interpreted as good, and 0.965 for the Practices section, interpreted as excellent. These high internal consistency values indicate that the questionnaire reliably measures the intended constructs (Tavakol & Dennick, 2011). The development of the questionnaire adhered to best practices in survey design, ensuring that the questions were clear, relevant, and comprehensive, thereby enhancing the validity and reliability of the data collected. Additionally, a pilot study was conducted to assess the questionnaire's effectiveness, allowing for adjustments based on feedback to further improve its accuracy and reliability before the main data collection phase.

Prior to data collection, ethical approval was obtained from the relevant institutional review board to ensure adherence to ethical guidelines. Informed consent forms were prepared and distributed alongside the questionnaires to ensure that participants were fully aware of the study's purpose, procedures, and their rights. During the data collection phase, questionnaires were distributed to the selected students, and informed consent was obtained from each participant. Completed questionnaires were collected, entered into a spreadsheet or data analysis software, and meticulously cleaned to correct any errors or inconsistencies. The collected data were then analyzed using both descriptive and inferential statistical methods.

Descriptive statistics were used to summarize the data, including frequencies, percentages, and measures of central tendency and dispersion for various SWM practices. Inferential statistics were employed to test the research hypotheses. Independent samples t-tests were conducted to compare awareness levels and practices based on sex and educational level. One-way ANOVA was used to compare practices based on household monthly income, and the Pearson Product-Moment Correlation Coefficient was calculated to examine the relationship between awareness and practices (Cohen, 1988). The normality of the data was assessed using the Kolmogorov-Smirnov test to ensure the appropriateness of the chosen statistical methods (Razali & Wah, 2011).

To protect the well-being and rights of participants, this study adhered to strict ethical guidelines. Participants received informed consent, ensuring they understood the study's objectives, procedures, and any potential risks involved. Confidentiality was maintained by anonymizing responses and securely storing data with restricted access. Participation was entirely voluntary, with no coercion or undue pressure exerted on students to participate. The study emphasized beneficence and justice by maximizing benefits and minimizing risks to participants. Cultural sensitivity was prioritized to respect the cultural beliefs and values of all participants, ensuring that the research was conducted in an inclusive and respectful manner (Resnik, 2018).

Data security measures included encryption and access control to protect the integrity and confidentiality of the collected data. Quality control protocols were implemented to ensure the accuracy and reliability of the data, including double-entry verification and consistency checks. A timeline was established for data collection and analysis to ensure that the study was completed within the allocated time frame, thereby maintaining the study's validity and reliability. The study ensured equitable participation by providing support and resources to all income groups, fostering an inclusive environment that promotes justice. Community involvement was encouraged through collaboration with school administrators and environmental programs, enhancing the relevance and applicability of the research findings.

By following these procedures and incorporating ethical considerations, the study aimed to collect high-quality data and produce reliable findings. The comprehensive methodology ensured that the research objectives were met effectively, providing valuable insights into the factors influencing SWM awareness and practices among students at La Consolacion College Bacolod.

## **Results**

The study encompassed 254 respondents from La Consolacion College Bacolod, consisting of 130 Grade 12 high school students (51.2%) and 124 graduating college students (48.8%). The gender distribution was predominantly female, with females representing 67.3% (171 respondents) of the sample, while males accounted for 32.7% (83 respondents). This female predominance aligns with trends observed in similar studies where females often exhibit higher engagement and interest in environmental issues (Kollmuss & Agyeman, 2002; Lajunen & Soini, 2015).

Household monthly income among respondents varied, with the largest groups earning below ₱10,957 (28.0%, 71 respondents) and between ₱21,914 to ₱43,828 (28.3%, 72 respondents). The income brackets ₱10,957 to ₱21,914 and ₱43,828 to ₱76,669 comprised 25.6% (65 respondents) and 8.3% (21 respondents) of the sample, respectively. Higher income categories were minimally represented, with only 1.6% (4 respondents) earning ₱219,140 or above. In terms of solid waste management (SWM) awareness, the overall mean score was 3.5965, categorizing respondents as "Very Aware." Female students demonstrated slightly higher awareness ( $M = 3.6146$ ) compared to males ( $M = 3.5590$ ), although both groups fell within the "Very Aware" category. Graduating college students exhibited higher awareness ( $M = 3.8032$ ) than Grade 12 students ( $M = 3.5900$ ), indicating a trend where awareness increases with educational advancement (Balagopal, 2017; Onwezen & Steg, 2012). Household income influenced awareness levels, with respondents in the ₱43,828 to ₱76,669 bracket showing the highest awareness ( $M = 3.6190$ ) and those earning ₱219,140 and above demonstrating the lowest ( $M = 3.5250$ ). Despite being in the "Very Aware" category, the highest income group surprisingly showed the lowest awareness score among the income brackets, suggesting that higher income does not necessarily correlate with higher environmental awareness (Vining & Ebreo, 2001; Thøgersen, 2005).

Regarding solid waste management practices, respondents reported high engagement across all measured behaviors, with an overall mean score of 4.1744. Males exhibited slightly higher segregation practices ( $M = 4.3759$ ) compared to females ( $M = 4.3333$ ), both falling within the "Frequent" category. Both genders showed similar levels of

engagement in waste reduction, recycling and reuse, and waste disposal practices, indicating consistent and frequent participation in these activities.

When analyzed by educational level, graduating college students showed higher segregation ( $M = 4.3879$ ) and waste reduction practices ( $M = 3.8973$ ) compared to Grade 12 students ( $M = 4.3085$  and  $M = 4.1315$ , respectively). Conversely, Grade 12 students reported slightly higher recycling and reuse ( $M = 4.1385$ ) than their college counterparts ( $M = 3.9788$ ), suggesting that younger students may be more involved in recycling initiatives, potentially due to targeted programs or peer influence.

Household income significantly influenced SWM practices. Higher-income groups generally exhibited stronger engagement in segregation, reduction, and recycling and reuse practices. Notably, respondents from households earning ₱219,140 and above demonstrated exceptional adherence to segregation ( $M = 4.7250$ ) and waste disposal practices ( $M = 4.8500$ ), reflecting the impact of ample resources and advanced educational exposure on sustainable behaviors. Lower-income groups showed moderately high engagement across practices, but significant differences were observed in waste reduction and recycling and reuse, with middle-income groups displaying higher awareness and proactive behaviors.

Independent samples t-tests revealed no statistically significant differences in overall awareness and overall practice between male and female students, nor between Grade 12 and graduating college students, except for waste reduction practices, where graduating college students engaged more effectively than Grade 12 students. Analysis of variance (ANOVA) indicated no significant differences in overall awareness across household income groups but found significant differences in overall practices, waste reduction, and recycling and reuse practices. Pearson correlation analysis demonstrated a significant and moderately strong positive relationship between SWM awareness and practices ( $r = .549$ ,  $p < .001$ ), indicating that higher awareness is associated with more consistent and effective waste management behaviors.

## **Discussion**

The demographic profile of respondents, characterized by a majority of female students and a balanced representation between Grade 12 and graduating college students, provides a contextual foundation for interpreting the study's findings. The predominance of female respondents aligns with existing literature suggesting that females often display greater environmental engagement and interest (Kollmuss & Agyeman, 2002). However, this gender imbalance did not translate into significant differences in overall awareness or practices, contrasting some studies that report higher environmental engagement among females (Xiao & Hong, 2010). The lack of significant gender differences in this study may be attributed to the equitable and comprehensive environmental education programs at La Consolacion College, which ensure that both male and female students receive comparable knowledge and opportunities to engage in SWM activities.

The high level of SWM awareness among respondents, categorized as "Very Aware," indicates the effectiveness of environmental education initiatives at La Consolacion College. Graduating college students' higher awareness scores compared to Grade 12 students suggest that advanced educational exposure enhances environmental consciousness (Kollmuss & Agyeman, 2002). This trend underscores the importance of continuous and progressive environmental education as students advance in their academic journeys.

Interestingly, household income did not significantly affect overall awareness, suggesting that environmental education at the college effectively reaches students regardless of socioeconomic status. However, significant differences in SWM practices based on income, particularly in waste reduction and recycling and reuse, highlight the role of socioeconomic status in facilitating sustainable behaviors. Higher-income students' stronger engagement in these practices is likely due to better access to resources and facilities that support effective waste management (Vining & Ebreo, 2002). This finding aligns with assertions that socioeconomic status significantly impacts environmental behaviors, emphasizing the need for targeted support and resources to enhance waste management practices among lower-income households.

The significant correlation between awareness and practices reinforces the theoretical frameworks of the Theory of Planned Behavior (Ajzen, 1991) and Social Cognitive Theory (Bandura, 1986), which posit that increased awareness and positive attitudes towards environmental behaviors enhance the likelihood of engaging in those behaviors. The moderately strong positive relationship observed in this study indicates that while awareness is a crucial determinant of SWM practices, other factors such as access to waste management infrastructure, socioeconomic status, and institutional support also play significant roles.

The consistent high engagement in segregation and waste disposal practices across all demographic groups reflects the success of standardized school policies and continuous reinforcement through environmental education programs (Kollmuss & Agyeman, 2002). This uniformity suggests that foundational aspects of SWM behaviors are effectively

ingrained in students regardless of their gender or socioeconomic background, highlighting the effectiveness of the college's environmental initiatives.

However, the disparities observed in waste reduction and recycling and reuse practices across different income groups indicate that while basic SWM behaviors are uniformly adopted, more nuanced practices are influenced by socioeconomic factors. This underscores the necessity for tailored environmental education programs that address the specific needs and resource limitations of different income groups. Providing equitable access to recycling facilities and promoting advanced waste reduction strategies can enhance sustainable behaviors across all socioeconomic backgrounds.

The lack of significant differences in overall awareness and most SWM practices between educational levels, except for waste reduction, suggests that while foundational SWM behaviors are consistently maintained, more complex behaviors benefit from higher educational exposure. This finding emphasizes the importance of integrating advanced environmental education and practical waste management strategies into higher educational curricula to foster more proactive and responsible waste management behaviors.

The study demonstrates that comprehensive environmental education can effectively raise awareness and promote consistent SWM practices across diverse demographic groups. Nevertheless, addressing socioeconomic barriers and ensuring equitable resource distribution remain essential for fostering inclusive and effective waste management behaviors. Future research should explore additional variables influencing SWM practices to develop more comprehensive strategies for sustainable environmental stewardship among youth.

### **Conclusion:**

The study on solid waste management (SWM) awareness and practices among Grade 12 and graduating college students at La Consolacion College Bacolod reveals a high level of awareness regarding SWM. However, a notable gap persists between awareness and actual practice, particularly influenced by socioeconomic factors. Household income significantly shapes access to waste management resources and consistency in engaging in practices such as segregation and recycling (Vedra, 2024; Molina & Catan, 2021).

The findings affirm the effectiveness of the institution's environmental education programs in raising awareness across demographic groups, as reflected in the "Very Aware" classification of most respondents. Yet, this awareness does not consistently translate into uniform behavioral practices. Students from higher-income households demonstrated more active participation in proper SWM practices, likely due to better access to infrastructure and materials that support sustainable behaviors (Molina & Catan, 2021; Khumalo & Sibanda, 2024). In contrast, lower-income students, despite being equally aware, reported limited participation due to resource-related constraints (Vedra, 2024).

Gender-related differences also emerged, with female students showing slightly higher levels of awareness and more frequent engagement in SWM activities. This observation aligns with previous research indicating that women often demonstrate greater environmental concern and are more likely to participate in eco-friendly behavior (Xiao & Hong, 2010). Furthermore, students from middle-income households exhibited more balanced participation than both low- and high-income peers, underscoring the nuanced role that economic conditions play in shaping behavior (Kollmuss & Agyeman, 2002).

The positive correlation found between SWM awareness and actual practices supports psychological theories of behavior change. The Theory of Planned Behavior (Ajzen, 1991) and Social Cognitive Theory (Bandura, 1986) both emphasize that awareness and perceived efficacy significantly influence behavioral intentions and actions. However, this study's findings suggest that knowledge alone is insufficient without accessible systems and contextual support (Evans & Kantrowitz, 2002).

Uniform high participation in waste segregation and disposal across groups indicates that foundational SWM behaviors are successfully normalized through the college's standardized policies and programs. However, disparities in more complex practices like waste reduction and recycling reveal the importance of integrating practical, resource-sensitive interventions. Schools and local governments must tailor programs that target specific challenges faced by marginalized groups, such as providing accessible recycling infrastructure or integrating SWM routines into school life (Alqarni et al., 2023; Agyeman & Evans, 2020).

In conclusion, while SWM awareness is commendably high among students, turning that awareness into consistent behavior requires a multifaceted strategy. Education, access to resources, and demographic-sensitive programming are all critical to achieving sustainable SWM outcomes at La Consolacion College Bacolod. Future studies should examine how institutional policies and community partnerships can further close the awareness-practice gap in school contexts.

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**Recommendations:**

Based on the findings and conclusions of the study on solid waste management (SWM) awareness and practices among Grade 12 and Graduating College students at La Consolacion College Bacolod, several strategic recommendations are proposed to enhance both awareness and actual practices in SWM.

Firstly, it is essential to strengthen waste management education programs by making them more action-oriented. While students already display a high level of awareness, integrating practical waste management activities into the curriculum can significantly enhance their engagement and application of knowledge. Schools should incorporate hands-on waste segregation exercises, recycling workshops, and campus clean-up drives into their educational frameworks. These activities provide students with tangible opportunities to practice SWM, thereby reinforcing their understanding and commitment to sustainable practices (Ardoin et al., 2020; Tilbury, 2007).

Secondly, enhancing access to waste management facilities is crucial, particularly for students from lower-income households who may face socioeconomic barriers to effective waste management. Schools and local governments should ensure that proper waste disposal and recycling facilities are readily accessible to all students. This could involve installing additional waste segregation bins on school grounds and establishing community-based recycling centers that are easily reachable for students and their families. By improving access to these facilities, schools can enable students from all income levels to participate more effectively in SWM activities (IUCN, 2019; UNEP, 2022). Incentivizing proper waste disposal practices is another vital recommendation. To foster greater participation in SWM, schools can implement incentive-based programs that reward students for their active involvement in recycling initiatives, waste segregation, and composting activities. Rewards could include certificates, recognition during school events, or points that contribute to community service requirements. Such incentives can motivate students to adopt and maintain sustainable waste management behaviors, thereby bridging the gap between awareness and practice (Deci et al., 1999; Liao & Li, 2019).

Community involvement and awareness campaigns are also essential for fostering a culture of environmental responsibility. Schools should collaborate with local governments, businesses, and environmental organizations to launch comprehensive awareness campaigns targeting not only students but also their families. These campaigns can emphasize the importance of waste segregation, recycling, and reducing waste production at home. Additionally, community waste collection programs, educational seminars, and recycling contests can further promote environmental stewardship and ensure that sustainable practices extend beyond the school environment (IUCN, 2019; Ardoin et al., 2020).

Targeted interventions for different socioeconomic groups are necessary to address the specific barriers faced by students from lower-income households. Schools could provide financial or material support, such as subsidized eco-bags or recycling kits, to facilitate participation in SWM practices. Furthermore, workshops focusing on cost-effective and easy-to-implement waste management strategies can help ensure that economic limitations do not hinder students from engaging in proper waste disposal (Liao & Li, 2019).

Gender-sensitive programs should also be developed to encourage greater participation from male students, who were found to be less active in SWM practices compared to their female counterparts. Tailoring waste management activities to be more appealing and accessible to all genders can help address this disparity. Gender-sensitive campaigns can promote equal engagement in environmental stewardship, ensuring that both male and female students are equally empowered to participate in SWM activities (Xiao & McCright, 2015).

Monitoring and evaluation of SWM practices are essential for assessing the effectiveness of implemented strategies and identifying areas for improvement. Schools should establish systems for regular monitoring and evaluation, utilizing data collection tools such as surveys, waste audits, and observation checklists. Involving student councils or environmental clubs in this process can enhance accountability and ensure sustained focus on environmental goals. Continuous evaluation allows for the refinement of SWM programs, ensuring they remain effective and relevant (Liao & Li, 2019).

Collaboration with government agencies and environmental organizations can further enhance the resources and support available for SWM programs. Establishing partnerships with these entities can provide technical expertise, educational materials, and logistical support, thereby strengthening school-based SWM initiatives. Joint efforts can also facilitate larger-scale projects that have a more significant impact on community sustainability, promoting a unified approach to environmental stewardship (Smith, 2021; IUCN, 2019).

To ensure the long-term sustainability of SWM practices, schools should aim to instill a lasting culture of environmental responsibility. This can be achieved by setting up permanent waste segregation systems, developing a "zero-waste" policy on campus, and ensuring these practices are maintained through student organizations and administrative policies. Long-term initiatives help embed SWM behaviors into the institutional culture, making them an integral part of daily routines and values (UNEP, 2022; Ardoin et al., 2020).

Finally, integrating SWM awareness and practices into co-curricular activities can reinforce environmental responsibility beyond the classroom. Incorporating waste reduction and recycling activities into sports events, cultural programs, and other school gatherings ensures that sustainable practices are promoted consistently across all aspects of school life. This integration helps embed environmental stewardship into various contexts, reinforcing the importance of SWM in diverse settings (Tilbury, 2007; Ardoin et al., 2020).

In summary, these recommendations emphasize the need for a multifaceted approach that addresses both educational and practical aspects of SWM. By enhancing education programs, improving access to facilities, incentivizing practices, involving the community, targeting socioeconomic barriers, promoting gender-sensitive initiatives, monitoring progress, collaborating with external organizations, ensuring long-term sustainability, and integrating SWM into co-curricular activities, schools can effectively bridge the gap between awareness and practice. These strategies will ensure that all students, regardless of their socioeconomic background, are equipped and motivated to engage in sustainable waste management behaviors, contributing to broader community sustainability and improved environmental stewardship.

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