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Implementing school-based solid waste segregation: Practices, challenges, and strategies for learner engagement among science teachers

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ABSTRACT

This study examined the practices and challenges of science teachers in implementing school-based solid waste segregation programs and identified the strategies they use to encourage learners' participation in waste management activities. The study employed a descriptive research design and utilized a researcher-made questionnaire to collect data from eighteen (18) science teachers in selected public elementary schools of Paoay District. The responses were analyzed using thematic analysis to determine common practices, strategies, and challenges experienced by the respondents. The findings revealed that science teachers implement several practices to promote proper waste segregation, including the use of labeled or color-coded waste bins, integration of waste management concepts in science lessons, classroom monitoring through assigned student roles such as eco-monitors, and participation in school clean-up drives and environmental campaigns. However, teachers encounter various challenges, including a lack of student discipline, limited waste-segregation facilities, inconsistent monitoring, and insufficient stakeholder support. Despite these challenges, teachers employ different strategies to sustain student participation, including environmental awareness activities, recycling projects, reward systems, and collaboration with student organizations. The study concludes that science teachers play a vital role in promoting environmental responsibility and implementing school-based waste segregation programs, but stronger institutional support, adequate facilities, and ongoing environmental education initiatives are necessary to sustain these programs in schools.

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Introduction

Solid waste management is a critical environmental concern that directly affects public health, environmental sustainability, and quality of life. In the Philippines, improper waste disposal and low levels of waste segregation continue to contribute to pollution, flooding, and health risks in communities (DENR, 2020). Schools play a vital role in addressing this concern, serving not only as learning

institutions but also as training grounds for developing environmentally responsible behaviors among learners.

Along with, school-based solid waste segregation programs are promoted as practical strategies for instilling environmental awareness and sustainable practices at an early age. Science teachers, in particular, are key implementers of these programs because environmental education and waste management concepts are embedded in the science curriculum (DepEd, 2019). Through classroom instruction and school activities, science teachers help learners understand the importance of waste segregation and its impact on the environment.

Despite existing policies and programs, the implementation of school-based solid waste segregation remains inconsistent. Many schools experience challenges such as limited facilities, inadequate materials, lack of technical support, and low student participation (World Bank, 2018). Teachers often carry the responsibility of implementing these initiatives while balancing instructional demands, which may affect the sustainability and effectiveness of waste segregation practices in schools.

Several studies suggest that teachers' practices, attitudes, and experiences significantly influence the success of environmental programs in educational settings (UNESCO, 2021). However, teachers may encounter difficulties related to insufficient training, unclear guidelines, and limited institutional support. Understanding these challenges is essential in identifying gaps between policy intentions and actual school-level implementation.

While several studies have explored solid waste management in communities and general school settings, limited research has focused specifically on the practices and challenges that science teachers face in implementing school-based solid waste segregation. Addressing this gap is important for better understanding teachers' experiences and developing targeted interventions that support the effective and sustainable implementation of environmental programs in schools.

Understanding the role of science teachers in waste segregation is crucial because they are the primary facilitators of environmental education in schools. Their knowledge, attitudes, and teaching strategies directly influence how students learn and practice proper waste management (DepEd, 2019).

Challenges faced by teachers, such as a lack of training, limited resources, and additional workload, can hinder the effectiveness of waste segregation programs (Garcia & Mercado, 2020). Identifying these challenges helps schools provide the necessary support and guidance.

Focusing on science teachers' practices also contributes to more sustainable school-based programs. When teachers are empowered and equipped, they can model positive behavior, engage students effectively, and foster a culture of environmental responsibility that extends beyond the classroom (UNESCO, 2021).

This study aims to examine the practices and challenges of science teachers in implementing school-based solid waste segregation. By identifying existing practices and the difficulties teachers encounter,

the research seeks to provide insights to guide school administrators, policymakers, and education stakeholders in strengthening environmental programs and promoting sustainable waste management in schools.

Review of related literature

This section presents related studies and literature that provide context and support for the current research. The review focuses on school-based solid waste management, the role of teachers in environmental education, and challenges in implementing waste segregation programs.

School-based solid waste segregation

Solid waste segregation is recognized as an essential component of effective waste management and environmental protection. According to the Department of Environment and Natural Resources (DENR, 2020), proper segregation at source reduces landfill waste, promotes recycling, and minimizes environmental hazards. In schools, waste segregation programs serve both functional and educational purposes by promoting discipline, responsibility, and environmental awareness among learners.

Studies show that schools implementing structured waste segregation programs contribute significantly to students' environmental knowledge and positive attitudes toward sustainability (Guerrero, Maas, & Hogland, 2013). When learners consistently practice segregation in school, they are more likely to apply these behaviors at home and in their communities.

Furthermore, school-based waste segregation programs promote discipline, cooperation, and shared responsibility among learners. Activities such as classroom waste monitoring, recycling projects, and eco-club initiatives encourage teamwork and accountability. Al-Khatib et al. (2015) noted that participatory approaches in waste management enhance students' sense of ownership and commitment to environmental practices. These initiatives also empower learners to become environmental advocates within their schools.

The impact of waste segregation programs extends beyond the school community and into learners' homes and local communities. When students consistently practice proper segregation in school, they are more likely to apply these behaviors in their daily lives, influencing family members and peers. This ripple effect contributes to broader community participation in sustainable waste management. As emphasized by UNESCO (2017), education for sustainable development enables learners to adopt responsible behaviors that support environmental protection and community well-being. Thus, school-based solid waste segregation serves as a foundation for developing environmentally responsible citizens.

Importance of environmental education in schools

Environmental education plays a critical role in shaping learners' attitudes, values, and behaviors toward environmental protection. UNESCO (2021) stated that education for sustainable development equips learners with the knowledge and skills needed to address environmental challenges such as waste mismanagement. Integrating solid waste segregation into school programs supports this goal by transforming environmental concepts into practical, everyday actions.

In addition, incorporating solid waste segregation into environmental education promotes the development of lifelong sustainable habits among learners. When students regularly practice waste segregation in school, they gain a deeper sense of responsibility for their actions and their impact on the environment. According to UNESCO (2021), learner-centered and action-oriented environmental education encourages behavior change by linking knowledge with real-world application. These practices help learners move beyond awareness toward active participation in environmental protection. Moreover, school-based waste segregation activities foster collaboration and community involvement. Projects such as recycling drives, composting initiatives, and environmental campaigns provide opportunities for learners to work together and engage with teachers and local stakeholders. DepEd (2019) highlighted that meaningful learning occurs when students are actively involved in problem-solving and community-related activities. Through these initiatives, learners not only strengthen their scientific understanding but also develop leadership skills and a commitment to sustainable practices that extend beyond the classroom.

Furthermore, environmental topics are essential in helping learners understand the relationship between human activities and environmental consequences. The Department of Education (DepEd, 2019) emphasized that science lessons should encourage environmental stewardship, critical thinking, and responsible action. Through waste segregation activities, learners experience hands-on learning that reinforces theoretical concepts discussed in the classroom.

Role of science teachers in environmental education

Science teachers play a vital role in promoting environmental literacy and sustainable practices in schools. Environmental concepts such as waste management, conservation, and pollution are integral parts of the science curriculum (DepEd, 2019). Through lessons, experiments, and school activities, science teachers influence students' understanding and behavior toward environmental issues.

UNESCO (2021) emphasized that teachers are key agents in education for sustainable development, as they translate environmental policies into meaningful classroom practices. Effective implementation of school-based programs largely depends on teachers' knowledge, commitment, and instructional strategies. It also noted that empowering teachers with adequate training and resources enhances the success of education for sustainable development initiatives, making science teachers essential drivers of environmental awareness and sustainability in schools.

Science teachers not only deliver environmental content but also model environmentally responsible behavior for learners. By consistently practicing and reinforcing proper waste segregation, recycling, and resource conservation in the classroom, teachers help normalize sustainable practices. According to Al-Khatib et al. (2015), teacher-led environmental initiatives significantly influence students' participation and compliance in school waste management programs. When teachers demonstrate commitment to environmental actions, learners are more likely to adopt similar behaviors.

Furthermore, science teachers play an important role in designing learner-centered and inquiry-based activities that promote critical thinking and problem-solving. Activities such as waste audits, biodegradation experiments, and project-based learning allow students to analyze real environmental

issues within their school community. DepEd (2019) highlighted that effective science instruction should connect concepts to real-life situations to encourage responsible decision-making. UNESCO (2021) also noted that empowering teachers with adequate training and resources enhances the success of education for sustainable development initiatives, making science teachers essential drivers of environmental awareness and sustainability in schools.

Best practices in implementing waste segregation in schools

Previous studies indicate that common school practices in waste segregation include the provision of clearly labeled waste bins, integration of waste management concepts into science lessons, recycling projects, clean-up drives, and environmental campaigns (Al-Khatib et al., 2015). These practices aim to promote proper waste disposal habits and increase environmental awareness among learners. Some schools also implement student-led initiatives such as eco-clubs, waste audits, recycling contests, and composting activities to strengthen student participation, responsibility, and sense of ownership toward environmental programs.

The effectiveness of these practices largely depends on administrative support and school-wide involvement. Schools with clear environmental policies, coordinated waste management plans, and active support from school heads demonstrate more organized and sustainable waste segregation programs (Hidayah & Agustin, 2021). Recognition and monitoring systems also motivate teachers and students to consistently practice proper waste segregation.

However, research suggests that the consistency of these practices varies across schools. Factors such as teacher initiative, administrative support, and availability of resources significantly influence program implementation (Mendoza & Santos, 2018). The consistency of implementation, monitoring, and reinforcement was identified as a key factor in effective waste segregation practices.

Furthermore, experiential and hands-on learning approaches strengthen waste segregation practices in schools. Ballantyne, Connell, and Fien (2006) noted that practical activities such as recycling projects and environmental campaigns enhance learners' understanding of environmental issues and encourage long-term pro-environmental behavior. These practices help transform waste segregation from a routine task into a meaningful learning experience, reinforcing schools' role in promoting sustainable environmental practices.

Challenges/constraints in implementing school-based waste segregation

Despite its importance, implementing waste segregation in schools faces several challenges. Studies report issues such as a lack of proper facilities, insufficient waste bins, limited funding, and poor monitoring systems (World Bank, 2018). In some cases, the waste collected is not properly segregated after disposal, discouraging teachers and students from sustaining the practice.

Teachers also experience challenges related to a lack of training, additional workload, and limited time to manage environmental programs alongside academic responsibilities (Garcia & Mercado, 2020). These challenges affect teachers' motivation and the long-term sustainability of waste segregation initiatives in schools.

Another significant challenge in implementing school-based waste segregation is the lack of coordination and support from external stakeholders. Some schools struggle to sustain segregation efforts because local waste collection systems do not consistently support the disposal of segregated waste. When segregated waste is eventually mixed during collection or transport, learners and teachers may feel that their efforts are ineffective. According to Guerrero, Maas, and Hogland (2013), weak linkages between schools and local waste management systems undermine the success of segregation programs and reduce stakeholders' trust in the process.

Additionally, learners' attitudes and inconsistent practices can hinder the effective implementation of waste segregation initiatives. Without continuous guidance, monitoring, and reinforcement, students may revert to improper disposal habits. UNESCO (2021) emphasized that behavior change requires sustained education, clear policies, and consistent enforcement. Schools that lack regular monitoring, environmental campaigns, or incentive systems often experience declining participation over time. These challenges highlight the need for comprehensive support, teacher training, adequate resources, and strong partnerships with local government units to ensure the long-term effectiveness of school-based waste segregation programs.

Student participation and school culture

Student participation is a crucial factor in the success of waste segregation programs. Studies show that learners are more engaged when they understand the purpose of segregation and see its impact (Zakianis & Djaja, 2019). However, inconsistent participation, lack of discipline, and low environmental awareness among students remain challenges in many schools.

A supportive school culture and strong administrative backing contribute to improved implementation. According to Hidayah and Agustin (2021), schools that promote environmental values through policies, routines, and recognition systems experience higher compliance and sustainability in waste segregation initiatives.

Active student involvement in waste segregation fosters responsibility and ownership of environmental practices. Assigning roles such as eco-monitors or club members makes participation more meaningful, and student-led activities encourage compliance and positive behavior (Zakianis & Djaja, 2019).

A supportive school culture also strengthens participation. Reinforcement through campaigns, reminders, and recognition, along with policies that promote environmental values, helps normalize sustainable behavior and ensures the continuity of waste segregation programs (Hidayah & Agustin, 2021).

Statement of the problem

This study aims to examine the practices and challenges of science teachers in implementing school-based solid waste segregation.

Specifically, it seeks to answer the following questions:

1. What practices do science teachers employ in implementing school-based solid waste segregation?
2. What challenges do science teachers encounter in implementing school-based solid waste segregation?
3. How do science teachers encourage and sustain learners' participation in solid waste management activities?

Methodology

This chapter presents the research design and data sources, including the study locale, population, and sampling; the data-gathering instrument; and data analysis, as well as the ethical standards.

Research design

This study employed a descriptive phenomenological research design to examine the practices and challenges faced by science teachers in implementing school-based solid waste segregation. Descriptive phenomenology aims to describe and interpret the essence of an individual's lived experiences concerning a particular phenomenon (Polit & Beck, 2014). It focuses on understanding how participants perceive and make sense of their experiences in their natural settings.

This design was considered appropriate because the study seeks to uncover the actual experiences, insights, and perspectives of science teachers regarding the implementation of environmental programs in schools. Through in-depth descriptions and reflective responses, the researcher identified common themes and patterns that characterize teachers' practices and the challenges they face in sustaining solid waste segregation initiatives.

Locale of the study

The study was conducted in selected public elementary schools within the Paoay District of the Schools Division of Ilocos Norte, Philippines. These schools were chosen because they actively implement school-based environmental and waste-segregation programs in compliance with the policies of the Department of Education (DepEd) and the Department of Environment and Natural Resources (DENR).

Respondents of the study

The respondents of the study were eighteen (18) science teachers handling elementary grade levels in the selected public schools. They were chosen using purposive sampling, as science teachers are directly involved in teaching environmental concepts and implementing waste segregation activities in schools. Their experiences and practices provided relevant data to achieve the study's objectives.

Data gathering instrument

Data were collected through an online interview questionnaire comprising open-ended questions designed to elicit detailed responses on the struggles and strategies of elementary school heads during and after flood events. The questionnaire was developed in alignment with the study's objectives and validated through expert review to ensure clarity, relevance, and the ability to capture rich qualitative

Abun et al., *Divine Word International Journal of Management and Humanities* 5(2)(2026) 3568-3585
data (Kvale & Brinkmann, 2015). The questions covered key areas such as immediate crisis response, long-term resilience building, and strategic planning for future disasters.

The primary data-gathering instrument used in this study was a **researcher-made questionnaire**. The questionnaire was divided into four parts. Part I was the profile of the respondents, years of teaching experience, grade level handled, and trainings attended related to Solid Waste Segregation. Part II was the practices of science teachers in implementing school-based solid waste segregation. Part III and Part IV were the challenges encountered by science teachers and strategies used to sustain student participation.

Validation of the instrument

The research instrument was validated by experts in science education and environmental education to ensure clarity, relevance, and content validity. Suggestions and comments from the validators were incorporated before the questionnaire was administered for the final time.

Data gathering procedure

Permission to conduct the study was sought from the Schools Division Office and school heads of the selected schools. After approval, the researcher personally distributed the questionnaires to the respondents. The purpose of the study was clearly explained, and respondents were assured that their answers would be kept confidential. Completed questionnaires were collected and prepared for data analysis.

Data analysis tool

The data gathered were analyzed using descriptive statistical tools. Frequency counts, percentages, and weighted means were used to describe the practices and challenges of science teachers in implementing school-based solid waste segregation. The results were interpreted using established scales to determine the level of implementation and the severity of challenges.

Ethical considerations

Ethical standards were strictly observed in the conduct of the study. Participation was voluntary, and informed consent was obtained from all respondents. Anonymity and confidentiality of responses were ensured, and data were used solely for academic and research purposes.

Data presentation and analysis

This chapter presents the study's findings based on responses gathered from 18 science teachers in the Paoay District. The data were collected using open-ended questions distributed through Google Forms, and the survey link was sent directly to the respondents. Their responses were analyzed using thematic analysis, where common patterns and ideas were grouped into themes. The results are presented in accordance with the study's research questions.

Problem 1: What practices do science teachers employ in implementing school-based solid waste segregation?

Theme 1: Practices in implementing school-based solid waste segregation

Practices	Description of Practices	Frequency
Use of labeled or color-coded bins	Placement of biodegradable, non-biodegradable, recyclable, and residual bins in classrooms and school areas	15
Presence of Material Recovery Facility (MRF)	Use of a school MRF for storing and sorting segregated waste	3
Student monitoring roles	Assigning eco-monitors, SELG officers, or classroom cleaners to oversee segregation	4
Orientation and reminders	Teachers orient students and regularly remind them about proper waste disposal	6
Clean-up routines	Conducting regular classroom or school clean-up drives	5
Inconsistent implementation	Waste segregation is not strictly implemented in some areas	1

Note. Data were gathered through open-ended questions using Google Forms from 18 science teachers of the Paoay District. Responses were analyzed and grouped into themes based on common ideas expressed by the participants.

The data reveal the common practices employed by science teachers in implementing school-based solid waste segregation. The results show that the most common practice is using labeled or color-coded bins, mentioned by the majority of respondents. This indicates that schools prioritize implementing visible, structured waste-disposal systems to guide students in properly segregating their waste. The presence of labeled bins helps learners easily identify the appropriate containers for biodegradable, recyclable, and non-biodegradable waste. This finding supports the study of Al-Khatib et al. (2015), which emphasized that clearly labeled waste bins are essential for effective waste segregation practices in institutions. Similarly, Ferronato and Torretta (2020) highlighted that source segregation, supported by proper facilities such as labeled containers, improves the efficiency of waste management systems.

“We placed color-coded bins in our classrooms and school grounds so that learners can easily identify where to throw biodegradable and non-biodegradable waste.” (P2)

“The labeled bins help students remember where to put their trash properly because they can easily see the type of waste indicated on each bin.” (P8)

Another practice identified by several teachers is conducting orientations and providing regular reminders on proper waste segregation. This suggests that teachers play an active role in reinforcing environmental awareness and ensuring that students understand the importance of proper waste disposal. According to UNESCO (2021), environmental education helps learners develop responsible environmental behavior through continuous guidance and awareness activities.

Additionally, some teachers reported organizing clean-up routines and assigning student monitoring roles such as eco-monitors or classroom cleaners. These practices encourage student participation and

responsibility in maintaining cleanliness within the school environment. This supports the findings of Zakianis and Djaja (2019), which emphasized that student involvement in environmental activities increases compliance with waste management practices.

“We assign eco-monitors in every class who check if their classmates are throwing their garbage in the correct bins.” (P10)

However, a few respondents noted inconsistent implementation in some areas of the school. Similar observations were reported by Guerrero et al. (2013), who explained that inconsistencies in waste management practices often arise from differences in resources and monitoring systems.

“Sometimes waste segregation is not strictly followed in some parts of the school because students forget or there are not enough bins.” (P12)

Overall, the findings indicate that teachers rely on facilities, student participation, and continuous environmental reminders to implement waste segregation programs in schools.

Problem 2: What challenges do science teachers encounter in implementing school-based solid waste segregation?

Theme 2: Strategies used by science teachers to encourage proper waste segregation

Strategies	Description of Strategies	Frequency
Environmental awareness activities	Campaign posters, environmental education discussions, and seminars	5
Use of labeled bins	Providing color-coded bins to guide students in proper disposal	8
Classroom monitoring	Assigning classroom cleaners or waste monitors	4
Integration in lessons	Teaching waste management concepts during science lessons	6
Clean-up drives and school campaigns	Conducting school-wide environmental activities	5
Waste reduction practices	Encouraging the use of tumblers, eco-bags, and recycling	4
Student participation initiatives	Involving SELG, YES-O, and parents in activities	3

Note. Data were collected via open-ended questions administered through Google Forms from 18 science teachers in the Paoay District. Responses were analyzed and grouped into themes based on common ideas expressed by the participants.

The findings indicate the strategies used by science teachers to encourage proper waste segregation among learners. The results reveal that the use of labeled bins remains one of the most frequently mentioned strategies, underscoring the importance of providing clear, accessible waste-disposal systems within the school. This supports the findings of Ferronato and Torretta (2020), which emphasize that proper waste infrastructure promotes responsible waste disposal behavior.

“Providing labeled bins is one of the easiest ways to guide learners in segregating their waste properly.” (P4)

Another common strategy is integrating waste management concepts into science lessons. Teachers incorporate environmental topics in their discussions to help learners understand the effects of improper waste disposal and the benefits of proper segregation. According to DepEd (2019), integrating environmental education in science lessons encourages learners to apply scientific knowledge to real-life environmental issues.

“During science lessons, I explain how improper waste disposal can affect the environment and why segregation is important.” (P7)

Teachers also conduct environmental awareness activities, such as cleanup drives and campaigns. These activities encourage collective participation among students. According to UNESCO (2021), experiential learning activities strengthen students’ environmental awareness and responsibility.

“We conduct clean-up drives in our school to help students understand the importance of keeping our surroundings clean.” (P13)

Theme 3: Challenges encountered by science teachers

Challenges	Description of Challenges	Frequency
Lack of student discipline	Students throwing garbage in the wrong bins or not following the rules	12
Lack of awareness	Some learners have a limited understanding of segregation practices	3
Limited facilities or bins	Insufficient number of waste bins or waste infrastructure	4
Inconsistent monitoring	Lack of regular supervision or reinforcement	3
Lack of stakeholder cooperation	Weak participation from school stakeholders or the community	2
Lack of municipal support	Segregated waste is sometimes mixed during collection	1

The most frequently mentioned challenge by science teachers is the lack of student discipline, which indicates that some learners still dispose of waste improperly despite existing guidelines and facilities. This finding is consistent with the study of Ojedokun and Balogun (2021), which reported that students’ attitudes and behavior significantly influence the success of waste management programs in schools.

“Some students still throw their garbage anywhere, even if we already explained the proper segregation.” (P7)

Another challenge reported by teachers is the limited availability of waste segregation facilities. According to the World Bank (2018), inadequate waste management facilities often hinder the effective

“Sometimes we do not have enough bins in the classrooms, which makes segregation difficult.” (P8)

Some respondents also reported limited awareness and inconsistent monitoring, which may contribute to students’ failure to follow proper waste-disposal practices. Without continuous supervision and reinforcement, students may gradually return to improper habits.

Additionally, a few teachers pointed out the lack of support from external stakeholders, including municipal waste collectors who sometimes mix segregated waste during collection. This situation can discourage both teachers and students from consistently practicing segregation. These findings highlight the importance of strong institutional support, adequate facilities, and continuous environmental education to sustain waste management initiatives in schools.

Theme 4: Effects of resource, facility, and discipline limitations on program implementation

Effects	Description of its Effect on Program Implementation	Frequency
Difficulty maintaining the program	Waste segregation becomes difficult to sustain	6
Lack of materials or bins	Insufficient resources reduce program effectiveness	5
Poor student discipline	Improper waste disposal leads to mixed waste	7
Weak implementation	The program becomes less organized or poorly implemented	3
Environmental risks	Poor waste practices may lead to pollution or unhealthy surroundings	2
Resorting to improper disposal	In some cases, waste may be burned due to a lack of facilities	1

The results indicate that poor student discipline significantly affects the effectiveness of the waste segregation program. When students fail to follow segregation guidelines, waste bins become mixed, reducing the purpose of segregation. According to Ferronato and Torretta (2020), effective waste segregation depends not only on infrastructure but also on behavioral compliance.

“When students do not follow the segregation rules, all the garbage becomes mixed again.” (P16)

Another identified effect is the difficulty of sustaining the program due to limited resources. Similar findings were reported by Garcia and Mercado (2020), who noted that limited resources can hinder the sustainability of environmental programs in schools.

“Without enough materials and support, it becomes difficult to maintain the waste segregation program.” (P1)

Some teachers also noted that the lack of resources leads to weak program implementation, as schools struggle to maintain organized waste management systems. In some cases, improper disposal practices such as burning waste may occur due to the absence of appropriate waste management facilities.

These findings suggest that the success of waste segregation programs depends not only on teacher initiatives but also on the availability of adequate resources and consistent student participation.

Problem 3: How do science teachers encourage and sustain learners' participation in solid waste management activities

Theme 5: Strategies used by science teachers to motivate learners to participate in waste segregation

Motivations	Motivation Strategy	Frequency
Integration in science lessons	Teaching environmental concepts and the consequences of improper waste disposal	8
Rewards and incentives	Giving recognition, awards, or prizes to encourage participation	5
Assigning student roles	Eco-monitors, waste ambassadors, or classroom cleaners	6
Hands-on activities	Recycling projects, sorting activities, and classroom waste management	6
Clean-up and environmental campaigns	Engaging students in school clean-up drives and environmental programs	4
Modeling behavior	Teachers demonstrating proper waste segregation practices	3

Note. Data were collected via open-ended questions administered through Google Forms from 18 science teachers in the Paoay District. Responses were analyzed and grouped into themes based on common ideas expressed by the participants.

The findings reveal that integrating environmental topics into science lessons is among the most common strategies teachers use to motivate learners. According to UNESCO (2021), integrating sustainability concepts into school curricula strengthens students' environmental responsibility.

"I explain in science class how waste can harm the environment so that students will understand why segregation is important." (P10)

Teachers also assign student roles, such as eco-monitors, to encourage responsibility among learners. According to Hidayah and Agustin (2021), assigning student responsibilities promotes accountability and strengthens environmental practices in schools.

"Assigning eco-monitors motivates students because they feel responsible for maintaining cleanliness." (P4)

In addition, rewards and incentives are used to encourage student participation and reinforce positive behavior. Recognition programs motivate students to consistently follow proper waste segregation practices.

“We give recognition to classes that consistently practice proper waste segregation.” (P16)

Teachers also utilize hands-on activities and recycling projects to make environmental learning more engaging and practical. These activities allow students to apply what they learn in the classroom to real-life environmental practices.

Overall, the findings indicate that science teachers use a combination of instructional strategies, participatory activities, and motivational techniques to sustain student involvement in school-based waste segregation programs.

Results and discussion

The study revealed that science teachers face several challenges in implementing school-based solid waste segregation programs, including a lack of student discipline, limited facilities and waste-segregation bins, inconsistent monitoring, and insufficient stakeholder support. Some teachers also noted that despite efforts to segregate waste properly, external factors such as municipal waste collection systems sometimes mix segregated waste, which discourages both teachers and learners from sustaining the practice. These challenges affect the consistency and effectiveness of waste segregation initiatives in schools. These findings are consistent with previous studies, which identified behavioral issues, inadequate facilities, and weak institutional support as major barriers to effective waste management in schools (Garcia & Mercado, 2020; Ojedokun & Balogun, 2021; World Bank, 2022). Furthermore, the improper handling of segregated waste during collection reflects broader systemic problems in waste management, as highlighted by Kaza et al. (2021), who emphasized that weak coordination among institutions and within waste management systems reduces the effectiveness of segregation efforts.

Despite these difficulties, science teachers employ various strategies to promote proper waste segregation and encourage student participation. These include the use of labeled and color-coded waste bins, integration of waste management concepts into science lessons, classroom monitoring through assigned student roles such as eco-monitors, and the conduct of environmental awareness activities and school clean-up drives. Teachers also motivate learners through hands-on activities such as recycling projects, environmental campaigns, and incentive-based participation programs. These strategies align with established practices in environmental education, which emphasize experiential learning, active participation, and the provision of appropriate facilities to influence pro-environmental behavior (Ferronato & Torretta, 2020; UNESCO, 2021; Yap & Dizon, 2024). Similarly, Aboelmaged (2021) noted that awareness programs and participatory activities significantly enhance students' engagement in sustainable waste practices, while Molina and Rivera (2022) highlighted the importance of integrating environmental concepts into classroom instruction to promote long-term behavioral change.

In addition, teachers maximize available resources and collaborate with student organizations such as

SELG and YES-O to strengthen environmental programs in schools. These initiatives help develop students' awareness, responsibility, and participation in maintaining a clean and sustainable school environment. The findings indicate that science teachers demonstrate commitment, creativity, and adaptability in addressing the challenges associated with waste segregation programs and in promoting environmental responsibility among learners. Their efforts highlight the important role of teachers in translating environmental education into practical school-based actions that support sustainable waste management practices (Department of Education, 2019; UNESCO, 2021; Hidayah & Agustin, 2021).

Moreover, this study contributes to existing theories and policies on waste segregation by providing localized, school-based evidence that supports the principles of environmental education and sustainable development. It reinforces the idea that behavior change in waste management depends not only on knowledge but also on consistent practice, institutional support, and participatory approaches, as emphasized in Education for Sustainable Development frameworks. The findings extend the current literature by highlighting the critical role of science teachers as implementers of policy at the grassroots level, demonstrating how national policies such as Republic Act No. 9003 and school-based environmental programs are translated into classroom practices. Additionally, the study underscores the importance of integrating behavioral, instructional, and systemic approaches in strengthening waste segregation initiatives. This contribution provides valuable insights for policymakers, school administrators, and educators in improving the design, implementation, and sustainability of environmental programs in schools.

Conclusion

The study concludes that science teachers in the Paoay District play a significant role in implementing school-based solid waste segregation programs and promoting environmental awareness among learners. However, teachers face several challenges, including a lack of student discipline, limited waste-segregation facilities, inconsistent monitoring, and insufficient stakeholder support. These factors affect the consistency and sustainability of waste segregation practices within the school environment.

Despite these challenges, science teachers employ a variety of effective practices and strategies to encourage proper waste management among learners. These include the use of labeled waste bins, the integration of environmental topics into science lessons, the assignment of student roles such as eco-monitors, the organization of clean-up drives and environmental campaigns, and the implementation of hands-on recycling and waste management activities. Teachers also utilize available resources and collaborate with student organizations to strengthen participation and awareness.

The findings highlight the dedication, resourcefulness, and commitment of science teachers in promoting environmental responsibility in schools. Their efforts demonstrate the importance of integrating environmental education with practical school activities to develop sustainable waste management habits among learners. The study also emphasizes the need for stronger institutional support, adequate facilities, continuous teacher training, and collaboration with local government units to enhance the effectiveness and sustainability of school-based solid waste segregation programs.

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