

# Implementing a Mini Waste Bank Education Program through Participatory Action Research to Foster Early Waste-Sorting Awareness among Grade 1–3 Elementary Students

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## Abstract

**Background:** Environmental education in early elementary grades is essential for shaping sustainable habits, yet waste management learning often remains theoretical and lacks structured participatory practice. As a result, students understand environmental concepts but struggle to apply them in daily routines.

**Aims:** This study aims to describe the implementation of a mini waste bank education program using a Participatory Action Research approach to foster early waste-sorting awareness among Grade 1–3 students.

**Methods:** A qualitative Participatory Action Research design was employed through iterative cycles of planning, action, observation, and reflection. Data were collected from classroom observations, participation logs, teacher reflective journals, and informal interviews. Activities included guided waste sorting, recyclable material identification, and mini waste bank simulations integrated into daily classroom routines.

**Results:** The findings reveal progressive improvements in students' recognition of waste categories, accuracy in waste placement, and initiative in reminding peers. Repeated, routine-based practices strengthened engagement, discipline, and environmental responsibility, while teachers reported enhanced classroom cleanliness and sustained student participation.

**Conclusion:** The study demonstrates that a participatory, routine-integrated mini waste bank program is a feasible and pedagogically appropriate model for early-grade environmental character education. By emphasizing habit formation through experiential learning, the program provides a transferable framework for sustainability-oriented elementary education, particularly in contexts where practical waste literacy remains limited.

## INTRODUCTION

Environmental issues related to waste management have become increasingly urgent in basic education contexts, particularly in developing countries where waste literacy remains limited among young learners. In elementary schools, environmental education is often introduced at a conceptual

level without sufficient emphasis on practical habit formation, even though early childhood is a critical period for shaping long-term behavioral patterns. Studies in environmental psychology indicate that habits related to cleanliness and waste sorting are more effectively established when introduced through repeated, concrete activities rather than abstract instruction alone (Mazar et al., 2021). Within Indonesian elementary schools, waste education is frequently integrated into thematic learning but rarely supported by structured school-based programs that translate knowledge into daily practice. As a result, students may understand environmental concepts theoretically while continuing unsustainable waste disposal behaviors in their daily routines. This condition highlights a gap between curriculum intentions and lived educational experiences in classrooms. Early-grade students, particularly those in Grades 1–3, require pedagogical approaches that align with their cognitive and developmental stages to ensure meaningful engagement. Therefore, exploring practice-based environmental education models for young learners is both timely and necessary.

One promising approach to bridging this gap is the implementation of school-based waste management programs that involve students directly in environmental practices. The mini waste bank concept has gained attention as an educational tool that combines environmental awareness with experiential learning, allowing students to interact with waste sorting and recycling activities in structured ways. Research on experiential environmental learning emphasizes that participatory activities can strengthen students' sense of responsibility and agency toward their environment (Mazar et al., 2021). In the context of elementary education, such programs also provide opportunities for character education, particularly in fostering discipline, care, and responsibility. However, many existing studies focus on upper elementary or secondary students, leaving early-grade learners underrepresented in empirical research. Additionally, school-based environmental initiatives are often reported as extracurricular activities rather than integrated educational practices. This limitation reduces their pedagogical impact and sustainability. Consequently, examining how mini waste bank programs can be implemented as part of everyday learning experiences for lower-grade elementary students becomes an important research endeavor.

The rationale for this study lies in the need to align environmental education with developmentally appropriate pedagogical strategies for early elementary students. At the Grade 1–3 level, students learn most effectively through concrete experiences, repetition, and social interaction rather than abstract explanations. Participatory Action Research offers a methodological framework that allows educators and students to collaboratively engage in problem identification and solution implementation within authentic learning contexts. Previous educational research highlights that participatory approaches can enhance ownership and relevance in school-based interventions (Wilhelm et al., 2021). By integrating a mini waste bank program through a participatory model, this study positions students not merely as recipients of instruction but as active contributors to environmental practices. This approach also enables teachers to adapt learning activities dynamically based on classroom realities. Moreover, the participatory framework supports reflective practice, allowing continuous improvement of educational interventions. Thus, this study is grounded in both pedagogical theory and practical educational needs.

From an institutional perspective, elementary schools play a strategic role in promoting sustainable behaviors within the broader community. Students often transfer school-based habits to their families, amplifying the social impact of educational programs. Implementing waste

management education through structured school programs can therefore contribute to broader environmental awareness beyond the classroom. Despite this potential, many schools lack empirical guidance on how to design and implement such programs effectively for young learners. Existing policy documents emphasize environmental education but provide limited operational models for early grades. This study responds to that gap by offering an implementation-focused examination of a mini waste bank program grounded in classroom practice. The findings are expected to inform teachers, school administrators, and curriculum developers seeking practical strategies for environmental character education. In this sense, the study addresses both pedagogical and institutional challenges within elementary education.

Recent international research underscores the importance of early environmental education in shaping pro-environmental attitudes and behaviors. Studies conducted in elementary education contexts show that students who engage in hands-on environmental activities demonstrate higher levels of environmental awareness and responsibility compared to those receiving lecture-based instruction (Zahra et al., 2024). Experiential learning theory suggests that knowledge becomes meaningful when learners actively participate in real-world activities that connect theory with practice (Dernova, 2015). In the context of waste management education, hands-on activities such as waste sorting and recycling simulations have been shown to improve students' understanding of environmental concepts. Research in Asian educational settings further indicates that school-based environmental programs are more effective when embedded in daily routines rather than isolated events (Xu et al., 2020). These findings highlight the pedagogical value of experiential and routine-based learning. However, much of the existing literature focuses on cognitive outcomes rather than habit formation. This indicates a need for studies that examine behavioral dimensions of environmental education.

Another body of literature emphasizes the role of participatory approaches in educational innovation. Participatory Action Research has been widely used to improve teaching practices and foster collaborative problem solving in schools (Messiou, 2019). In environmental education, participatory models allow students to engage with real environmental issues while reflecting on their actions and outcomes. Studies applying PAR in sustainability education report increased student engagement and contextual relevance of learning activities (Kim et al., 2018). Nevertheless, most PAR-based environmental studies involve older students or community groups rather than early elementary learners. Additionally, research on waste bank programs tends to focus on community empowerment or economic outcomes, with limited attention to their pedagogical applications in formal education settings. This imbalance suggests an underexplored intersection between participatory methodology, waste bank programs, and early-grade education. Addressing this intersection can contribute novel insights to the field of elementary environmental education.

Despite growing interest in environmental education and participatory learning, limited research has examined the implementation of mini waste bank programs specifically for early-grade elementary students. Existing studies often emphasize outcomes such as environmental knowledge or economic benefits while overlooking the process of habit formation in young learners. Furthermore, participatory approaches are rarely applied to structured waste management education at the lower elementary level. Many school-based programs are reported descriptively without systematic reflection on their educational processes. This creates a lack of practical,

research-based models that teachers can adapt to their own classrooms. The absence of detailed implementation studies limits the transferability of successful practices across educational contexts. Moreover, early-grade students' perspectives and participation are frequently underrepresented in environmental education research. These gaps collectively point to the need for an implementation-focused study that centers on young learners and participatory processes.

The purpose of this study is to describe the implementation of a mini waste bank education program using a Participatory Action Research approach in early elementary classrooms. The study seeks to explore how participatory activities can foster waste-sorting awareness and environmentally responsible habits among Grade 1–3 students. It aims to document the learning processes that emerge when students actively engage in waste management practices as part of their daily school routines. The study also examines teachers' roles in facilitating and reflecting on participatory environmental learning activities. By focusing on implementation rather than measurement of causal effects, the research emphasizes contextual understanding and practical relevance. The findings are intended to provide insights into how environmental character education can be embedded meaningfully in early-grade instruction. This study further aims to contribute to the limited body of literature on participatory environmental education for young learners. Ultimately, the research seeks to offer a transferable educational model for elementary schools facing similar environmental education challenges.

## **METHOD**

### **Research Design**

This study employed a qualitative Participatory Action Research design to examine the implementation of a mini waste bank education program in early-grade elementary classrooms. Participatory Action Research was selected because it emphasizes collaborative problem-solving and reflective practice within authentic educational settings, as articulated by (Hennessy et al., 2021) in discussions of practitioner-led inquiry. The research design followed cyclical stages of planning, action, observation, and reflection, allowing iterative refinement of learning activities. In the planning stage, researchers and teachers jointly identified classroom waste management challenges and designed age-appropriate interventions. The action stage involved the implementation of waste-sorting activities and mini waste bank simulations embedded in daily classroom routines. Observations were conducted systematically during each cycle to document student engagement and behavioral responses. Reflection sessions were held with teachers to evaluate instructional adjustments and emerging learning patterns. This design enabled the study to focus on implementation processes rather than causal measurement, aligning with qualitative educational inquiry principles discussed by (Maxwell, 2004).

### **Participant**

The participants in this study consisted of Grade 1–3 students enrolled at a public elementary school, along with their classroom teachers and school administrators. Early-grade students were selected due to their developmental suitability for habit formation through repetitive and concrete learning experiences, as supported by child development research discussed by Piagetian-informed educational studies (Slavin, 2020). Teachers participated as co-researchers who facilitated learning activities and contributed reflective insights throughout the research cycles. School administrators

supported the program by integrating the activities into routine school practices. Student participation was inclusive and non-selective, ensuring that the program reflected authentic classroom dynamics. Parental consent and institutional approval were obtained prior to implementation to ensure ethical compliance. The participatory structure positioned students not as passive subjects but as active contributors to environmental practices. This participant configuration reinforced the collaborative ethos central to Participatory Action Research, as emphasized in educational PAR literature (Anderson, 1998).

### **Instrument**

Multiple qualitative instruments were used to capture implementation processes and learning experiences during the study. Classroom observation sheets were developed to document student behaviors related to waste sorting, participation, and consistency across activities. Reflective journals were maintained by teachers to record instructional decisions and perceived changes in student awareness, drawing on reflective practice frameworks proposed by (Pavlovich, 2007). Informal interview guides were used to elicit teachers' perspectives on program feasibility and classroom integration. Student participation logs documented attendance and involvement in waste bank activities. Visual documentation in the form of photographs was used internally to support observational accuracy, though not as primary analytic data. The instruments were designed to be developmentally appropriate and non-intrusive for early-grade learners. Instrument triangulation enhanced data credibility by allowing cross-validation across sources. This approach aligns with qualitative rigor principles discussed in educational research methodology (Yee et al., 2022).

### **Analysis plan**

Data analysis followed a descriptive qualitative approach focusing on pattern identification across PAR cycles. Observation notes, reflective journals, and interview summaries were coded inductively to identify recurring themes related to student engagement and waste-sorting awareness. Coding procedures were informed by thematic analysis principles outlined by (Byrne, 2022), emphasizing familiarity, pattern generation, and theme refinement. Data from different instruments were compared through triangulation to strengthen interpretive validity. Reflective discussions with teachers served as member-checking mechanisms to confirm analytic interpretations. Temporal comparisons across research cycles were used to examine changes in classroom practices and student behaviors. The analysis prioritized process-oriented insights rather than numerical outcomes. This analytic strategy supported a nuanced understanding of how participatory environmental education unfolds in early-grade classrooms.

Table 1. Alignment of PAR Cycles with Educational Activities and Data Sources.

| <b>PAR Cycle</b> | <b>Core Educational Activities</b>                 | <b>Primary Data Sources</b>               |
|------------------|----------------------------------------------------|-------------------------------------------|
| Planning         | Identification of waste issues, lesson co-design   | Teacher discussions, planning notes       |
| Action           | Waste sorting practice, mini waste bank simulation | Observation sheets, participation logs    |
| Observation      | Monitoring student engagement and routines         | Observation records, visual documentation |
| Reflection       | Evaluation and instructional adjustment            | Teacher reflective journals, interviews   |

Table 1 illustrates how each Participatory Action Research cycle was systematically aligned with specific educational activities and corresponding data sources. This alignment demonstrates methodological transparency and strengthens the study's credibility by clearly linking actions to

evidence. The table also highlights how data collection was embedded naturally within classroom routines, supporting ecological validity. Such explicit mapping of PAR cycles to pedagogical activities is rarely detailed in elementary environmental education studies, contributing methodological novelty while remaining consistent with PGSD-focused research.

## RESULTS AND DISCUSSION

### Results

The implementation of the mini waste bank education program revealed clear changes in students' daily waste-handling behaviors across the PAR cycles. During the initial observation phase, most Grade 1–3 students disposed of waste randomly without distinguishing between organic and inorganic materials. Following the first action cycle, students began to recognize waste categories during guided classroom activities. Repeated waste-sorting practices embedded in routine school activities increased students' consistency in placing waste in designated containers. Teachers reported that students increasingly reminded peers to sort waste correctly during breaks and after lessons. Classroom cleanliness improved as fewer mixed-waste piles were observed in learning spaces. Students showed high enthusiasm during mini waste bank simulations, particularly when handling recyclable materials. These findings indicate that practical exposure supported the development of early waste-sorting awareness.

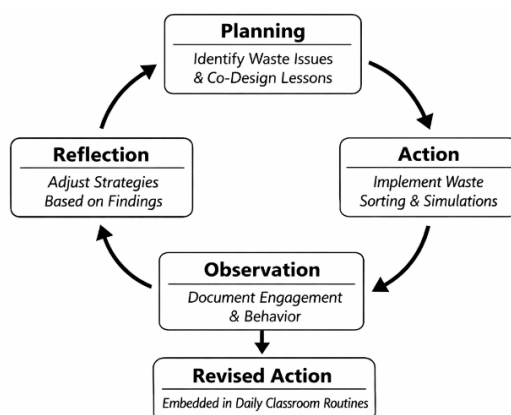
Students' participation levels also increased as the program progressed through subsequent PAR cycles. Observation records showed that nearly all students actively engaged in waste-sorting activities by the second cycle. Younger students initially required direct guidance, but gradually demonstrated independent sorting behaviors. Participation logs indicated stable attendance and consistent involvement in daily activities. Teachers' reflective notes highlighted improvements in students' discipline and responsibility related to classroom cleanliness. The mini waste bank activities encouraged collaborative learning as students worked in small groups. This collaboration fostered social interaction and shared responsibility among learners. Overall, the results demonstrate that participatory environmental activities can be effectively implemented in early elementary classrooms.

**Table 2.** Observed Changes in Student Waste-Sorting Behavior Across PAR Cycles.

| Indicator                           | Initial Observation | Cycle 1 Action | Cycle 2 Action |
|-------------------------------------|---------------------|----------------|----------------|
| Recognition of waste categories     | Low                 | Moderate       | High           |
| Correct waste placement             | Low                 | Moderate       | High           |
| Student initiative in waste sorting | Very limited        | Emerging       | Consistent     |
| Peer reminders and collaboration    | Absent              | Occasional     | Frequent       |

Table 2 summarizes observed behavioral changes across the PAR cycles. The gradual shift from low to high levels of correct waste sorting indicates habit formation through repeated practice. The emergence of peer reminders suggests internalization of environmental responsibility. This table strengthens the Results section by providing structured evidence aligned with qualitative observation data.

**Figure 1** illustrates the cyclical nature of the Participatory Action Research process applied in this study. The diagram clarifies how educational activities and reflection were continuously refined. This visualization enhances methodological transparency and links classroom practice with observed outcomes.



**Figure 1.** PAR-Based Mini Waste Bank Implementation Flow in Early-Grade Classrooms.

## Discussion

The findings of this study align with prior research emphasizing the importance of experiential learning in environmental education. Studies by (Fuller, 2023) show that direct engagement with environmental practices strengthens students' awareness and responsibility from an early age. The observed improvement in waste-sorting behavior supports experiential learning theory, which posits that learning is most effective when grounded in concrete experiences as discussed (Sherwood et al., 2025). Unlike cognitive-only instruction, participatory activities enabled students to connect abstract environmental concepts with daily routines. This connection is particularly relevant for early-grade learners who rely on sensory and action-based learning. The mini waste bank program provided a structured yet flexible learning environment. Such contextualized learning has been highlighted as critical in sustainability education by (Reffhaug & Lysgaard, 2024). Therefore, this study reinforces the pedagogical value of practice-based environmental education in elementary settings.

The participatory nature of the program also contributed significantly to its effectiveness. Participatory Action Research emphasizes collaboration and reflection, allowing educators to adapt interventions based on classroom realities as outlined by (Mertler, 2024). Teachers' involvement as co-researchers increased ownership and instructional relevance. This collaborative approach aligns with findings by (Hoang et al., 2025), who note that teacher engagement is crucial for sustaining school-based environmental initiatives. Students' increasing initiative in waste sorting reflects the empowerment fostered by participatory learning. Rather than being passive recipients, students became active agents in environmental practices. This agency is essential for character education, as suggested by UNESCO-oriented environmental education frameworks. The study thus demonstrates the compatibility of PAR with early elementary pedagogy.

In comparison with existing waste bank studies, this research offers a distinct educational perspective. Many studies on waste banks focus on community empowerment or economic outcomes, such as those reported by (Adiatmika & Nain, 2022). In contrast, this study situates the waste bank concept within formal classroom instruction. The emphasis on habit formation rather than economic incentives differentiates this work from community-based models. This educational framing aligns more closely with PGSD objectives centered on character development. Additionally, focusing on Grades 1–3 addresses a gap identified in previous literature that often targets older students. Early

intervention increases the likelihood of long-term behavioral consistency. Consequently, this study extends the application of waste bank programs into underexplored educational contexts.

The integration of daily routines played a crucial role in sustaining student engagement. Research by (Jeremiah et al., 2025), highlights that routine-based environmental practices enhance habit formation more effectively than isolated activities. The mini waste bank activities were embedded within classroom schedules, reinforcing repetition and consistency. This approach contrasts with project-based environmental education that may lose impact once the project ends. Teachers' reflections indicate that routine integration reduced instructional burden over time. Students internalized waste-sorting practices as part of normal school life. Such normalization is essential for sustainable behavior change. The findings thus contribute to discussions on how environmental education can move beyond episodic interventions.

From a broader educational perspective, the study supports the role of elementary schools as agents of environmental change. Previous research by (Keane & Evans, 2022) emphasizes schools' potential to influence family and community behaviors through students. Teachers reported that students shared waste-sorting practices at home, indicating spillover effects. This aligns with social learning theory perspectives discussed (Li et al., 2023). Although not formally measured, these observations suggest wider social relevance. The study therefore contributes to sustainability education literature by highlighting indirect community impacts. Its context-specific insights enrich global discussions on environmental education in developing countries. The focus on early grades provides a novel contribution to Scopus-indexed literature.

### **Implications**

The findings imply that elementary schools can effectively integrate environmental character education through participatory and routine-based programs. Teachers can adopt mini waste bank activities as part of daily instruction without requiring complex resources. Curriculum developers may consider incorporating waste management practices explicitly into early-grade learning objectives. School administrators can support sustainability initiatives by institutionalizing simple environmental routines. The participatory model also encourages reflective teaching practices aligned with professional development goals. These implications support the relevance of the study within PGSD-focused educational discourse. Importantly, the study demonstrates that environmental education need not rely on advanced infrastructure. Instead, pedagogically grounded participation can drive meaningful change.

### **Limitations**

This study is limited by its qualitative design and context-specific setting. The findings are based on observations and reflections within a single elementary school. Behavioral changes were documented descriptively rather than measured quantitatively. The short implementation period limits conclusions about long-term sustainability. Student perspectives were inferred from behavior rather than formal interviews due to developmental considerations. Additionally, community-level impacts were not systematically assessed. These limitations should be considered when interpreting the results. Nevertheless, the study provides valuable implementation insights.

### **Suggestions**

Future research may combine participatory approaches with quantitative measures to examine behavioral change more rigorously. Longitudinal studies could assess the sustainability of

waste-sorting habits over time. Comparative studies across multiple schools may enhance generalizability. Researchers could also explore parental involvement in reinforcing school-based environmental practices. Integrating digital tools for waste education may offer additional innovation. Further studies may examine links between environmental habits and broader character education outcomes. Such research would strengthen evidence for policy and curriculum development. These directions can expand the contribution of PGSD-based environmental education research.

### **CONCLUSION**

This study demonstrates that implementing a mini waste bank education program through a Participatory Action Research approach provides a feasible and pedagogically sound strategy for fostering early waste-sorting awareness among Grade 1–3 elementary students. By embedding environmental practices into daily classroom routines, the program moved beyond conceptual instruction toward habit-oriented learning that aligns with the developmental characteristics of young learners. The participatory design enabled teachers and students to collaboratively shape learning activities, ensuring contextual relevance and sustained engagement. Rather than positioning environmental education as an isolated project, the program functioned as an integral component of everyday school life. The observed behavioral shifts indicate that repeated, concrete experiences are central to cultivating environmental responsibility at an early age. Importantly, the findings highlight that meaningful environmental education does not require complex infrastructure, but rather thoughtful pedagogical integration. This reinforces the role of elementary schools as foundational spaces for sustainability-oriented character education. The study thus contributes empirical insight into how early-grade environmental learning can be operationalized in practice.

From a broader academic perspective, this research extends existing literature by situating the mini waste bank concept within formal elementary education rather than community-based or economically oriented frameworks. The use of Participatory Action Research foregrounds process, reflection, and co-construction of learning, offering a methodological contribution that remains underrepresented in early-grade environmental education studies. The focus on habit formation among lower elementary students addresses a critical gap in sustainability education research, which often prioritizes older learners or cognitive outcomes. By emphasizing implementation processes, this study provides transferable pedagogical lessons for educators working in similar contexts, particularly in developing-country settings. The findings also suggest that early environmental interventions have the potential to influence broader social practices through students' everyday interactions beyond school. While the study does not claim generalizability, it offers a robust contextual model that can inform future research and practice. Overall, this study strengthens the argument that participatory, routine-based environmental education is a promising pathway for cultivating sustainable behaviors from the earliest stages of formal schooling.

### **AUTHOR CONTRIBUTION STATEMENT**

Conceptualization, research design, and methodological development were conducted by Mawar Padatu. Data collection, classroom coordination, and implementation of the Participatory Action Research cycles were carried out by Mawar Padatu. Observation, documentation, and qualitative data analysis were performed by Mawar Padatu. The interpretation of findings and integration of results with relevant theoretical frameworks were completed by Mawar Padatu.

Manuscript drafting, revision, and final editing were fully undertaken by Mawar Padatu. The author reviewed and approved the final manuscript for submission.

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