

Mini Waste Bank Management Education to Foster Environmental Concern at UPT SPF SD Inpres Bangkala III

Mawar Padatu*, Eka Dayanti, Ismu Ningrat, Isnaeni, Kostantina Ohoiwutun, Satriani

Universitas Megarezky Makassar, Indonesia

*mawarpdtau@gmail.com

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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

Waste management is one of the most visible environmental problems in school life, yet the educational response to it often reveals a persistent contradiction between what children know and what they routinely do. Environmental education can improve knowledge, attitudes, and pro-environmental intentions, but behavioral outcomes are typically less consistent because everyday action is shaped by habit, opportunity, social cues, and the physical environment (van de Wetering et al., 2022; Świątkowski et al., 2024). Reviews focused on children similarly show that sustainable

behavior develops through interaction among individual understanding, family influence, school practices, and repeated opportunities to act rather than through information alone (Hosany et al., 2022; Liu & Green, 2024). This distinction is important in elementary education because simple practices such as disposing, separating, and collecting waste occur many times during an ordinary school day. When these routine moments are treated only as cleanliness rules, students may comply temporarily without understanding why different waste streams require different forms of management. Conversely, when waste becomes part of a meaningful learning experience, ordinary school routines can become a setting for environmental character formation. Systematic reviews of early environmental education therefore emphasize concrete, participatory, and developmentally appropriate experiences rather than abstract explanation as the sole instructional strategy (Ardoin & Bowers, 2020; Güler Yıldız et al., 2021). The educational challenge is consequently not merely to introduce environmental concepts, but to create repeated and understandable opportunities through which young learners can connect those concepts with responsible action.

The knowledge-action gap becomes particularly evident in waste-sorting contexts because the presence of bins or environmental messages does not automatically produce accurate disposal behavior. Research in educational institutions has found that waste characteristics, infrastructure, and user behavior interact in ways that can either support or undermine recycling practices, making the school environment an important site for behavioral intervention (Sağlam & Aydın, 2024). Among school children, knowledge about plastics and waste may precede changes in attitudes and practices, but the transition from awareness to consistent behavior is neither immediate nor automatic (Salazar et al., 2022). Field evidence also indicates that environmental education becomes more influential when information is combined with behavioral prompts and opportunities to practice the desired action in context (Kurokawa et al., 2023). For younger learners, this issue is amplified because environmental categories such as recyclable, organic, and residual waste are easier to understand when represented by visible objects and direct activity. The original school record underlying this study identified limited waste-management understanding and inappropriate disposal habits as practical problems requiring educational attention at UPT SPF SD Inpres Bangkala III. Those conditions make waste management more than a housekeeping issue because they affect how students learn responsibility toward shared spaces and resources. A school-based intervention is therefore most relevant when it transforms a familiar environmental problem into a structured opportunity for students to observe, discuss, classify, and manage waste themselves.

Early elementary school is a strategically important period for such intervention because children are still developing the routines, social expectations, and practical judgments that organize everyday behavior. Research on children's environmental behavior shows that younger learners can understand pro-environmental norms and even encourage environmentally responsible action when expectations are concrete and socially meaningful (Hu & Wu, 2022). Primary-school studies further demonstrate that student voice and direct participation can reveal forms of environmental understanding that are easily missed by lecture-centered approaches (Banks & Taylor, 2025; Reffhaug et al., 2024). Experiences in school grounds and other place-based settings also suggest that caring relationships with local environments are strengthened when students participate in real stewardship rather than encounter sustainability only as curriculum content (Harris, 2021; Ruck & Mannion, 2021). This developmental perspective gives environmental concern an operational meaning that extends beyond verbal agreement with environmental values. For early-grade students,

concern can be expressed through attention to cleanliness, willingness to sort waste, participation in management activities, and growing responsibility for a shared classroom or school environment. Such forms of concern are especially suitable for observation because they connect environmental values with behaviors that occur in a setting children know well. Accordingly, environmental education in Grades 1-3 should be designed around concrete participation and guided reflection while avoiding the assumption that a short lesson alone can establish durable long-term habits.

The mini waste bank offers a practical way to organize these learning processes because it gives students a visible place and procedure for distinguishing, collecting, and discussing waste that still has value. Unlike a conventional lesson that ends when explanation is complete, a mini waste bank can link environmental knowledge with a sequence of actions such as identifying waste, separating it, placing it appropriately, and considering its potential for reuse or recycling. Action-oriented sustainability education has been associated with stronger opportunities for students to develop competence because learners are asked to do something with environmental knowledge rather than merely reproduce it (Sass et al., 2024). Similarly, whole-school research stresses that sustainability is more coherent when organizational routines and educational aims reinforce one another (Holst, 2023). Participatory approaches add another layer by positioning students and teachers as contributors to the learning process, which can strengthen ownership and contextual relevance (Korfiatis & Petrou, 2021; Wilhelm et al., 2021). For schools with limited resources, the attraction of a mini waste bank is that the intervention can be built around ordinary waste materials, simple sorting facilities, discussion, and teacher guidance rather than expensive technology. This low-resource character is particularly relevant to elementary settings seeking feasible ways to embed environmental responsibility in daily school life. The pedagogical rationale for the present study therefore rests on the combination of concrete waste-management practice, participation, and reflection around a problem already experienced in the school environment.

Existing literature generally supports the educational value of interventions that move children from environmental information toward participation, but the reported outcomes and mechanisms are diverse. Meta-analytic evidence indicates that environmental education can improve environmental outcomes among children and adolescents, while intervention studies show that design features strongly influence whether knowledge is translated into behavior (van de Wetering et al., 2022; Świątkowski et al., 2024). Action-oriented learning has been linked with sustainability-related competence, and school interventions that incorporate behavioral cues have generated measurable improvements in environmental knowledge, attitudes, and practices (Kurokawa et al., 2023; Sass et al., 2024). Waste-focused research also suggests that school programs can shape students' plastic-related practices and that environmental certification can support pro-environmental behavior when school structures provide consistent reinforcement (Salazar et al., 2022, 2024). Beyond the individual student, school environmental education can generate intergenerational effects, with children influencing recycling or environmental behavior within families (Deng et al., 2022; Jaime et al., 2023; Jia & Yu, 2021). However, these studies range from large-scale programs and nudging interventions to family-based and certification models, making it difficult to infer how a small, classroom-proximate waste activity functions pedagogically in the lower primary grades. The literature therefore establishes that environmental learning can influence behavior, but it provides less detail about the implementation process through which young children interpret and enact waste-management responsibility in a short school-based intervention. This

limitation makes process-oriented evidence valuable, particularly when the intervention is designed for early-grade learners and uses infrastructure that schools can reproduce with minimal resources.

A second limitation in the literature concerns participation, because environmental education frequently values student agency in principle while documenting it more extensively among older students or in broader whole-school initiatives. Studies of participation show that ownership, collective efficacy, and opportunities to contribute to decisions are closely related to how students experience sustainability learning (Korfiatis & Petrou, 2021; Torsdottir, Olsson, et al., 2024; Torsdottir, Sinnes, et al., 2024). Collaborative action can also help students understand sustainability as a shared rather than purely individual responsibility (Tayne, 2022). Action-research studies demonstrate that school environmental practices can be refined through cycles of observation and reflection, yet much of this work addresses teacher learning, school-wide change, or learners beyond the earliest primary grades (Inwood, 2022; Matsekoleng & Awshar, 2022). Recent primary-school studies have expanded the field through critical reading, arts-based student voice, and co-constructed environmental pedagogies, illustrating the value of approaches that make children active meaning-makers (Banks & Taylor, 2025; Muela-Bermejo & Pérez-Martínez, 2025; Salvi et al., 2025). At the same time, research continues to identify barriers between environmental concern and action, indicating that supportive routines and contexts remain essential even when students express positive attitudes (Huoponen, 2024; Schuster & Ohl, 2025). The explicit research gap addressed here is therefore the limited implementation-focused evidence on how a simple mini waste bank education activity, organized through Participatory Action Research, can support environmental concern among Grade 1-3 students without relying on large-scale infrastructure or a long intervention period. Filling this gap requires careful description of the educational process and its observed responses while avoiding causal claims that the available descriptive evidence cannot support.

Against this background, the present study aims to describe the implementation of mini waste bank management education for fostering environmental concern at UPT SPF SD Inpres Bangkala III. It focuses specifically on how Grade 1-3 students were introduced to waste concepts, waste categories, sorting practices, and the environmental meaning of responsible management through presentation, interactive discussion, and practical engagement during the three-day activity. The study also examines the supporting conditions and barriers recorded during implementation, because these contextual factors help explain why environmental learning may or may not be translated into routine behavior. Methodologically, Participatory Action Research is used as an implementation framework that connects problem identification, data collection, planning, action, and evaluation/reflection within the school setting. The theoretical contribution lies in showing how action-oriented and participatory environmental learning can be interpreted at the micro level of early-grade waste routines rather than only through broad measures of environmental attitudes or program outcomes. Its practical contribution is a low-resource model that teachers and schools can adapt when they seek to make waste education more concrete and closely connected to students' daily experiences. By retaining the limits of the original descriptive evidence, the study also distinguishes observed educational change from statistically demonstrated causal effectiveness, which strengthens the interpretive validity of its claims. In this way, the research positions a modest school-based waste activity within the wider international discussion on how sustainability education can move from awareness toward meaningful participation in the earliest years of formal schooling.

METHOD

Research Design

This study was organized as Participatory Action Research (PAR) and reported through a qualitative, implementation-focused perspective. PAR was appropriate because the school problem was addressed through linked stages of identifying an environmental issue, gathering contextual information, planning an educational response, implementing action, and evaluating/reflection on the activity rather than through experimental manipulation. The approach is consistent with school-based action research that treats practitioners and participants as contributors to context-sensitive educational improvement (Inwood, 2022; Matsekoleng & Awshar, 2022). The study did not use a control group, randomization, or a standardized pre-test/post-test design, so the analysis was intended to describe implementation processes and observed or reported changes rather than estimate a causal treatment effect. This distinction is important because participatory school interventions are strongest when claims remain aligned with the evidence produced by the design (Wilhelm et al., 2021).

Research Setting and Time

The study was conducted at UPT SPF SD Inpres Bangkala III in Makassar City, South Sulawesi, Indonesia, during a Teaching Practice Program implemented by students of the Elementary School Teacher Education Program at Universitas Megarezky. The broader Teaching Practice Program ran from 9 October to 8 December 2025, while the focused mini waste bank management education activity was conducted for three days, from 2 to 4 December 2025. The school setting was selected because the preliminary activity record identified limited waste sorting and limited student understanding of appropriate waste management as practical concerns. Educational activities took place within the existing school environment so that explanations and demonstrations could be connected directly with the waste practices students encountered in their daily routines.

Participants

The documented participant groups consisted of Grade 1, Grade 2, and Grade 3 students at UPT SPF SD Inpres Bangkala III, together with school teachers and university Teaching Practice students who supported implementation. The lower grades were intentionally targeted because the program sought to introduce environmental understanding and responsible waste practices from an early stage of schooling. Participation therefore followed a criterion-based educational focus on the lower-grade classrooms rather than a probability-sampling procedure. The available study record identifies the participant groups but does not state an exact numerical total for students, teachers, or facilitators; accordingly, no sample size is invented in this report. The unit of interpretation is the implementation of the school-based activity and the patterns recorded across participating groups, not an estimate intended to represent a statistically defined population.

Research Instruments

Data were gathered using the qualitative tools documented in the study record: direct observation of the school environment and educational activity, interviews used during initial data collection, and activity documentation. Observation focused on visible waste-management conditions, students' participation during presentation and discussion, responses to explanations of organic and inorganic waste, and engagement with the mini waste bank activity. Interviews were used to identify contextual problems and implementation conditions, including limited prior understanding and school-level support. Documentation captured the sequence and context of the

activity and supported the descriptive reconstruction of implementation. Because these instruments were used to document processes rather than to produce a psychometric score, the study does not treat environmental concern as a latent scale variable.

Instrument Credibility and Trustworthiness

The source manuscript does not report a formal content-validity index, expert-judgment coefficient, pilot test, Cronbach's alpha, Rasch analysis, or inter-rater reliability statistic, and none of these values is manufactured in the present revision. Psychometric reliability coefficients are not directly applicable to the non-scale observation and interview records used in this study. Instead, credibility is supported by the use of more than one evidence source, explicit alignment between each PAR stage and the corresponding activity record, and conservative interpretation of changes as observed or reported rather than statistically proven. Thematic organization provides a transparent way to identify recurring patterns in qualitative evidence (Byrne, 2022), while practitioner-led inquiry benefits from explicit alignment between evidence and instructional reflection (Hennessy et al., 2021). This reporting choice also makes clear which conclusions are supported by the existing evidence and which forms of validity evidence would require additional primary data.

Data Collection Procedure

Data collection followed the five stages documented in the original PAR procedure. First, problem identification was conducted through a school visit and direct observation of waste-related conditions. Second, observations and interviews were used to summarize the main concerns, particularly limited waste sorting and limited understanding of appropriate waste management. Third, the planning stage translated these concerns into an educational strategy centered on environmental cleanliness, environmental concern, and the sorting and management of organic and inorganic waste. Fourth, the action stage delivered presentation-based education and interactive discussion, supported by a projector and mini waste bank, so that students could connect explanations with practical waste-management examples. Fifth, evaluation/reflection reviewed the implementation against the intended educational outcomes and recorded supporting and inhibiting conditions. Figure 1 visualizes this source-grounded sequence, while Table 1 aligns each stage with its main activity and evidence source.

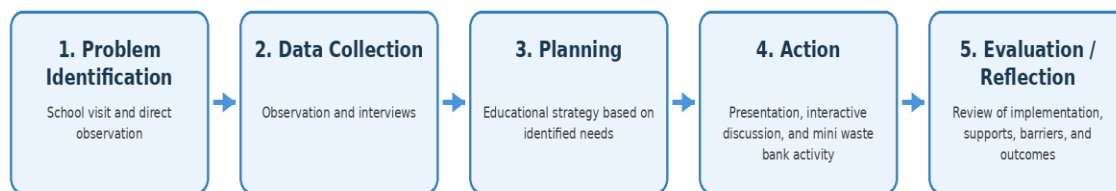


Figure 1. PAR-Based Mini Waste Bank Education Procedure

Figure 1 presents the five-stage PAR sequence documented in the study. The flowchart is intentionally shown as a source-grounded implementation sequence rather than as multiple experimental cycles because the original record reports problem identification, data collection, planning, action, and evaluation/reflection without documenting repeated quantitative intervention cycles.

Table 1. Alignment of PAR Stages, Educational Activities, and Evidence Sources

PAR stage	Source-grounded activity	Primary evidence source
Problem identification	School visit and direct observation of waste-related conditions	Observation

PAR stage	Source-grounded activity	Primary evidence source
Data collection	Observation and interviews to identify limited sorting and limited waste-management understanding	Observation and interview notes
Planning	Preparation of educational steps focused on cleanliness, environmental concern, and waste sorting	Planning/activity record
Action	Presentation, interactive discussion, explanation of organic/inorganic waste, and mini waste bank activity	Activity observation and documentation
Evaluation / reflection	Review of implementation, perceived outcomes, supporting factors, and barriers	Evaluation/reflection record

Table 1 clarifies the relationship between the five PAR stages and the evidence available for interpreting the activity. The mapping also prevents later sections from attributing measurements or repeated cycles that were not documented in the original study record.

Data Analysis

The available qualitative evidence was analyzed descriptively to preserve the level of detail supported by the study record. Observation-derived and interview-derived information was organized into five analytic dimensions: initial waste-management condition, educational response, student participation and environmental concern, supporting conditions, and implementation barriers. The analysis then compared the documented situation before the focused educational activity with the responses described during and after implementation, without converting qualitative statements into invented numerical scores. Thematic grouping was used as an organizing procedure rather than as a claim that a full independent coding study had been conducted, following the logic of transparent pattern identification in qualitative analysis (Byrne, 2022). Findings were therefore presented as descriptive patterns and contextual interpretations, and no inferential statistical software or significance criterion was used because the original study did not generate quantitative outcome data.

RESULTS AND DISCUSSION

Results

The broader Teaching Practice Program at UPT SPF SD Inpres Bangkala III took place from 9 October to 8 December 2025, while the focused mini waste bank management education was implemented from 2 to 4 December 2025. The activity involved university Teaching Practice students, school teachers, and students in Grades 1-3. Education was delivered through presentation and interactive discussion so that students could ask questions and relate the material to situations in their school environment. The learning content covered the meaning of waste, common waste categories, the importance of sorting, the benefits of appropriate management, and possible consequences of leaving waste unmanaged. The projector and mini waste bank were used as supporting resources to make the explanation more concrete and to connect the discussion with practical handling of waste. Together, these components formed the core implementation of the environmental education activity recorded in the study.

Initial observations identified limited routine waste sorting and limited understanding of appropriate waste management among the target students. The activity record also described inappropriate disposal habits as a concern because unmanaged waste could reduce cleanliness and environmental comfort at school. During the education sessions, students received repeated

explanations about the distinction between organic and inorganic waste and why separation should occur before further management. The reported outcome was a clearer student understanding of waste categories and of the importance of sorting and managing waste appropriately. The record further indicates that students became more aware that discarded materials are not always valueless and may have further use when handled correctly. These changes are reported as descriptive educational responses because the study did not administer a standardized before-and-after knowledge test.

Environmental concern was also reflected in the active participation observed during the learning activity. Students engaged with the presentation and interactive discussion rather than receiving information only through one-way explanation. The practical emphasis encouraged them to connect environmental cleanliness with their own responsibility for handling waste in the school environment. The mini waste bank served as a concrete reference through which sorting, collection, and the possible value of recyclable materials could be discussed. The activity therefore moved the concept of caring for the environment from a general message toward an observable school-based practice. Because long-term follow-up was not part of the available record, this result is interpreted as an immediate response to the educational activity rather than evidence of permanent behavioral change.

Three supporting conditions were consistently identified in the implementation record: active student participation, the availability of relevant facilities, and support from the school. The available facilities included a projector for presenting the educational material and a mini waste bank that provided a physical focus for the activity. School support helped the program take place within the existing Teaching Practice context and enabled the environmental message to be delivered in a familiar setting. Two main barriers were also documented, namely students' limited initial understanding of waste management and established disposal habits that were difficult to change within a short period. These barriers explain why an educational activity can generate positive immediate responses without guaranteeing that all new practices will become stable routines. The implementation evidence therefore points to both the feasibility of the activity and the need for reinforcement beyond the three-day intervention.

Table 2. Descriptive Evidence of Mini Waste Bank Education Outcomes

Dimension	Documented evidence	Interpretation boundary
Initial condition	Limited sorting and limited waste-management understanding	Descriptive baseline; no standardized score
Knowledge / understanding	Reported clearer understanding of categories, sorting, and management	Observed/reported response; no pre-post effect size
Environmental concern / participation	Active participation and attention to cleanliness and responsible waste handling	Immediate response; not evidence of permanent habit change
Supporting conditions	Student participation, projector, mini waste bank, and school support	Implementation enablers
Barriers	Limited initial understanding and established disposal habits	Constraints requiring continued reinforcement

Table 2 synthesizes the findings according to the dimensions that were explicitly documented during the school activity. The table avoids numerical categories because the original data did not include standardized scores, frequencies, or percentage changes. Instead, it distinguishes the initial condition, the response observed or reported during implementation, and the appropriate

interpretation boundary for each dimension. This structure makes visible the strongest evidence for increased understanding, active participation, and environmental concern while keeping the claims proportional to the data. It also shows that facilities and school support functioned as enabling conditions whereas limited prior understanding and established habits remained constraints. Accordingly, the results provide an implementation profile of the mini waste bank education rather than a statistical test of intervention effectiveness.

Discussion

The first important finding is that students were reported to understand waste categories and appropriate management more clearly after participating in the educational activity, although the study did not quantify the magnitude of that change. This pattern is theoretically consistent with the view that environmental learning becomes more accessible when knowledge is connected with concrete actions and recognizable objects rather than delivered as abstract information. Meta-analytic evidence shows that environmental education can improve children's environmental outcomes, but behavioral effects vary according to intervention design and the extent to which learners can act on what they learn (van de Wetering et al., 2022; Świątkowski et al., 2024). The present finding also parallels school-based research showing that knowledge, attitudes, and practices around waste develop as related but distinct stages, meaning that improved understanding should not automatically be interpreted as stable behavior change (Salazar et al., 2022). Likewise, Kurokawa et al. (2023) found that environmental education became more behaviorally salient when instructional content was accompanied by practical cues that supported action. The contribution of the current study is therefore not evidence that three days of instruction permanently changed behavior, but evidence that a concrete waste-management activity can create an immediate bridge between environmental concepts and students' interpretation of everyday school practices. This distinction strengthens the educational meaning of the result while preventing the descriptive evidence from being overstated.

The second finding concerns the pedagogical role of the mini waste bank itself, which functioned as a concrete reference point for translating environmental concern into an actionable sequence of sorting and management. Action-oriented perspectives on sustainability education argue that students develop stronger competence when they have opportunities to apply environmental knowledge in meaningful situations rather than merely repeat prescribed answers (Sass et al., 2024). The mini waste bank supports this mechanism because it makes waste categories, placement decisions, and potential material value visible within the environment where the problem occurs. This interpretation is consistent with evidence that waste and recycling behavior in educational institutions is shaped jointly by user understanding and the infrastructure made available for action (Sağlam & Aydın, 2024). It also resonates with research showing that repeated or socially reinforced recycling practices can extend beyond individual knowledge and influence broader behavioral patterns (Deng et al., 2022). At an institutional level, Holst (2023) argues that sustainability education gains coherence when learning and organizational practice reinforce one another, and a mini waste bank offers a modest version of that alignment within a school. The practical implication is that low-resource environmental education can be strengthened when schools provide a visible structure through which students can enact the environmental responsibility being discussed.

A third finding is the active student participation recorded during presentation, interactive discussion, and the practical waste-management activity. Participation matters because

environmental concern is more likely to become personally meaningful when students are treated as contributors to a shared problem rather than as passive recipients of rules. Research on student participation links ownership and collective efficacy with stronger engagement in sustainability learning, while whole-school studies show that participation is related to students' perceived capacity to act (Korfiatis & Petrou, 2021; Torsdottir, Olsson, et al., 2024; Torsdottir, Sinnes, et al., 2024). The collaborative dimension also aligns with Tayne's (2022) account of sustainability action as a collective process in which students learn to see environmental issues as socially shared responsibilities. Recent primary-school work using co-constructed and student-voice pedagogies similarly demonstrates that children can generate meaningful environmental interpretations when instructional spaces allow them to respond, question, and participate (Banks & Taylor, 2025; Salvi et al., 2025). In the present study, the interactive format did not amount to full student co-design of the intervention, but it moved the learning process beyond one-way transmission and created space for practical engagement. This nuance extends participatory environmental education to a simpler early-grade format that may be feasible in schools where more elaborate participatory programs are difficult to sustain.

The fourth finding is that implementation depended not only on student response but also on contextual support and barriers within the school environment. Active participation, a projector, a mini waste bank, and school support helped the activity proceed, whereas limited initial understanding and established habits constrained the speed with which new practices could be normalized. This pattern supports research showing that the movement from environmental concern to behavior is mediated by situational enablers and barriers, even when learners already express positive environmental attitudes (Huoponen, 2024). Family and social-context studies also show that environmental behavior is relational, with children both influencing and being influenced by the expectations and practices of people around them (Jaime et al., 2023; Jia & Yu, 2021). The role of the school is therefore not simply to provide information, but to create consistent social and physical conditions in which responsible waste practices are easy to repeat and visibly supported. This argument is compatible with whole-institution approaches that emphasize alignment among curriculum, infrastructure, routines, and organizational commitment (Holst, 2023). For UPT SPF SD Inpres Bangkala III, the implication is that the short educational activity is best understood as an initiating intervention whose value will depend on continued reinforcement through classroom and school routines.

The early-grade focus provides a fifth contribution because much environmental behavior research combines broad age ranges or concentrates on older students, even though childhood is a formative period for environmental learning. Systematic reviews of early childhood environmental education identify clear educational potential but also note uneven evidence regarding how specific pedagogies produce lasting behavioral outcomes (Ardoin & Bowers, 2020; Güler Yıldız et al., 2021). Broader reviews of children's sustainable behavior likewise call for closer attention to development, context, and the mechanisms that connect learning with everyday action (Hosany et al., 2022; Liu & Green, 2024). The present activity is consistent with evidence that young children can understand environmental norms and respond to concrete pro-environmental expectations when those expectations are embedded in meaningful social situations (Hu & Wu, 2022). It also complements place-based and stewardship research showing that relationships with the environment develop through situated experience rather than through decontextualized knowledge alone (Harris, 2021;

Ruck & Mannion, 2021). What this study adds is a narrowly focused example of how environmental concern can be cultivated through ordinary waste practices among Grade 1-3 students in an Indonesian elementary-school context. This micro-level perspective is modest in scale but conceptually useful because it shows how sustainability education can begin with recurring material practices that are developmentally accessible to young learners.

Viewed critically within the global literature, the study contributes most strongly as an implementation account rather than as an efficacy trial. Large-scale and quantitatively evaluated programs have demonstrated that school environmental education can influence pro-environmental behavior and sometimes extend effects to households, but such designs answer different questions from those addressed here (Jaime et al., 2023; Salazar et al., 2024). Participatory and action-research scholarship shows the value of context-sensitive reflection, yet it also indicates that sustainability learning depends on sustained opportunities for participation and institutional follow-through (Inwood, 2022; Matsekoleng & Awshar, 2022). Newer primary-school studies using critical reading and collaborative dialogue further demonstrate that environmental learning can be deepened when students are invited to interpret complexity rather than only perform correct behavior (Muela-Bermejo & Pérez-Martínez, 2025; Reffhaug et al., 2024). The present study extends this landscape by showing how a simple mini waste bank can function as a locally grounded entry point to environmental concern, while its three-day duration, single-school context, unreported participant count, and absence of standardized pre-post measurement limit claims about magnitude, durability, and generalizability. Future research should therefore combine the implementation strengths of PAR with clearly reported participant numbers, validated age-appropriate measures, repeated observations, and longer follow-up to test whether immediate responses develop into stable environmental habits. The conceptual novelty lies in positioning the mini waste bank not primarily as an economic mechanism, but as a participatory pedagogical device that connects environmental understanding, material practice, and early-grade responsibility within the everyday life of a school.

Implications

The findings suggest that elementary schools can use a mini waste bank as a low-resource pedagogical device for connecting environmental concepts with visible school routines. Teachers can integrate short sorting demonstrations, discussion of waste value, and repeated reminders into classroom or school cleanliness activities rather than treating waste education as a one-off message. School leaders can strengthen implementation by maintaining clear sorting facilities, assigning responsibility for routine use, and ensuring that teachers reinforce the same expectations across learning spaces. Because student participation was a supporting factor, future implementation should provide age-appropriate opportunities for children to handle, classify, and discuss waste under supervision. The program is particularly relevant for early-grade settings in which concrete activity can make environmental responsibility easier to understand than abstract sustainability terminology.

Limitations

Several limitations should guide interpretation of the findings. The study was conducted in a single elementary school and the focused educational activity lasted only three days, so the evidence cannot establish long-term behavioral sustainability or generalizability across schools. The available source record identifies Grade 1-3 students, teachers, and Teaching Practice students as participants but does not report exact participant numbers, which prevents more detailed sample description. The original study also did not use a standardized pre-test/post-test, validated environmental-

concern scale, quantitative observation frequency, or comparison group; consequently, statements about improvement remain descriptive rather than causal. Formal psychometric reliability statistics are not applicable to the available qualitative records, and the source manuscript does not provide a documented expert-validation coefficient. In addition, long-term follow-up and family-level spillover were not measured, even though previous research suggests that these pathways may be relevant to children's environmental behavior.

Future Research

Future studies should retain the practical strengths of the mini waste bank while using a longer longitudinal design that follows students after the initial education period. Researchers should report exact participant characteristics and can combine structured observation with age-appropriate knowledge and environmental-responsibility measures to examine change more rigorously. Repeated observations would make it possible to distinguish short-term enthusiasm from stable waste-sorting habits, while teacher and parent data could clarify whether school practices transfer into the home. Comparative research across several elementary schools would also help identify which infrastructure and implementation conditions are necessary for the program to work consistently. Finally, participatory designs could give students a larger role in developing labels, routines, monitoring strategies, or recycling ideas so that future studies examine not only compliance with waste rules but also emerging environmental agency.

CONCLUSION

This study shows that mini waste bank management education can provide a concrete and contextually relevant way to introduce environmental concern to Grade 1-3 students at UPT SPF SD Inpres Bangkala III. Through presentation, interactive discussion, explanation of waste categories, and practical engagement with waste management, the activity connected environmental knowledge with responsibilities that students encounter in daily school life. The reported responses included improved understanding of waste sorting and management, active participation, and stronger attention to school cleanliness, while school support and available facilities helped implementation. At the same time, limited prior understanding and established disposal habits remained important barriers, indicating that a short intervention should be reinforced through continued routines.

The study contributes an implementation-focused perspective by treating the mini waste bank primarily as an educational device rather than only as a recycling or economic mechanism. Its findings support the value of action-oriented and participatory environmental learning but do not demonstrate a statistically causal effect because the original study did not include standardized before-and-after measurement. The strongest practical lesson is that environmental responsibility can be introduced through simple, visible, and repeatable practices that are accessible to young learners and feasible for schools with limited resources. Further research with clearer participant reporting, validated measures, repeated observation, and longer follow-up is needed to determine whether the immediate educational responses documented here develop into durable pro-environmental habits.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed substantially to the conception and implementation of this study. Mawar Padatu, Eka Dayanti, Ismu Ningrat, Isnaeni, Kostantina Ohoiwutun, and Satriani participated

in the preparation and implementation of the mini waste bank education activities, data collection, classroom observation, documentation, and interpretation of the findings. All authors contributed to the development of the research methodology, discussion of the results, and preparation of the manuscript. The authors jointly reviewed, revised, and approved the final version of the manuscript and agreed to be accountable for the accuracy and integrity of the work.

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