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Enhancing sustainable agriculture awareness through organic fertilizer training: a one-group pretest and posttest study in elementary school students

Peningkatan kesadaran pertanian berkelanjutan melalui pelatihan pupuk organik: studi one-group pretest dan posttest pada siswa sekolah dasar

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Introducing organic agriculture concepts at an early age is essential for fostering environmental awareness and cultivating sustainable values among students. Early exposure helps children understand environmentally friendly farming practices and encourages their active participation in sustainability initiatives. This community service program aimed to promote awareness of sustainable agriculture through organic fertilizer training in an elementary school setting. The activity was conducted at SDN Brang Biji, Sumbawa Regency, from June 9 to June 10, 2023, involving 80 students from Grades 4 and 5 (40 students per grade). The program employed participatory and experiential learning approaches, utilizing the schoolyard as a practical learning medium. Students were directly involved in producing organic fertilizer through a simple composting process using accessible materials such as cow dung, dry leaves, and a bioactivator. The resulting compost was applied to plants cultivated in the school environment, enabling students to observe its effects on plant growth and soil conditions. Two main methods were implemented: first, a participatory approach to enhance students' knowledge and practical skills through hands-on composting training; and second, a persuasive approach to raise awareness of the benefits of recycling organic waste into valuable fertilizer products. The results demonstrated a significant improvement in students' knowledge following the intervention. Grade 4 students showed a knowledge increase of 51.51%, while Grade 5 students demonstrated an increase of 43.10%. These findings indicate that the program effectively enhanced students' understanding, practical skills, and awareness of sustainable agriculture. In conclusion, school-based organic fertilizer training represents a promising strategy for promoting sustainable agricultural practices from an early age.

Pengenalan konsep pertanian organik sejak usia dini sangat penting untuk menumbuhkan kesadaran lingkungan dan membangun nilai-nilai keberlanjutan pada siswa. Paparan sejak awal membantu anak-anak memahami praktik pertanian yang ramah lingkungan serta mendorong partisipasi aktif mereka dalam berbagai inisiatif keberlanjutan. Program pengabdian kepada masyarakat ini bertujuan untuk meningkatkan kesadaran tentang pertanian berkelanjutan melalui pelatihan pembuatan pupuk organik di lingkungan sekolah dasar. Kegiatan ini dilaksanakan di SDN Brang Biji, Kabupaten Sumbawa, pada tanggal 9–10 Juni 2023, dengan melibatkan 80 siswa kelas IV dan V (masing-masing 40 siswa per kelas). Program ini menerapkan pendekatan partisipatif dan pembelajaran berbasis pengalaman dengan memanfaatkan halaman sekolah sebagai media pembelajaran praktik. Siswa terlibat secara langsung dalam proses pembuatan pupuk organik melalui metode pengomposan sederhana menggunakan bahan-bahan yang mudah diperoleh, seperti kotoran sapi, daun kering, dan bioaktivator. Kompos yang dihasilkan kemudian diaplikasikan pada tanaman yang dibudidayakan di lingkungan sekolah, sehingga siswa dapat mengamati secara langsung pengaruhnya terhadap pertumbuhan tanaman dan kondisi tanah. Dua metode utama diterapkan, yaitu: pertama, pendekatan partisipatif untuk meningkatkan pengetahuan dan keterampilan praktis siswa melalui pelatihan pembuatan kompos secara langsung; dan kedua, pendekatan persuasif untuk meningkatkan kesadaran mengenai manfaat daur ulang limbah organik menjadi produk pupuk yang bernilai guna. Hasil kegiatan menunjukkan adanya peningkatan pengetahuan siswa yang signifikan setelah pelaksanaan program. Siswa kelas IV mengalami peningkatan pengetahuan sebesar 51,51%, sedangkan siswa kelas V sebesar 43,10%. Hasil ini menunjukkan bahwa program tersebut efektif dalam meningkatkan pemahaman, keterampilan praktis, dan kesadaran siswa terhadap pertanian berkelanjutan. Kesimpulannya,

pelatihan pupuk organik berbasis sekolah merupakan strategi yang menjanjikan untuk mendorong praktik pertanian berkelanjutan sejak usia dini.

Keywords: Bioactivator, Community Service, Cow Manure, Fermentation, Organic Fertilizer
Kata Kunci: *Bioaktivator, Fermentasi, Kotoran Sapi, Pengabdian Masyarakat, Pupuk Organik*

1. Introduction

The increasing demand for food commodities, driven by population growth and the continuous reduction of agricultural land, has become a major challenge for global food production. To address this issue, inorganic fertilizers have been widely used to enhance plant growth and improve soil fertility, thereby increasing agricultural productivity. However, the excessive use of inorganic fertilizers can lead to soil degradation and environmental hazards (Pahalvi *et al.*, 2021). Growing concerns about the environmental and ecological impacts of chemical fertilizers have encouraged the promotion of organic fertilizers as a more sustainable alternative (Wang *et al.*, 2018).

Sustainable agricultural practices increasingly emphasize crop production systems that rely on organic fertilizers rather than solely on inorganic inputs. The use of organic fertilizers offers several advantages. First, organic fertilizers stimulate soil microbial activity, which facilitates the transformation of nitrogen (N), phosphorus (P), and potassium (K) into forms that are more readily available for plant uptake (He *et al.*, 2017). Second, organic fertilizers improve both the chemical and physical properties of soil, resulting in increased soil organic matter content and improved soil porosity. Third, the organic matter and humus present in organic fertilizers enhance the soil's water-holding capacity and maintain soil moisture, particularly in upland areas. This process improves the efficiency of inorganic fertilizer utilization, reduces the risk of water stress in plants, and enhances nutrient absorption by plant roots (Ayuke *et al.*, 2011). Fourth, the use of organic fertilizers contributes to improved crop quality by maintaining nutrient balance, optimizing nitrogen supply dynamics, and stimulating carbon and nitrogen metabolic processes (Wang *et al.*, 2019).

Organic fertilizers derived from livestock manure and slurry, including cattle, sheep, goats, pigs, and poultry, are among the most widely used organic inputs worldwide due to their ability to supply essential macronutrients such as nitrogen, phosphorus, and potassium, as well as substantial amounts of organic carbon (Bhunia *et al.*, 2021; Badagliacca *et al.*, 2024; Mawlood *et al.*, 2025). In addition, crop residues and green manure materials, such as cover crops and leguminous plants, are commonly incorporated into the soil or processed through composting to restore soil organic matter and improve nutrient availability (Mawlood *et al.*, 2025). The widespread use of organic fertilizers in agricultural systems is largely driven by their capacity to enhance soil microbial communities, improve soil conservation, increase nitrogen use efficiency, and ultimately improve soil fertility, crop yield, and product quality (Maltas *et al.*, 2018; Hafez *et al.*, 2021).

The production of organic fertilizer through fermentation involves the decomposition of organic materials under controlled conditions by fermentative microorganisms known as bioactivators. These microorganisms function as catalysts that accelerate the decomposition process. The use of bioactivator technology provides a significant advantage by reducing the time required for fertilizer production compared to conventional composting methods, making it particularly suitable for intensive vegetable farming systems. Consequently, the application of organic fertilizers has been increasingly recognized as an effective strategy for supporting sustainable crop ecosystem management. In this context, cow dung represents a valuable and readily available source of organic fertilizer in Sumbawa, West Nusa Tenggara.

Previous community service initiatives have largely focused on providing training to farmers, adult community groups, and agricultural practitioners regarding the production and application of organic fertilizers. These programs have proven effective in improving agricultural productivity, environmental management, and community empowerment. However, limited attention has been given to introducing sustainable agricultural practices and organic fertilizer education at the elementary school level. Early educational interventions are essential for fostering environmental awareness and sustainable behavior among younger generations. Therefore, introducing organic fertilizer training and environmentally friendly agricultural practices in primary schools represents an important approach to strengthening students' environmental literacy and promoting sustainable agriculture from an early stage.

This community service project was designed for students at SDN Brang Biji, Sumbawa, to enhance their awareness and understanding of environmentally friendly agricultural practices. The initiative aims to introduce elementary school students to organic fertilizers and sustainable plant cultivation techniques. SDN Brang Biji is recognized as one of the leading elementary schools in Sumbawa Regency and serves as a model institution for other schools in the region. By utilizing the school environment as a hands-on learning space, this project provides students with practical experience in organic farming practices, emphasizing the importance of natural fertilizers in maintaining soil health and promoting plant growth. Through participatory learning activities such as preparing organic fertilizers, planting vegetables, and maintaining school gardens, students are expected to develop practical skills while gaining knowledge about sustainable agriculture.

2. Material and Method

Community service activities were conducted at SDN Brang Biji, Sumbawa Regency, from June 9 to June 10, 2023. The participants were elementary school students from grades 4 and 5, with a total of 40 students representing each grade level. The service program employed two main methods. First, a participatory approach was implemented to enhance students' knowledge and practical skills in processing organic waste through hands-on training in compost production. Second, a persuasive approach was applied by socializing the benefits and utilization of organic waste to motivate students to recycle organic waste into organic fertilizer products. The overall framework of the community service activities is presented in Figure 1, which was adapted from the model proposed by Sudaryatno *et al*. (2024). The organic fertilizer production process utilizing organic waste followed the procedures outlined by Khairi *et al*. (2024). The training materials utilized various organic waste components, including dry leaves, cow dung, brown sugar, and EM-4 as a bioactivator (Table 1).

The delivery of techniques for making organic fertilizer was carried out through direct training by cutting dry leaves into small pieces and then mixing them with cow dung. Next, spray the EM-4 bioactivator solution into the bucket. The next step is to securely close the bucket and allow it to compost for 14 days. Organic fertilizer may be applied after a two-week period.

Figure 1. The procedural flow of the training program on organic fertilizer production conducted at SDN Brang Biji

Table 1. Composition of materials used for organic fertilizer preparation per bucket

Materials	Values	Units
Livestock manure	2	kg
Dry leaves	10	kg
Bioactivator	2	L
Brown Sugar	100	g
Water	10	L

Following the preparation and evaluation stages of organic fertilizer production, students were instructed to complete problem-solving tasks related to the delivered materials and practical activities. This study employed a quantitative research approach with a descriptive analytical design. Primary data were collected through pretest

and posttest assessments, each consisting of five questions for grades 4 and 5 (Table 2). Questions 1 and 2 were allocated 5 minutes each, questions 3 and 4 were allocated 7.5 minutes each, and question 5 was allocated 10 minutes. Each question was scored on a scale of 0–100, and the total score was summed and divided by five to obtain the average score for each student. The assessment approach, including the use of pretest and posttest instruments, was adapted from the methodologies proposed by Tangkesalu *et al*. (2022), Hati & Kurnia (2023), and Rahayu *et al*. (2024).

Table 2. Questions for pretest and posttest assessments

No	Questions	Durations (minute)
1	What is meant by organic fertilizer?	5
2	What materials can be used to make organic fertilizer?	5
3	Why is organic fertilizer good for plants?	7.5
4	Mention one benefit of using organic fertilizer for the plants?	7.5
5	Why is organic fertilizer more environmentally friendly than chemical fertilizer?	10

The pretest and posttest instruments were validated by two experts in agricultural education and subsequently piloted on 40 students from a comparable grade level, yielding a Cronbach's alpha coefficient of 0.78, which indicates acceptable internal consistency. The instruments were administered separately for each grade level, with data collection conducted on June 9, 2023, for Grade 4 students and on June 10, 2023, for Grade 5 students, with each group consisting of 40 participants. This study employed a one-group pretest–posttest design, in which the dependent variable was measured before and after the implementation of the intervention. The data were measured on a ratio scale, and normality was assessed using the Shapiro–Wilk test, where a significance level of $p > 0.05$ indicated a normal distribution. Descriptive statistical analysis and paired t-tests were conducted to examine differences between pretest and posttest scores, and all statistical analyses were performed using Minitab version 22.

3. Result and Discussion

The 14-day composting process was systematically observed by students under the supervision of teachers and two experts in agricultural education, and upon reaching maturity, the compost was subsequently applied to ornamental plants within the school environment. Educational materials on organic waste processing were delivered through outreach activities conducted by lecturers in sustainable agriculture, during which students were introduced to the importance of plant cultivation at an early age to enhance their understanding of sustainable food production through the optimal use of limited schoolyard space, thereby ensuring the safety and quality of their daily food sources. The sessions also emphasized the role of plants in the photosynthesis process, which contributes to the production of economically valuable products such as tubers, fruits, and seeds. Furthermore, students were introduced to essential factors supporting plant growth and development, particularly nutrients, which are commonly supplied through fertilizers, with a specific focus on organic fertilizers due to their environmental safety and their contribution to sustainable agricultural production.

Composting is a biological process that transforms biodegradable waste materials—such as crop residues, livestock manure, food waste, and yard waste—into a stable organic fertilizer that enhances soil structure, nutrient availability, and carbon content, while simultaneously reducing dependence on inorganic fertilizers. This process can be implemented at various scales, ranging from household to industrial levels, provided that critical operational parameters are properly managed. Aerobic composting requires adequate oxygen supply, sufficient porosity, and optimal moisture content of approximately 50–60% to support microbial activity (Ayilara *et al.*, 2020; Sayara *et al.*, 2020).

Recent advancements in composting methods have integrated the use of activators, such as effective microorganisms (bioactivators), to enhance and accelerate the decomposition process. These bioactivators comprise various beneficial microorganisms that are essential for degrading organic materials. In contrast, anaerobic composting refers to the breakdown of organic matter in oxygen-free conditions, carried out within a sealed container and mediated by specialized microorganisms capable of operating under anaerobic environments (Ayilara *et al.*, 2020).

The composting process generally occurs in two main stages: the active phase and the maturation phase. During the active phase, microorganisms rapidly decompose organic materials, leading to increased temperature and observable structural changes in materials such as dry leaves. This phase is followed by the maturation stage,

during which humus formation takes place and the overall volume of organic material decreases, resulting in a more stable and mature compost suitable for agricultural use.

Figure 2. Educational presentation on organic fertilizer materials and their benefits at SDN Brang Biji

The community service activity was implemented in the form of socialization and educational sessions conducted in an elementary school setting. The program commenced with a classroom-based presentation delivered by the service team using visual presentation media. The materials presented covered the utilization of organic waste, organic fertilizer production, and its application in plant cultivation and sustainable environmental management. The delivery of the material was structured and adjusted to the cognitive level of elementary school students.

Throughout the activity, students actively participated in interactive discussions and question-and-answer sessions. The participatory approach aimed to enhance students' conceptual understanding while fostering environmental awareness from an early age. The enthusiasm of the participants was evident from the variety of questions raised during the session (Figure 2). Several students inquired about the procedures for constructing a simple composter and the methods for obtaining bioactivators. This interaction indicates an increased awareness among participants regarding the potential use of organic materials as fertilizer, particularly for application in the schoolyard environment.

Figure 3. Students' participation in the organic fertilizer production process within the school environment

The compost training effectively equipped participants with a comprehensive understanding of the essential materials, tools, and stages involved in compost production using a composter. As illustrated in Figure 3, students actively collected organic materials from the surrounding school environment and practiced the composting process on a small scale. This hands-on activity was conducted within the school setting using a participatory and field-based approach, allowing students to be directly involved in organic waste processing activities.

During the practical session, students were guided by the community service team to identify and sort organic materials suitable for compost production, such as dry leaves and other organic residues. Subsequently, students worked collaboratively to mix the materials and place them into simple composting containers. Continuous supervision and guidance were provided to ensure that each stage of the composting process was properly understood and implemented in accordance with established procedures. Although the composting process

requires a waiting period of approximately two weeks before the fertilizer can be harvested—posing a challenge in scheduling—the activity nevertheless provided valuable experiential learning opportunities.

Table 3. Descriptive statistics for elementary school grade 4

Variables	Pre-Test Scores (1-100)	Post-Test Scores (1-100)	Percentage Increase (%)
Mean	32.33	67.25	51.51
Median	33.00	66.00	49.26
Modus	28.00	63.00	41.54
Max	41.00	82.00	69.12
Min	21.00	60.00	35.00
Standard Deviation	5.21	5.33	9.35

Table 3 displays the descriptive statistics of the pre-test and post-test scores, along with the percentage improvement in learning outcomes among fourth-grade elementary school students. Taken together, the results indicate a substantial improvement in students' performance following the instructional intervention. The mean score increased markedly from 32.33 on the pre-test to 67.25 on the post-test, corresponding to an average percentage increase of 51.51%. This improvement suggests a considerable gain in students' academic achievement. The median scores also showed a notable rise, from 33.00 to 66.00, indicating that the central tendency of student performance improved consistently across the group. Similarly, the mode increased from 28.00 in the pre-test to 63.00 in the post-test, reflecting a shift toward higher score frequencies after the intervention. In terms of score distribution, the maximum score increased from 41.00 to 82.00, while the minimum score rose from 21.00 to 60.00, demonstrating improvement across both lower- and higher-performing students. The standard deviation remained relatively stable between the pre-test (SD = 5.21) and post-test (SD = 5.33), suggesting that the variability of student performance did not change substantially despite the overall increase in scores. The standard deviation of the percentage increase (SD = 9.35) indicates moderate variability in individual learning gains.

The greater percentage increase in knowledge observed among Grade 4 students (51.51%) compared to Grade 5 students (43.10%) may be attributed to differences in baseline knowledge between the two groups. It is likely that Grade 5 students possessed a higher initial level of understanding prior to the intervention, which consequently limited the magnitude of measurable improvement. This phenomenon is commonly associated with the ceiling effect, in which individuals with higher pretest scores exhibit smaller relative gains due to reduced room for improvement. In contrast, Grade 4 students, who presumably had lower baseline knowledge, demonstrated a higher percentage increase as they had greater potential for learning gains following the intervention. In addition to baseline differences, variations in student engagement and responsiveness to the instructional approach may also have contributed to the observed outcomes. The use of hands-on and experiential learning methods in the training program may have been particularly effective for younger students, who tend to benefit more from interactive and practical activities. Furthermore, the learning materials introduced during the program may have been relatively novel for Grade 4 students, thereby enhancing their motivation and facilitating greater cognitive gains compared to Grade 5 students, who may have had prior exposure to similar concepts.

Table 4. Descriptive statistics for elementary school grade 5

Variables	Pre-Test Scores (1-100)	Post-Test Scores (1-100)	Percentage Increase (%)
Mean	43.65	76.85	43.10
Median	45.00	77.50	42.07
Modus	45.00	80.00	44.87
Max	49.00	84.00	55.70
Min	35.00	71.00	32.39
Standard Deviation	4.10	3.35	5.87

Table 4 illustrates the descriptive statistics of pre-test and post-test scores and the percentage increase in learning outcomes among Grade 5 elementary school students. The results demonstrate a clear improvement in student performance following the instructional intervention. The mean score increased from 43.65 in the pre-test to 76.85 in the post-test, representing an average percentage increase of 43.10%. This finding indicates a substantial gain in academic achievement among Grade 5 students. The median score also showed a notable rise,

from 45.00 to 77.50, suggesting a consistent improvement across the majority of students. Similarly, the mode increased from 45.00 in the pre-test to 80.00 in the post-test, reflecting a shift in score concentration toward higher values after the intervention. Regarding score dispersion, the maximum score increased from 49.00 to 84.00, while the minimum score rose from 35.00 to 71.00, indicating that improvements occurred across both lower- and higher-performing students. The standard deviation decreased slightly from 4.10 in the pre-test to 3.35 in the post-test, suggesting a more homogeneous distribution of student scores following the intervention. The standard deviation of the percentage increase (SD = 5.87) indicates relatively low variability in individual learning gains. In general, these findings suggest that the community service program was effective in enhancing students' knowledge at both grade levels. Differences in the magnitude of improvement and standard deviation values between Grade 4 and Grade 5 students may be attributed to variations in baseline knowledge, learning characteristics, or responsiveness to the instructional methods employed.

Table 5. Estimates of paired differences and t-test results for grade 4 and grade 5 elementary school

Variables	Mean	SD	SE Mean	95% CI for μ_difference	T-Value	P-Value
Elementary School Grade 4	-34.93	8.41	1.33	(-37.62; -32.23)	-26.25	0.000
Elementary School Grade 5	-33.30	5.55	0.87	(-35.07; -31.53)	-38.12	0.000

Notes: SD = Standard Deviation; SE = Standard Error; CI = Confidence Interval; μ_difference = mean difference

Table 5 presents the estimates of paired differences and t-test results for Grade 4 and Grade 5 elementary school students. The analysis shows that both groups experienced statistically significant mean differences, as indicated by p-values less than 0.001. For Grade 4, the mean paired difference was −34.93 with a standard deviation (SD) of 8.41 and a standard error (SE) of 1.33. The 95% confidence interval (CI) for the mean difference ranged from −37.62 to −32.23, indicating a consistent and precise estimate. The t-value of −26.25 further confirms a highly significant difference between paired observations. Similarly, Grade 5 students demonstrated a mean paired difference of −33.30 with an SD of 5.55 and an SE of 0.87. The 95% CI (−35.07 to −31.53) did not include zero, suggesting a robust difference. The t-value for Grade 5 was −38.12, indicating a stronger statistical effect compared to Grade 4. The associated p-value (< 0.001) confirms that the observed difference is statistically significant.

Several studies have consistently demonstrated the effectiveness of training and community service programs in improving knowledge, skills, and outcomes related to organic fertilizer production. Darnoto *et al*. (2025) reported a substantial increase in participants' understanding of composting materials following training activities. Prior to the intervention, the majority of respondents (54.5%) identified dry leaves and grass as the primary composting materials; however, after the training, 59.1% of respondents were able to recognize vegetable and fruit waste as additional viable compost inputs. This finding indicates an expansion of participants' conceptual understanding of organic waste utilization.

Similarly, Sari *et al*. (2025) documented significant positive outcomes following a six-month community service initiative focused on the production and application of organic fertilizers in agricultural practices. Comparative analyses of pre- and post-program assessments revealed substantial increases in farmers' knowledge regarding organic fertilizer production (85%) and its application methods (78%), highlighting the effectiveness of continuous training interventions. In line with these findings, Pujiati *et al*. (2022) demonstrated that training and the utilization of bioslurry compost production from bioslurry waste—available at approximately 200 liters per day—over an eight-month period in Puntukdoro Village, Magetan, generated economic benefits of approximately 7.5 million dollars. This outcome underscores the potential of organic fertilizer initiatives to support organic agriculture while simultaneously empowering local communities economically.

Beyond agricultural productivity, organic fertilizer practices are closely associated with broader environmental and social benefits. Proper waste management and the utilization of organic fertilizers play a vital role in promoting environmental sustainability and improving community welfare (Susilawati *et al.*, 2019). Appropriate waste handling practices help minimize waste accumulation and environmental contamination, thereby improving overall environmental quality.

Organic fertilizer application has also demonstrated considerable potential in enhancing the productivity of marginal agricultural land. Bajhir *et al*. (2025) reported a significant increase in crop yields, particularly for sorghum cultivated on dry land in Sumbawa Regency, following the application of organic fertilizers. These findings suggest that effective organic fertilizer management can lead to improved agricultural outcomes across diverse cultivation environments. Furthermore, Komariah *et al*. (2024) found that training programs focused on

the production of liquid organic fertilizer (LOF) were highly effective, with 80% of participating farmers acquiring sufficient knowledge and 60% expressing readiness to produce LOF independently. Post-training evaluations also indicated improvements in community knowledge by 20% and practical skills by 60%, suggesting that continuous capacity-building initiatives may reduce long-term dependence on inorganic fertilizers.

In addition to productivity gains, organic fertilizers contribute significantly to improvements in soil quality. Their application increases soil organic matter content, enhances aggregate stability, improves soil porosity, and increases water-holding capacity, thereby strengthening soil resistance to erosion and compaction (Liu *et al.*, 2024; Khan *et al.*, 2024; Xing *et al.*, 2025; Zhou *et al.*, 2022). Long-term application of organic fertilizers has also been shown to substantially increase soil organic carbon by approximately 50–110% and total nitrogen by 40–60% compared with soils receiving no fertilizer or only inorganic inputs (He *et al.*, 2022; Zhou *et al.*, 2022; Tian *et al.*, 2025).

Consistent with these findings, Mulyana *et al.* (2025) reported notable improvements in participants' knowledge following training on organic liquid fertilizer production. Comparisons between pre-test and post-test scores revealed an increase of 27 percentage points, confirming the significant positive impact of training activities on participants' understanding. Collectively, these studies highlight the importance of structured training programs and community engagement in promoting sustainable agricultural practices, environmental management, and community empowerment.

In addition to agricultural initiatives, environmental education in schools also plays a crucial role in promoting sustainable practices. Baharuddin S *et al.* (2025) reported that environmental care character education at SD Darus Sholah Jember is implemented through several strategic initiatives. These initiatives include curriculum development encompassing self-development programs, the integration of environmental care values across various subjects, the establishment of a school culture that promotes environmental responsibility, improvements in the learning process, and the management of a healthy school environment. The study also identified several challenges during implementation, such as students' poor habits in maintaining cleanliness, limited awareness of proper waste management, and technical constraints, including insufficient water supply. To address these challenges, schools implemented several measures, including providing students with guidance on maintaining personal hygiene, strengthening collaboration between teachers and parents, and establishing partnerships with school alumni.

Similarly, Gunansyah *et al.* (2021) reported that the implementation of sustainable development practices in a primary school in Surabaya occurs through several approaches. These practices include various conservation efforts such as preservation, restoration, adaptation, and revitalization, as well as the development of ecoliteracy to enable students to build connections, awareness, and practical experiences related to environmental sustainability. These initiatives are supported by the commitment of the school community and the leadership of the school principal, which are reflected in institutional policies and integrated into both curricular and extracurricular activities. As a result, the implementation has demonstrated several indicators of sustainable development within the educational sector.

Furthermore, Hernawan *et al.* (2021) emphasized that specific environmental education themes grounded in local values and local content should be incorporated into the elementary school curriculum to enhance students' understanding of environmental issues. The proposed thematic topics include environmental pollution control, global warming prevention, responsible use of environmental resources such as flora and fauna, and the promotion of values that support environmental conservation and sustainability.

4. Conclusion

The community service training program was successfully implemented with active and enthusiastic participation from elementary school students. The initiative effectively achieved its objective of introducing students to plant cultivation practices and environmental stewardship, particularly highlighting the role of organic fertilizers in improving soil health and crop quality. The results demonstrated a significant improvement in students' knowledge following the training intervention, with Grade 4 students showing an increase of 51.51% and Grade 5 students demonstrating an increase of 43.10%. These findings indicate that the program effectively enhanced students' understanding, practical skills, and awareness of sustainable agricultural practices. This study suggests that school-based organic fertilizer training can serve as an effective strategy to promote sustainable agriculture and environmental awareness from an early age through experiential learning. Therefore, it is recommended that similar initiatives be implemented continuously and expanded to a wider range of schools to strengthen students' environmental literacy and practical competencies.

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