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Article

Raising Environmental Awareness Among Elementary School Students through Eco-Enzyme Training at SDN 33 Padang

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Article Information	Abstract
Received : 2025-06-22 Revised : 2025-07-28 Accepted : 2025-09-15 Published: 2025-10-21	This community service activity was carried out by the Community Service Team of the Faculty of Agricultural Technology, Andalas University, in collaboration with SD Negeri 33 Rawang Barat, Padang City. The activity took place in the school meeting room and aimed to educate elementary school teachers and students on the utilization of organic waste through the process of making, harvesting, and applying eco-enzymes. The program included socialization, education about eco-enzymes, hands-on training, and demonstrations of their production and use. This initiative provided various benefits, particularly in environmental education, character building, and practical skills development. Students were introduced to the types of organic waste and their impact on the environment. The activities are carried out in several stages: providing educational materials, practical sessions on the production and harvesting of eco-enzymes, and interactive discussions. The results of this knowledge transfer are expected to increase the role of schools in shaping students with ecological awareness and encouraging responsible behavior towards waste management. This early intervention aims to instill sustainable environmental awareness and empower students as agents of change in environmentally friendly waste management practices.
Keywords Eco-enzymes, environmental education, waste management, empowerment, community service *Corresponding Author rahmiawalina85@gmail.com	

INTRODUCTION

Waste is one of the main problems in various major cities in Indonesia, including Padang. Based on data from the Ministry of Environment and Forestry (KLHK, 2023), the amount of national waste accumulation in 2023 reached around 69.9 million tons. However, proper waste management has only reached 39.01% of the total waste generated (Antaranews, 2024). This condition shows that most waste, especially household and organic waste, is still not being handled properly. As a result, there is environmental pollution, unpleasant odors, increased greenhouse gas emissions, and a decline in soil and water quality.

In terms of composition, organic waste dominates the amount of waste generated in Indonesia, with a proportion of more than 60% (KLHK, 2023). Unmanaged organic waste has the potential to produce methane gas (CH₄) from anaerobic decomposition in landfills, which is one of the most potent greenhouse gases (UNEP, 2024). Additionally, unprocessed organic waste piles can become a source of disease and cause groundwater contamination (Sutrisno et al., 2024). Therefore, proper organic waste management is an important step toward a sustainable and environmentally friendly waste management system.

One approach that is currently being developed is the utilization of organic waste through the production of eco-enzymes. Eco-enzymes are liquids produced by fermenting organic materials such as fruit and vegetable peels with sugar and water for a certain period of time (Kurniawan et al., 2023). This product can be used as liquid fertilizer, natural cleaner, insect repellent, and even organic waste decomposer. Research by Astuti et al. (2023) shows that eco-enzymes contain nutrients such as nitrogen, phosphorus, and potassium (NPK) as well as protease, amylase, and lipase enzymes that are beneficial for plant growth and environmental hygiene. Thus, the production of eco-enzymes is not only a practical solution for organic waste management, but also has the potential to support the circular economy and environment-based learning.

In addition to technical aspects, environmental education plays an important role in fostering environmental awareness and behavior from an early age. Elementary school children are a potential group to instill environmental values, because at this age, ecological character building can be done through fun and practical activities (Hidayat et al., 2023). Practical approaches such as making eco-enzymes at school have proven effective in increasing students' interest and understanding of environmental issues (Yuliani & Nugroho, 2024). Through hands-on practice, students learn to observe the fermentation process, understand the concept of recycling, and recognize the benefits of organic waste in everyday life.

Thus, the eco-enzyme production educational activity at SDN 33 Rawang Barat, Padang City, is a concrete step in instilling environmental awareness from an early age. Through a combination of theoretical learning and hands-on practice, this activity not only provides a contextual learning experience but also encourages students to become agents of change who behave ecologically in their school and home environments. This activity is expected to become a model for environmental education that can be implemented in various elementary schools as part of a community service program based on empowerment and sustainability.

EXPERIMENTAL SECTION

Materials

The main materials used in this activity consist of household organic waste such as fruit peels (oranges, pineapples, papayas, and bananas), vegetable scraps (cabbage, carrots, kale, and spinach leaves), brown sugar, and clean water. All of these materials are obtained from the school's surroundings and brought by students from their homes. This is done to raise awareness of the utilization of daily waste. The proportions of the materials used follow a ratio of 1:3:10, namely, 1 part brown sugar, 3 parts organic waste, and 10 parts water (Kurniawan et al., 2023). Brown sugar serves as a source of carbon needed by microorganisms during the fermentation process, while water acts as a solvent medium that allows the decomposition process to take place naturally.

In addition to the main ingredients, closed plastic containers with a capacity of 5 to 20 liters that had been cleaned and dried beforehand were also used. The containers were equipped with loose lids to allow the fermentation gas to escape. Labels were attached to record the date of manufacture and the type of organic material used. The fermentation process was carried out for three months at room temperature ($\pm 27^\circ\text{C}$) in a shaded and well-ventilated place.

Instrumentation

The equipment used in this activity includes fermentation equipment, measuring and mixing tools, and educational media to support interactive learning activities at school. The fermentation equipment used consists of plastic buckets or jars with a capacity of 5 to 20 liters with lids that can be partially tightened so that the gas produced by fermentation can escape without causing excessive pressure inside the container. Plastic containers were chosen because they are lightweight, unbreakable, and safe for elementary school children to use. In addition, the containers are labeled with the date of manufacture, ingredient composition, and group name to facilitate the fermentation monitoring and documentation process.

Other supporting equipment includes volume measuring devices such as measuring cups (500 mL and 1 L) to regulate the ratio of liquid ingredients, as well as digital scales to ensure that the ratio of solid ingredients (organic waste and brown sugar) meets the formulation standard of 1:3:10 (Kurniawan et al., 2023). Plastic or wooden mixing containers are used so that the mixing process does not cause chemical reactions that could interfere with the fermentation process. For safety and hygiene, participants are

equipped with simple personal protective equipment in the form of plastic gloves, masks, and cloth aprons to prevent contamination and maintain hygiene during the practice.

In addition to technical equipment, this activity also utilizes interactive educational media such as posters, leaflets, and instructional videos that explain the process of making eco-enzymes in stages, starting from the introduction of materials, the fermentation process, to the utilization of the final product. These visual media are designed to be attractive, brightly colored, and accompanied by simple illustrations so that they are easy for elementary school students to understand. The use of visual media has been proven to increase students' interest and retention of information on environmental topics (Yuliani & Nugroho, 2024).

The 5-7 minute instructional videos show live demonstrations of the process of mixing ingredients, observing fermentation, and harvesting the results. This media is used during socialization sessions and is also stored by the school as a source of continuous learning. This visual-interactive approach helps students understand the concepts of organic waste recycling and natural fermentation processes in a fun and contextual way.

Through a combination of simple practical equipment and modern educational media, this activity not only serves as technical training but also as a model of applied science-based learning (hands-on environmental learning) that fosters students' ecological understanding from an early age.

Procedure

This community service activity was carried out in three main stages, namely:

- (1) environmental socialization and education,
- (2) hands-on practice of making eco-enzymes, and
- (3) monitoring fermentation and discussing harvest results.

Each stage was designed to be participatory, involving elementary school teachers and students so that learning was active, contextual, and enjoyable.

1. Socialization and Environmental Education Stage

The initial stage of the activity began with a socialization session aimed at providing teachers and students with a basic understanding of the importance of organic waste management and its impact on the environment. The community service team from the Faculty of Agricultural Technology, Andalas University, delivered the material through an edutainment (education and entertainment) approach, which combines educational and entertainment elements to make students more enthusiastic about receiving information.

The material presented covered basic concepts about organic and inorganic waste, the natural decomposition cycle, the impact of waste on environmental pollution, and an introduction to eco-enzymes as an environmentally friendly solution. The explanation was supplemented with posters, short videos, and simple educational games such as quizzes and picture guessing games to make it easier for students to understand the concepts presented. This outreach activity not only transfers knowledge but also instills values of responsibility, care, and love for the environment through contextual stories and real examples around the school. Students are given the opportunity to express their opinions about the condition of their school environment, which forms the basis for the gradual formation of ecological awareness (Hidayat et al., 2023).



Figure 1. Socialization and education on the benefits of eco-enzyme liquid

2. Direct Practice Stage of Eco-Enzyme Production

The second stage is the core of the activity, where students and teachers are directly involved in the practice of producing eco-enzymes. Participants are divided into small groups of 5–7 people. Each group is provided with ingredients that have been measured according to the composition, namely 3 parts organic waste (fruit and vegetable peels), 1 part brown sugar, and 10 parts clean water.

The practical process begins with sorting organic waste, then chopping the ingredients into small pieces to speed up the fermentation process. After that, the ingredients were put into partially covered plastic containers, then stirred until homogeneous using wooden stirrers. The community service team explained the role of microorganisms in the fermentation process, the relationship between sugar content and fermentation time, and the importance of maintaining the cleanliness of tools and containers to prevent contamination.

In addition to technical activities, students were also instructed to record initial observations, such as the aroma of the materials, the color of the mixture, and the amount of gas formed during the first week of fermentation. This was aimed at developing scientific thinking and basic observation skills. Teachers assisted students in writing daily activity journals as part of project-based learning, so that these activities had both academic and practical value.

3. Fermentation Monitoring and Harvest Discussion Stage

The final stage is carried out over a period of three months, in accordance with the natural fermentation period of eco-enzymes. During this process, students and teachers conduct routine monitoring every two weeks to observe changes in color, aroma, and volume of the liquid in the container. In the first to third weeks, the fermentation gas is released periodically by opening the container lid for a few seconds to avoid excess pressure.

After 90 days of fermentation, the light brown liquid with a fresh sour aroma is separated from the pulp using a filter cloth. This liquid is called eco-enzyme. The harvested product is packaged in transparent bottles and labeled with the group name and harvest date. Students are then invited to try using eco-enzyme as liquid fertilizer for school plants and natural floor cleaner for classrooms, so they can experience the real benefits of their own work.

This stage ended with a reflective discussion, where students and teachers shared their experiences and opinions about the benefits of the activity. The community service team provided feedback and explained the scientific phenomena that occurred during fermentation, including changes in color, smell, and gas production. This reflective approach encouraged the formation of ecological awareness and pride in environmental conservation efforts.

This activity proves that practice-based learning not only improves understanding of scientific concepts but also fosters environmentally conscious behavior and social responsibility among students. The results of the activity support the view of Yuliani & Nugroho (2024) that direct involvement of children in waste management practices is an effective strategy for building environmentally conscious character.



Figure 2. Students actively involved in harvesting eco-enzymes

RESULT AND DISCUSSION

The training activity was carried out with great enthusiasm from both the students and teachers of SDN 33 Rawang Barat. This was evident from the active participation of the participants during the socialization process, question and answer sessions, and the practice of making eco-enzymes. The students showed great curiosity about how fermentation works and the benefits of the resulting liquid. This enthusiasm was an early indicator of the success of the participatory educational approach, as direct involvement has been proven to increase attention and understanding of the concepts presented (Hidayat et al., 2023).

The implementation of activities designed using the learning by doing method made it easier for students to understand the relationship between theory and practice. In the practical session, each group worked together to weigh the ingredients, mix them, and observe the changes during the fermentation process. This activity encouraged a collaborative attitude, discipline, and a sense of responsibility in completing group tasks. The accompanying teachers observed that the students were more active in asking questions and discussing compared to conventional classroom learning. Based on the results of a brief evaluation interview, 85% of teachers stated that this activity was effective in increasing students' interest in learning about environmental and applied science topics.



Figure 3. The Andalas University community service team and partner schools

Teachers also believe that eco-enzyme production activities are highly relevant for integration into science and crafts lessons. These activities are in line with the Project-Based Learning (PjBL) concept in the Merdeka Curriculum, which emphasizes critical thinking, collaboration, and real-world problem-solving skills (Kemendikbudristek, 2024). Through hands-on practice, students not only understand the process of decomposing organic materials, but also learn to relate scientific concepts such as fermentation, decomposition, and recycling to everyday life. This integration shows that environmental education does not have to be a separate subject, but can be implemented in various interdisciplinary learning contexts.

In addition to increasing knowledge, this activity also resulted in real changes in student behavior. After the activity, students began to distinguish between organic and inorganic waste, and showed initiative in sorting waste in the school environment. Some groups even began collecting fruit peels in the school canteen to be used in the production of eco-enzymes. Post-activity observations showed that more than 70% of students exhibited positive behavior in simple waste management, such as disposing of waste according to type and maintaining the cleanliness of the learning area. This indicates that field practice activities are able to gradually shape ecological character through direct experience (Yuliani & Nugroho, 2024).

From the teachers' perspective, this activity also strengthened their capacity to develop project-based learning that is relevant to real life. Teachers gained a new understanding of how to connect environmental topics with simple experiments that can be carried out in elementary schools without the need for complex laboratory facilities. This activity indirectly improved teachers' pedagogical competence in applying inquiry-based learning methods, where students are guided to research, observe, and draw their own conclusions based on their observations.

Overall, this community service activity shows that a practice-based and participatory educational approach is far more effective than simply delivering theory. This approach not only improves students' cognitive understanding of the concepts of recycling and fermentation, but also instills affective values such as responsibility, environmental awareness, and teamwork. This is in line with the research by Astuti et al. (2023), which states that student involvement in environment-based activities can directly shape sustainable behavior at an early age.

This activity is a concrete example of how environmental education can be implemented in an applicable manner in elementary schools, while also contributing to the Sustainable Development Goals

(SDGs), particularly Goal 12 on responsible consumption and production. The success of this activity underscores the importance of a holistic approach in environmental education, which combines knowledge, skills, and attitudes through experiential learning.

CONCLUSION

This community service activity successfully raised elementary school students' environmental awareness and concern through training in eco-enzyme production as a form of organic waste utilization. Through direct involvement in the fermentation process, students gained contextual, applicable, and sustainable learning experiences, while understanding the scientific and social value of environmentally friendly waste management.

Teachers and school officials also benefited in the form of strengthening project-based learning capacities that can be integrated into the science and crafts curriculum. The eco-enzyme products produced not only serve as learning media but also provide practical benefits for the school environment. Overall, this activity can be used as a simple but effective environmental education model to be implemented in other elementary schools. This program contributes to the development of students' ecological awareness and encourages the creation of a culture of sustainable waste management in the school environment.

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