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Strengthening Students' Organic Waste Awareness Through Liquid Organic Fertilizer Training at SMA Taman Harapan I

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Abstract: *Mismanagement of organic waste which is generated from school food and canteen activities may lead to the environmental and sanitation issues. The overall goal of this program is to expand students' learning, skills development and environmental the short term through training focusing on organic waste management and production of organic liquid fertilizers. The program has been implemented in SMA Taman Harapan I, Bekasi with Capacity Building approach along with Community Based Participatory Approach. The activities consisted of environmental education, demonstration, practical manufacturing of liquid organic fertilizer from organic materials and EM4 bioactivator, discussions and assessment by questionnaire. Fifty-five evaluation responses were captured. The mean rates of accuracy for the post-activity knowledge assessment were 89.6%. Participants exhibited good knowledge of biodegradability, function of EM4 and composting benefits. Furthermore, all (100%) participants reported some level of agreement that the activity enhanced their awareness about organic waste management and 97.8% expressed interest in processing organic waste into compost. These results suggest that participatory and practice-based environmental education can deepen students' technical knowledge of waste management concepts, as well as their environmental attitudes and dispositions to be engaged citizens in the school community.*

INTRODUCTION

Organic waste constitutes an environmental problem and needs to be resolved not only in homes or at the level of communities but also within educational institutions. Daily consumables including food, canteen activities, leftover drinks, vegetables fruits and other biodegradable matter is the organic waste generated by schools. If this type of waste is discharged improperly, it will generate nuisances in the form of foul odors with important urban pollution problems and be a health hazard. Schools offer in fact the right context for an introduction to waste-management practices, linked up with the educating of young generations on environmental and sustainable development issues. Waste management should not be restricted only to disposal. Reconstituted, organic resources allow for re-utilization and upgrading into more valuable environmental products.

Processing of organic waste is one of the applications of Reduce, Reuse and Recycle (3R): it prevents biodegradable wastes to go into the disposal stream and transforms them

into useful end products (Ihsan et al., 2024). Kustiyah et al. (2023) Demonstrated composters are made with existing materials and have been shown to convert household organic waste into a source of liquid organic fertilizer and thus proved to be environmentally agreeable [46] as well as having the potential for community educational use.

The most common method of using organic waste is the one that transforms them into liquid organic fertilizer. Liquid organic fertilizer is obtained through biological decomposition or fermentation (for example, using fruit waste, vegetable waste, food residues, and so on). The nutrient features of the resulting fertilizer may vary depending on raw materials and fermentation steps (Jati & Yulianti, 2018; Mangera & Ekowati, 2022). By this means, the use of organic refuse as fertilizer can alleviate both waste and be of use to plants. Fermentation is a key fermentation process in liquid organic fertilizer production. Different characteristics of Effective Microorganisms 4 (EM4) and it is commonly used as a bioactivator that accelerate decomposition and fermentation. Nur et al. (2016) showed that EM4 could be used to extract household organic waste into liquid organic fertilizer. Nasution et al also found similar results. (2017) on the fermentation of organic liquid materials. Ramadhan et al. The same team also developed EM4 for the production of a liquid organic fertilizer from fruit waste Ramadhan et al. (2019).

The process of making fertilizer may vary due to the types of supporting materials and fermentation conditions. Adi et al. An example of the application of biostimulants with organic fertilization is shown by Adi et al. Widyabudiningsih et al. (2021) Study on the impact of fermentation times using EM4 to produce liquid organic fertilizer from fruit peel waste. The latest studies still illustrate the capability of EM4 in turning organic waste into liquid fertilizer (Pungut et al., 2025; Widyabudiningsih et al., 2025). But the processing of organic waste preserves more than fertilizer. Waste-management operations can serve as environmental education. Students provide a direct link between the theoretical framework of environmental education in schools and the practical problems related to their daily environment, making them strategic sites around which environmental knowledge and responsible habits can be built.

Cahyono et al. (2023) concluded that there is a significant association between students' environmental knowledge and their attitudes regarding 3R waste management in the schools. School-based composting activities lead to experiential environmental learning as the students are involved in processes rather than just receiving theoretical descriptions (Mpuangnan et al., 2023). Aprilia et al. Training in organic waste composting demonstrated, as with the prior example for this approach for developing sustainable practices in schools (2025). Experiential learning, in which participants learn by doing, may make hands-on environmental activities particularly beneficial. It was shown in the Warjoto and Barus (2021) study regarding a training program about liquid organic fertilizer production as an applied learning to increase students environmental care. Community training by Suparti et al. The study by Suparti et al. (2023) also demonstrated that direct engagement with household organic waste-based liquid organic fertilizer production would support community knowledge and explicit practices of using available local resources.

Participation also takes an important place in environmental programs. Seeking to empower the target community through inclusion of their voice in identifying problems, practising solutions and evaluating activities is more likely to lead to meaningful learning. De Boni et al. In this context, De Boni et al. (2022) highlight the potential of participatory approaches in organic waste management that will support more inclusive and green practices in waste management. A greater environmental awareness is tied to other wider

social values. Attaufiq et al. (2024) also stated that Pancasila-based environmental education contributes to youth ecological awareness. Environmental stewardship may be a product of social responsibility, cooperation, and concern for the collective. Supriyanto et al. Moreover, (2023) illustrated how environmental actions can be linked to religious value and character development. On the basis of these concerns, we designed a program called The Compos Challenge: One Day of Organic Waste Awareness at SMA Taman Harapan I, Bekasi! With education, demonstration, and hands-on production of liquid organic fertilizer the program gave students a gateway to the field of organic waste management. Community service activity was carried out to: (1) enhance participants' comprehension of organic waste management practices; (2)provide practical experience in the production of liquid organic fertilizer utilizing organic material and EM4; and (3)raise environmental awareness and practice sustainable waste-management efforts within the school setting.

IMPLEMENTATION METHOD

The community service is held at SMA Taman Harapan I, which is in Pejuang Jaya, Medan Satria, Bekasi, West Java. The core implementation took place on 21st July 2026. It was a Capacity Building program with Community-Based Participatory Approach (CBPA). Because the activity was designed to improve participants' knowledge, awareness and practical skills related to organic waste management, Capacity Building was identified. The participatory approach was built in not to treat students simply as passive recipients of information. The program was implemented on 44 students consisting of 30 female and 14 male from SMA Taman Harapan I, accompanied by four teachers. The busines process consisted of three key steps; preparatory, implementation and monitor & evalution.

Table 1. Stages of Program Implementation

Stage	Main Activities
Preparation	Initial observation, coordination with the school, development of educational materials, preparation of equipment and materials, and division of team responsibilities
Implementation	Environmental education, demonstration, hands-on liquid organic fertilizer production, discussion, and question-and-answer session
Monitoring and Evaluation	Pre-test and post-test, observation of participant involvement, monitoring of fermentation, and activity documentation

Preparation Stage

In the preparation phase, the implementation team worked closely with different representatives from school. One of the team members identified potential sources of organic waste while others prepared plenty of educational materials about organic waste, environmental impacts, 3R principles, and liquid organic fertilizer preparation process. It is how the team prepare for the preparation of materials and equipment for the practical session. These consisted of organic materials (fruits and vegetables), a bioactivator (EM4), sugar, fermentation vessels, and supporting equipment.

Implementation Stage

The programme consisted of an introductory session explaining what organic waste, where it comes from and adverse environmental impacts from poor waste disposal / sustainable waste management facts. Next, participants learned about liquid organic fertilizer and how it is made. The team explained the functions of organic materials, EM4, supporting materials, fermentation phase, storage and potential use. The training session was then followed by a demonstration and an activity. They were engaged in preparing the organic materials, adding support agents and EM4 to the organic materials, blending the material ingredients and putting it into a container for fermentation. The intent behind this participatory design was to expose students directly while reinforcing the learning display in their educational presentation.

Monitoring and Evaluation Stage

Evaluation was done by conducting pre-test and post-test through Google Forms. A pre-test was conducted before the educational session to assess participants' knowledge and a post-test following the program. Post-test data were analyzed descriptively by number of responses, average, highest and lowest score. Along with knowledge evaluation, qualitative observation was made on the involvement of participants during educational session and practical activity, discussion & question & answer sessions. We only monitored the fertilizer-production process after the implementation-day. Documentation was gathered on the first day and roughly fourteen days post-fermentation onset. The fermentation duration is one of the relevant parts in producing a liquid organic fertilizer (Seen as studies on preparing organic fertilizers with different fermentation periods (Paramita, 2023; Widyabudiningsih et al., 2021)).

RESULTS AND DISCUSSION

Program Implementation

Successfully Implemented The Compos Challenge: One Day of Organic Waste Awareness program at SMA Taman Harapan I, Bekasi The workshop was an integration of environmental education with a practicum on Reprocessing Organic Waste and Producing Liquid Organic Fertilizer. The training involved a lecture, demonstration, hands-on practice with the intervention, group discussion, question-and-answer component and participant evaluation. The implementation record indicates that four teachers oversaw 44 grade 6 students (30 females; 14 males) in the program. On the other hand 45 recorded responses were generated by Google Forms evaluation. Consequently, the participation figures in this section relate to the implementation log and not the 45 responses captured via the evaluation form for questionnaire findings.

This was the most engaging activity for all participants as they were involved hands-on during the demonstration and practical session. Students were directly involved with how to prepare organic elements and use EM4. The practical aspect was meant to change environmental education from mostly a theoretical practice into an experiential practice. The activity was participatory in nature, which aligns with Warjoto and Barus (2021), as they proved that practical training of producing liquid organic fertilizer can support students environmental based learning. Similarly, Kustiyah et al. This highlights that the

activities related to their utilization of organic waste can lead to environmental benefits and enhance community engagement in proper management (2023).

Figure 1. *Implementation of the Compos Challenge Program at SMA Taman Harapan I*

Participants' Initial Knowledge of Organic Waste Management

Designed to assess participants familiarity with organic waste and composting. The findings reveal that, generally, participants started with a fairly high level of basic understanding on organic waste. It was also found that 100% of the respondents were aware of what organic waste is. Similarly, 97.8% indicated knowing examples of organic waste at home or school and levels (fruit peels and food scraps) that would be composted were also identified by 97.8%. Similarly, a high proportion (95.6%) indicated that they knew about the environmental impacts of improperly discarded organic waste materials. On the other hand, participants showed less initial knowledge about some technical aspects of composting. Just 73.3 % stated that they found out that EM4 could supplement the composting process, and seventy-five.6 % cited that they knew fundamental steps to produce compost. This suggests the participants had some general environmental knowledge, and an opportunity to strengthen their technical skills in creating composted materials.

Table 2. Participants' Initial Knowledge of Organic Waste Management

Initial Knowledge Indicator	Participants Who Reported Knowing
Meaning of organic waste	100.0%
Examples of organic waste at home or school	97.8%
Food scraps and fruit peels can be composted	97.8%
Environmental impacts of improper organic waste disposal	95.6%
Benefits of compost for plants	86.7%
Correct separation of organic and inorganic waste	88.9%
School canteen organic waste can be composted	86.7%

EM4 can support the composting process	73.3%
Basic steps of compost production	75.6%
Composting can reduce waste sent to final disposal sites	88.9%

Pre-activity findings show that participants did not enter the program with no understanding of organic waste. In fact, they had a fairly high baseline knowledge to begin with — especially when it came to general environmental concepts. Thus, the main added value of the program wasn´t just sharing organic waste definition but in reinforcing participants technical and practical beliefs on how to process organic waste. This result is in line with Cahyono et al. (2023) emphasized the correlation of environmental knowledge with student attitudes toward 3R waste management. In the present programme, an existing base of environmental knowledge offered a starting point for more focused composting skills.

Post-Activity Knowledge of Composting

After the theoretical and practical exercises, participants filled a survey with questions about organic waste management and composting. Analysis of the results suggests comprehending to a good extent following completing the programme.

Table 3. Post-Activity Knowledge Test Results

Knowledge Question	Correct Responses
Reason organic waste should be properly managed	97.8%
Identification of an example of organic waste	86.7%
Difference between solid and liquid compost	86.7%
First step in compost production	88.9%
Function of EM4 in composting	93.3%
Identification of vermicomposting	73.3%
Understanding of the Bokashi process	88.9%
Benefit of processing organic waste into compost	95.6%
Appropriate action after participating in the activity	88.9%
Reason organic waste should be chopped before composting	95.6%

For example, for the ten knowledge questions, the mean percentage correct was around 89.6%. This finding proves that nearly all participants understood the main ideas conveyed in the activity. Examining questions directed towards the environmental role of organic waste management (97.8%), composting do in terms of benefit gained (95.6%), chopping organic wastes prior to the ability of compost (95.6%) and EM4 function (93.3%) yielded particularly high values. The finding about EM4 is especially interesting because this was an area of weakness in participants pre-test knowledge. Prior to the activity, 73.3%

of participants indicated that they were aware EM4 would act as a composting agent. At the end of the program, 93.3% accurately stated that it sped up decomposition of organic materials. The pre-and post-activity questions were not exactly the same and therefore must not be interpreted as a formal paired comparison, however the results suggest that the educational and practical sessions did reinforce participants understanding of EM4's role.

A parallel is found when dealing with composting methods. At the start, 75.6% of participants said that they knew how to compost. Prior to the activity, only 70.4% had appropriately indicated what step in the compost-production process is first; after the activity this increased to 88.9%. Our results support the benefit of combining explanation and demonstration. These findings are in line with Ramadhan et al. (2019) and Nasution et al. (2017) mentioned that the purposes of fermentation and EM4 in organic fertilizer production process. Technical concepts tending toward abstraction could be translated into observable and understandable processes for students by introducing the concepts indirectly through exercises. For vermicomposting, however, the lowest score of 73.3 % was obtained in the survey responses for this question. This also suggests that there would be some technical terms associated with varying composting methods that still may not be well known to participants. This would enable future programs to have a more-suited comparison of traditional composting vs. Bokashi, vermicomposting and liquid organic fertilizer production.

Environmental Awareness and Participant Perceptions

Apart from knowledge, the questionnaire assessed perceptions regarding organic waste management at post-test. The results were strongly positive. In each case, all respondents said they felt increased concern about the issue of organic waste management as a result of the educational material. In the same way, all respondents agreed or strongly agreed that the type of composting discussed during the activity was practical (agree = 6; agree = 4) enough that it could take place at home or school.

Table 4. Participants' Post-Activity Perceptions

Statement	Main Result
The material increased concern about organic waste management	100% agreed/strongly agreed
Able to distinguish compostable organic waste from non-compostable waste	Very high agreement
Understood the difference between solid and liquid compost	Majority agreed/strongly agreed
Composting method was easy to practice at home or school	100% agreed/strongly agreed
Interested in processing organic waste into compost after the activity	97.8% agreed/strongly agreed
Willing to apply organic waste sorting and processing in daily life	Predominantly positive responses

It is important to note that all respondents felt the method would be easy to apply at home or school as perceived ease of implementation may affect the degree to which knowledge gained during community engagement transcends into everyday practice. Interestingly enough, 97.8% of respondents were interested in composting organic waste

after the activity was completed. It shows that the program was able to spark interest outside of just the training within that instant.

The participants were also environmental-aware. All respondents agreed (or strongly agreed) that knowledge gained by watching the interactive video during the activity made them more concerned about organic waste management. This indicates that the activity did not just fulfill its function of technical training, but also enhanced participants' environmental consciousness. Results are similar to Warjoto and Barus (2021) whose study also found that practical organic fertilizer training were influential in environmental awareness among students. Ihsan et al. Likewise, (2024) emphasized that organic waste can be processed into valuable products, and this is an active way to encourage eco-friendly conduct.

Hands-On Production of Liquid Organic Fertilizer

A key aspect of the program was the hands-on component where participants could see and practice the conversion of organic waste into liquid organic fertilizer. The second activity was the practical and the participants were taught how organic materials were prepared with supportive ingredients and EM4, then kept in storage for fermentation. Students were also given a brief overview of the purpose of fermentation and how the liquid organic fertilizer resulting from this process can potentially be used on plants.

The activity showed that organic waste can be approached as a resource instead of simply material for disposal. Being in line with the 3R philosophy, especially reuse and recycling, organic raw materials that would otherwise turn into waste are transformed into a potentially useful good. Using EM4 during the activity, also allowed them a tangible connection between their learning and the production process. Nasution et al. EM4 as Activity in Organic Fertilizer Fermentation Ramadhan et al. As a result, Ignacio et al. (2019) used it for the preparation of liquid organic fertilizer from fruit waste.

Figure 2. *Liquid Organic Fertilizer Making by Hand*

Following implementation day, we monitored fermentation. The liquid organic fertilizer production continues even after mixing the ingredients since Day 1 and on Day 14 is recorded in program documentation the produced mixture of fertiliser.

Figure 3. Liquid Organic Fertilizer on 1st Day and 14th Day

The rest of the learnings from the follow-up documentation also reinforced that patience, proper storage and monitoring are required during fermentation.

Contribution to Environmental Awareness and Sustainable Behaviour

The findings indicate that the program produced three key educational effects in terms of (1) knowledge reinforcement, (2) practical understanding and (3) environmental intention. The first finding was that they had well-absorbed the main concepts presented throughout the program, coming in at a mean correct-response rate of roughly 89.6% on the post-activity knowledge questions. Second, participants had been exposed directly to liquid organic fertilizer production. This is significant, because environmental education (RE) that includes a technical dimension has greater significance when learners can see how the relevant concepts are implemented in practice. Third, the willingness to add value with organic waste management items other than activity is highly represented in the questionnaire. Except for a few comments about the application of sorting and waste-processing practices in everyday life — most respondents were very positive.

The results confirm the need for participatory environmental education. Simply not enough that we train the people like educating them about the use and care of Environmental issue. Experiences that invite students to partake in solutions to environmental problems might enable a sense of agency where they see their individual and collective contributions as part of managing the environment.

It also becomes a meaningful activity for implementation of Pancasila values, especially mutual cooperation, social responsibility and care to collective welfare. Attaufiq et al. (2024): Environmental education is actually integrated with Pancasila values to teach ecological awareness to the next generation. Related to citizenship, likewise providing students with civic skills and encouraging them to be active in the solutions of environmental issues taking place around their communities address environmental responsibility. On a wider educational front, the program also embodies the principle of environmentally sustainable development as moral obligation. Supriyanto et al. The environmental values were uniquely presented together with religious and character education (Supriyanto et al, 2023). So the program not only offered environmental knowledge, but it also allowed us to reinforce that responsibility toward the environment in which we are inserted.

Program Limitations and Implications

However, irrespective of some preferential outcomes in the results, it must also be stated that this study has a few limitations. First, the initial knowledge at baseline was already relatively high in general organic waste topics. The program providing such a

change can thus not be construed as taking participants from no knowledge of the environment to full knowledge. Instead, it was more about building specialized technical knowledge and hands-on practical experience. Second, the instruments before-activity and after-activity were not composed only from same questions. The pre-activity part predominantly assessed self-reported familiarity via that "knowing/not knowing" responses while the post-activity section comprised of objective MCQs and perception statements. Therefore, they should not claim a direct statistical pre-test–post-test comparison or percentage increase in knowledge from the available data.

Third, the implementation of the principal took one day. Such an option limited the possibilities for students to operate the entire fermentation process independently. This limitation was somewhat alleviated in the Day 14 documentation, but for future programs could see increased involvement of students monitoring and applying the completed fertiliser to plants at school.

Fourth, the program focused on primary outcome measures of knowledge and perception and intention to change behavior immediately after delivery. It did not even assess whether participants actually modified their waste-management practices weeks or months later.

Notwithstanding these limitations, the results indicate that the Compos Challenge offered a suitable eco-education service model integrating environmental education with participatory learning and compost practices both at home and in local community. Future implementation should be identical to the current one, with the addition of using similar pre-test and post-test instruments and extended behavioral follow-up of participants.

CONCLUSION AND IMPLEMENTATION

The SMA Taman Harapan I successfully integrated environmental education with practical training on organic waste management and liquid organic fertilizer preparation by hosting a Compos Challenge: One Day of Organic Waste Awareness program. This activity allowed the participants hands-on experience in using organic waste and EM4, while reinforcing their knowledge on sustainable waste management.

Results for knowledge questions from the evaluation showed an average post-activity percentage of correct-response between 89.6%. Results showed that participants had strong understanding on the organic waste management objectives, role of EM4 in composting benefits and relevant preparation of raw organic materials. Participants also showed positive environmental awareness, with all participants agreeing or strongly agreeing that the activity increased their interest around organic waste management, and 97.8% showing interest in processing organic waste into compost after the activity finished!

These findings suggest that integrating learning materials with participatory and applied practical activities can improve students' technical knowledge, environmental and sustainability awareness, and interest in sustainable waste management. Since the pre-activity and post-activity instruments were not identical this finding should not be interpreted as a direct statistical measure of increased knowledge.

They are recommended to be continued through school environmental programs or gardening activities and/or student organizations. Future programs should also offer longer monitoring periods, involve students in the application of the resulting fertilizer and use standardized paired pre- post-test instruments to measure changes in participants knowledge and behaviour more accurately.

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