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The Effect of Ecoenzyme Manufacturing Practices on Improving Students' Knowledge and Attitudes Towards Organic Waste Management at the Raudlatul Firdaus Islamic Boarding School

Septa Pri Ramaja[1], Selviana[2]
Public Health, Muhammadiyah University of Pontianak, Jl. A. Yani No. 111, Pontianak, Indonesia

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ABSTRACT
Organic waste management is a challenge faced by the community, including in Islamic boarding schools. One innovative solution is the production of ecoenzymes through the fermentation of fruit and vegetable waste, which are useful as organic fertilizers, natural cleaners, and pest control. This study aims to determine the effect of ecoenzyme production practices on improving students' knowledge and attitudes in organic waste management. The research method used a quasi-experimental design with a one-group pretest-posttest design. A total of 30 students from the Raudlatul Firdaus Islamic Boarding School, Sungai Ambawang, were selected through purposive sampling. Data were obtained through questionnaires before and after the ecoenzyme production practice, then analyzed using the Wilcoxon test. The results showed a significant increase in students' knowledge (mean pretest 6.03 to 8.83; $p < 0.05$) and attitudes (mean pretest 33.30 to 45.60; $p < 0.05$) after participating in the practice. This study indicates that the ecoenzyme production practice is effective in increasing students' awareness and skills regarding organic waste management. Ecoenzyme education and training programs can be used as a sustainable strategy to support the cleanliness of Islamic boarding school environments while empowering students.

Corresponding Author:
Selviana
Muhammadiyah University of Pontianak, Jl. A. Yani No. 111, Pontianak, Indonesia
selviana@unmuhpnk.ac.id

INTRODUCTION

Waste is a problem faced by many countries worldwide. Indonesia is one of the developing countries with the largest waste contributors in the world. Waste, or garbage, is the result of human activities in the form of solids, liquids, or gases that are no longer considered useful. Waste production is increasing in line with population growth and human activities (Septiani et al., 2021). Therefore, it is deemed necessary for the public to understand and understand how to manage and utilize waste. Waste management is a crucial issue that must be prioritized by the government, given the significant population growth that has implications for the increasing volume of waste produced (Apriliani et al., 2024).

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One creative method that can be used to process organic waste is to create ecoenzymes. Ecoenzymes are products of organic waste management produced from a combination of vegetable and fruit waste, molasses (brown sugar), and water. The fermentation process lasts for 90 days. The final product of this fermentation is ecoenzymes, which appear as a light to dark brown liquid (Hemalatha & Visantini, 2020). A community service program conducted by Majapahit University, attended by several students, stated that ecoenzymes can reduce the volume of organic waste and offer cost savings for households by replacing more expensive commercial products. In addition, ecoenzymes contribute to reducing the use of hazardous chemicals that have a negative impact on human health and the environment (Istigfaroh et al., 2024). Ecoenzyme fermentation products can also reduce microbial growth because they contain significant levels of microbial activity (Rukmini & Astuti Herawati, 2023). Processing organic waste into ecoenzymes can be used for various purposes, such as organic fertilizer, environmental conservation, and pest control (Manyullei, Fikri, et al., 2024).

Given the numerous benefits of ecoenzyme production, it is crucial to equip students with the knowledge and attitudes necessary to process organic waste into ecoenzymes as a viable solution for kitchen waste. Various activities, such as outreach and training on ecoenzyme production using lectures and practical exercises, have proven effective in enhancing the community's knowledge and skills in processing organic waste into useful products (Alim et al., 2023). According to research by Januariana et al. (2024), knowledge is everything gained through experience, both in learning and seeking information on various subjects. The more information or experience gained, the broader the individual's knowledge perspective. Meanwhile, attitude refers to a person's closed reaction to a stimulus or object (Januariana et al., 2024). Through ecoenzyme production practices and outreach, the community is introduced to environmentally friendly ways to reduce organic waste while utilizing ecoenzyme products for their daily needs (Meilani et al., 2024). Humaira's (2021) report shows that the greater the community's motivation to sort waste, the greater their actions or attitudes in differentiating between organic and non-organic waste. The relationship between motivation and waste sorting behavior is very close. This motivation is formed by various factors such as hygiene, economic factors, knowledge, and belief in existing societal norms (Humaira, 2021).

Islamic boarding schools (pesantren) are social facilities that provide religious and social services. Raudhatul Firdaus Islamic Boarding School is located in Durian Village, Sungai Ambawang District. It has 423 students enrolled in junior high and high school. Kitchen waste remains a significant problem at the school. Organic waste management at the school is generally inadequate. Waste disposal is not separated into inorganic and organic waste. The accumulation of organic waste has become a problem as the number of students increases.

Most organic waste from fruit peels, which originates from the anaerobic decomposition process, if left untreated, will produce an unpleasant odor. Leachate from the waste becomes an environmental pollutant and can become a source of disease (Lolita Endang Susilowati et al., 2021). From various existing studies, it can be concluded that processing organic waste

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into ecoenzymes not only provides benefits for the environment but also for the economy. For example, ecoenzymes can be used as organic fertilizers that can increase agricultural productivity, as well as as natural, environmentally friendly cleaning agents (Manyullei et al., 2022). Based on the description above, researchers are interested in conducting research on the effect of ecoenzyme production on improving students' knowledge and attitudes towards organic waste management. This understanding and ability can become students' provisions in processing organic waste into more useful products.

METHODS

The type of research conducted was a quasi-experimental design with a one-group pretest-posttest study. This study measured the effect of ecoenzyme production on improving students' knowledge and attitudes towards organic waste management. The initial stage of this study was to administer a pre-test questionnaire to 30 respondents from the student population at the Raudlatul Firdaus Islamic Boarding School, Sungai Ambawang, who were selected using a purposive sampling method. After participating in the ecoenzyme production practice program directly, respondents were given a post-test questionnaire. Organic waste processing became the dependent variable in this study, while knowledge and attitudes became the independent variables. Data were analyzed using univariate and bivariate analysis, the difference in scores between the pre-test and post-test was analyzed using Wilcoxson to test the significance of changes in students' knowledge and attitudes.

RESULTS AND DISCUSSION

Table 1. Respondent Characteristics

Variables	n	%
Gender		
Man	30	100
Woman	0	0
Age		
<17	8	26.7
≥17	22	73.3

Source: Primary Data, 2025

Based on the data in Table 1, the study population, consisting of 30 students at the Raudlatul Firdaus Islamic Boarding School in Sungai Ambawang, was predominantly male (100%). Furthermore, the respondents' age range was concentrated in late adolescence, with the majority (73.3%) aged ≥17 years.

Table 2. Pre-Test Knowledge Item Analysis

Question	Correct		Wrong	
	N	%	N	%
Understanding Eco Enzymes	21	70.0	9	30
Eco Enzyme Main Ingredients	22	73.3	8	26.7

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Question	Correct		Wrong	
	N	%	N	%
Tools and Materials for Making Eco Enzyme	14	46.7	16	53.3
Eco Enzyme fermentation process	15	50.0	15	50.0
Eco Enzyme Helps Fertilize Plants	15	50.0	15	50.0
Eco Enzyme Manufacturing Site	12	40.0	18	60.0
Eco Enzyme Manufacturing Process Time	21	70.0	9	30.0
Eco Enzyme Disinfectant Liquid Substitute	19	63.3	11	36.7
Fruit Peel Waste as a Material for Making Eco Enzymes	18	60.0	12	40.0
Benefits of Eco Enzyme for the Environment	24	80.0	6	20.0

Source: Primary Data, 2025

In Table 2. Based on the item-by-item analysis of respondents' knowledge before being given the ecoenzyme making practice, 16 respondents (53.3%) answered questions about the tools and materials for making ecoenzymes incorrectly, and 18 respondents (60.0%) answered questions about the place where ecoenzymes are made incorrectly.

Table 3. Pre-Test Attitude Item Analysis

Question	ST		S		N		TS		STS	
	N	%	N	%	N	%	N	%	N	%
Learn How to Make Eco Enzyme	3	10.0	12	40.0	2	6.7	8	26.7	5	15.7
Islamic Boarding Schools Should Manage Organic Waste	4	13.3	8	26.7	11	36.7	5	16.7	2	6.7
Assisting the Eco Enzyme manufacturing program	7	23.3	7	23.7	10	33.3	4	13.3	2	6.7
Eco Enzyme Can Be an Eco-Friendly Cleaning Alternative	5	15.7	12	40.0	6	20.0	1	3.3	6	20.0
Making Eco Enzymes Can Become a Real Practice in Protecting the Islamic Boarding School Environment	7	23.3	6	20.0	7	23.3	9	30.0	1	3.3
Making Eco Enzyme is Difficult and Troublesome	2	6.7	13	43.3	6	20.0	3	10.0	6	20.0
Eco Enzyme is safe for use in Islamic boarding school environments.	10	33.3	11	36.7	2	6.7	2	6.75	5	16.7
Invite Friends to Join in Learning to Make Eco Enzymes	4	13.3	10	33.3	9	30.0	4	13.3	3	10.0

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Question	ST		S		N		TS		STS	
	N	%	N	%	N	%	N	%	N	%
Eco Enzyme Can Be Included in Islamic Boarding School Programs	6	20.0	11	36.7	9	30.0	3	10.0	1	3.3
Islamic Boarding Schools Support Eco Enzyme Educational Activities	5	16.7	17	56.7	3	10.0	2	6.7	3	10.0

Source: Primary Data, 2025

In Table 3. Based on the item-by-item analysis of respondents' attitudes before being given the ecoenzyme making practice, there were 6 respondents (20%) who strongly disagreed that ecoenzymes could be an environmentally friendly cleaning alternative, and 6 respondents (20%) strongly disagreed that making ecoenzymes was difficult and troublesome.

Table 4. Post-Test Knowledge Item Analysis

Question	Correct		Wrong	
	N	%	N	%
Understanding Eco Enzymes	30	100.0	0	0
Eco Enzyme Main Ingredients	28	93.3	2	6.7
Tools and Materials for Making Eco Enzyme	28	93.3	2	6.7
Eco Enzyme fermentation process	20	66.7	10	33.3
Eco Enzyme Helps Fertilize Plants	29	96.7	1	3.3
Eco Enzyme Manufacturing Site	25	83.3	5	16.7
Eco Enzyme Manufacturing Process Time	29	96.7	1	3.3
Eco Enzyme Disinfectant Liquid Substitute	26	87.7	4	13.3
Fruit Peel Waste as a Material for Making Eco Enzymes	22	73.3	8	26.7
Benefits of Eco Enzyme for the Environment	27	90.0	3	10.0

Source: Primary Data, 2025

In Table 4. Based on the item-by-item analysis of respondents' knowledge before being given the ecoenzyme making practice, 2 respondents (6.7%) answered questions about the tools and materials for making ecoenzymes incorrectly, and 5 respondents (16.7%) answered questions about the place where ecoenzymes are made incorrectly.

Table 5. Post-Test Attitude Item Analysis

Question	ST		S		N		TS		STS	
	N	%	N	%	N	%	N	%	N	%
Learn How to Make Eco Enzyme	18	60.0	9	30.0	3	10.0	0	0	0	0
Islamic Boarding Schools Should Manage Organic Waste	14	46.7	15	50.0	1	3.3	0	0	0	0
Assisting the Eco Enzyme manufacturing program	16	53.3	14	46.7	0	0	0	0	0	0

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Question	ST		S		N		TS		STS	
	N	%	N	%	N	%	N	%	N	%
Eco Enzyme Can Be an Eco-Friendly Cleaning Alternative	18	60.0	11	36.7	1	3.3	0	0	0	0
Making Eco Enzymes Can Become a Real Practice in Protecting the Islamic Boarding School Environment	19	63.3	10	33.3	1	3.3	0	0	0	0
Making Eco Enzyme is Difficult and Troublesome	19	63.3	10	33.3	1	3.3	0	0	0	0
Eco Enzyme is safe for use in Islamic boarding school environments.	21	70.0	7	23.3	2	6.7	0	0	0	0
Invite Friends to Join in Learning to Make Eco Enzymes	17	56.7	12	40.0	1	3.3	0	0	0	0
Eco Enzyme Can Be Included in Islamic Boarding School Programs	17	56.7	13	43.3	0	0	0	0	0	0
Islamic Boarding Schools Support Eco Enzyme Educational Activities	22	73.3	6	20.0	2	6.76	0	0	0	0

Source: Primary Data, 2025

In Table 5. Based on the item-by-item analysis of respondents' attitudes before being given the ecoenzyme making practice, there were no respondents (0%) who strongly disagreed that ecoenzymes could be an environmentally friendly cleaning alternative, and no respondents (0%) strongly disagreed that making ecoenzymes was difficult and troublesome.

Table 6. Wilcoxon Test Results

Variables	Mean	Elementary School	N	P value
Knowledge				
Pre-test	6.03	1,299	30	0.000
Post-test	8.83	1,440	30	
Attitude				
Pre-test	33.30	6,727	30	0.000
Post-test	45.60	3,500	30	

Source: Primary Data, 2025

The results of the bivariate analysis obtained an average knowledge before the practice of making ecoenzymes of 6.03 and after 8.83. The p value obtained from the results of the Wilcoxson test (p value <0.05) indicates that there is a very significant difference in knowledge about organic waste processing in respondents before and after the practice of making ecoenzymes. In the attitude variable, the average attitude score before the practice of making ecoenzymes was 33.30 and after 45.60. The p value obtained from the Wilcoxson test (p value <0.05) indicates a very significant difference in attitudes about organic waste processing in respondents before and after the practice of making ecoenzymes.

One way to create a clean and healthy environment is to properly process organic waste. In this study, students from the Raudlatul Firdaus Islamic Boarding School in Sungai

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Ambawang served as respondents, with the majority of respondents aged 17 years and above (73.3%). This was done because many students still do not understand how to properly process organic waste. Waste fruit peels are rarely utilized by students at the Islamic boarding school, due to a lack of knowledge of how to process waste properly. However, fruit peel waste can still be processed into a useful product, namely ecoenzymes (Ayun et al., 2021). This indicates that many students still do not understand how to process organic waste into ecoenzymes.

There was an increase in respondents' knowledge after the ecoenzyme-making practice, as indicated by a decrease in incorrect answers regarding the tools and materials aspect from 16 respondents (53.3%) to 2 respondents (6.7%), and in the manufacturing location aspect from 18 respondents (60.0%) to 5 respondents (16.7%). This indicates that the ecoenzyme-making practice was effective in increasing respondents' knowledge regarding the tools, materials, and location used.

Before the ecoenzyme making practice, there were still 6 respondents (20%) who strongly disagreed that ecoenzymes could be an alternative environmentally friendly cleaner, and 6 respondents (20%) strongly disagreed that making ecoenzymes was difficult and troublesome. However, after being given the practice, there were no more respondents (0%) who stated that they strongly disagreed on both aspects. This shows that the ecoenzyme making practice was able to increase the respondents' positive attitudes, both in accepting ecoenzymes as environmentally friendly cleaners and in viewing the process of making them as something that is easy to do.

In this study, 10% of respondents had good knowledge before being given the practice of processing organic waste into ecoenzymes, and after the practice, this figure increased to 80%. This demonstrates that the practice of processing organic waste into ecoenzymes has a significant impact on knowledge about organic waste processing. According to Ridwan (2021), knowledge is the result of human effort to become knowledgeable (Ridwan et al., 2021). Through a good understanding of organic waste processing, it is hoped that someone can implement and create a clean and healthy environment.

Regarding the attitude variable before the practice, only 16.7% of students were categorized as very positive towards organic waste processing. After being given the practice of processing organic waste into eco-enzymes, this increased to 100%. Attitude is defined as an individual's tendency to respond to an object, individual, group, or situation in a certain way that reflects feelings, beliefs, and behavioral tendencies (Fahmi, 2025). A positive attitude towards the importance of processing organic waste into eco-enzymes will encourage students to maintain environmental cleanliness at the Islamic boarding school.

The results of the bivariate analysis in this study showed a significant change in knowledge, increasing by 70% and attitude by 83.3% after participating in the ecoenzyme-making practice. This research aligns with research conducted by Manyullei et al. (2024) which found an increase in respondents from pre-test to post-test. Knowledge about waste processing using the Tatakura and Ecoenzyme methods showed a significant difference.

Participants were able to recycle organic waste into ecoenzymes (Manyullei, Handayani, et al., 2024).

This is also supported by research by Amananti et al. (2024), which showed an improvement in student achievement after participating in the activity. This study also demonstrated that a hands-on approach, such as ecoenzyme production training, can be an effective method for educating students about complex scientific concepts like ecoenzymes (Amananti et al., 2024).

CONCLUSION

The practice of making ecoenzymes has been proven to have a significant impact on improving students' knowledge and attitudes in managing organic waste at the Raudlatul Firdaus Islamic Boarding School. Knowledge increased from 10% in the good category before the intervention to 80% after the intervention, while very positive attitudes towards organic waste management increased from 16.7% to 100%. The results of the pre-test and post-test analysis showed a very significant increase (p value <0.05) in both variables. This indicates that the hands-on educational approach is effective in fostering students' awareness, skills, and positive behavior. Thus, ecoenzyme making training can be a sustainable solution in organic waste management and the formation of an environmentally friendly culture in Islamic boarding schools.

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