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Environment-Based Horticulture Learning: The Effect of Fertilizer Usage Variation on Students' Environmental Literacy

Eka Trisianawati[1], Novi Nurmayanti[2], Ninda Permasari[3]
[1,2,3] Universitas Pgri Pontianak

[1]trisnawatieka@gmail.com

Abstract

This study investigates the influence of various fertilizer types—NPK, organic, granulated, and block compost—on students' environmental literacy within an environment-based horticulture learning context. The research aims to determine whether fertilizer-based practical activities contribute to measurable improvements in students' environmental literacy. A quantitative approach was employed by comparing students' environmental literacy levels before and after participating in horticultural practicum activities. Data were collected using standardized questionnaires and assessment instruments designed to evaluate environmental literacy. The improvement scores were analyzed using the N-Gain technique, and an independent sample t-test was conducted to assess the significance of the observed differences.The results show an average pre-practicum score of 55, which increased to 74 following the practicum. The independent sample t-test produced a significance value of 0.000, which is lower than 0.05. This indicates that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, demonstrating that the fertilizer-based practicum had a significant impact on students' environmental literacy. The findings suggest that integrating diverse fertilizer applications into horticulture learning can effectively enhance students' environmental literacy. This supports the use of environment-based, hands-on learning strategies as a pedagogical approach for fostering environmental awareness and responsible behavior among students.

Keywords: Fertilizer Variations, Environmental Literacy, Horticulture

Introduction

Environmental issues have increasingly become a global concern, and public awareness regarding sustainability continues to rise, including among university students. As a result, environmental education has become essential for strengthening students' understanding of ecological systems and sustainable practices (Zainal Arifin et al., 2023). Within the agricultural sector, fertilizer usage remains a fundamental component of plant cultivation. Chemical fertilizers such as NPK, containing nitrogen, phosphorus, and potassium are widely applied to boost crop productivity (Mali et al., 2020; Priyono, 2022). However, their excessive use has been associated with soil degradation, water contamination, and long-term declines in soil health (Fathoni et al., 2024; Pahlepi et al., 2023). In contrast, organic fertilizers including granulated organics and block compost, which are derived from natural materials, offer more environmentally friendly alternatives due to their positive effects on soil structure and reduced ecological risks (Priyono, 2022; Simanjuntak et al., 2013). This contrast highlights the importance of integrating sustainability considerations into agricultural education.

Previous studies have examined the environmental impact of chemical and organic fertilizers, the importance of agricultural sustainability, and the role of soil health in modern cultivation systems. However, much of the existing research emphasizes agronomic outcomes, with limited attention to how fertilizer-related learning activities contribute to the development of

environmental literacy among students (Nasution, 2021). Environmental literacy—comprising knowledge, attitudes, and skills necessary to make informed environmental decisions—is a crucial component in preparing future agronomists, agricultural scientists, and biology educators (Yuniwati, 2023). Horticulture courses, in particular, provide students with practical exposure to plant cultivation and fertilizer application, making them an ideal setting for integrating sustainability-based learning approaches (Safii et al., 2024).

Despite the relevance of fertilizer usage within horticulture education, studies specifically linking fertilizer variation with students' environmental literacy remain scarce. Research exploring how different types of fertilizers—such as NPK, granulated organic, and block compost—affect students' environmental knowledge and awareness is still limited (Irawati et al., 2024). This indicates a clear gap in the literature regarding the role of hands-on agricultural practices in shaping environmental literacy outcomes.

Therefore, this study aims to investigate the effect of different fertilizer types on students' environmental literacy within an environment-based horticulture learning framework. By examining the educational implications of NPK, organic, granulated, and block compost fertilizers, the research seeks to contribute to the development of sustainability-oriented curricula. The findings are expected to provide insights that support environmentally responsible agricultural practices and empower students to become advocates for sustainable farming (Latifah et al., 2023). Through this approach, the study aims to broaden students' understanding of the connections between fertilizer use and ecological sustainability, thereby enriching environmental literacy in higher education settings..

Method

This study employs a quantitative experimental approach, grounded in the positivist paradigm. Its primary objective is to quantitatively examine the influence of different fertilizer types (NPK, organic, and block compost) on students' awareness of environmental literacy. Data were gathered through a questionnaire-based survey and a series of tests (pretest and posttest) to explore the phenomenon under investigation. The collected data were then analyzed using statistical methods to draw conclusions. Rather than focusing on hypothesis testing, this research emphasizes the measurement of variables related to fertilizer usage and environmental literacy awareness.

The study was conducted among biology students enrolled in a horticulture course at Universitas PGRI Pontianak during the 2021/2022 academic year. To collect relevant data, the researchers administered questionnaires and tests that captured students' perceptions of assigned tasks and assessed their environmental literacy skills. The instrument used to evaluate environmental literacy was adapted from the framework developed by Szczytko et al. (2019), as outlined in the following table.

Table 1. Questionnaire for Measuring Environmental Liter

No.	Aspect	Statement
1	Hope	I believe people will be able to solven most environmental problems.
2	Hope	The actions I can take are too small to help solve most environmental problems.
3	Hope	I believe scientists will be able to find ways to solve environmental problems.
4	Hope	Even when some people give up, I know there will be people who will continue to try to solve environmental problems.

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5	Hope	Environmental issues are beyond our control.
6	Hope	Since people can learn from our mistakes, we will influence the environment in a positive direction.
7	Hope	Every day, more people care about environmental issues.
8	Hope	If everyone works together, we can solve environmental problems.
9	Hope	Environmental problems are so complex, we will never be able to solve them.
10	Hope	I know that there are many things I can do to help solve environmental problems.
11	Hope	I feel powerless to solve environmental problems.
12	Behavior	I turn off the lights at home when they are not in use.
13	Behavior	I pick up trash that I find outside.
14	Behavior	I turn off the water when not in use.
15	Behavior	I close the refrigerator door after I take something out.
16	Behavior	I recycle trash at home.

This study employed two primary types of data analysis, one of which focused on evaluating students' environmental literacy skills. After collecting scores from both the initial (pretest) and final (posttest) assessments, the researchers applied the N-Gain Score formula to assess the improvement in students' performance. The N-Gain Score is used to compare the actual gain in students' abilities with the maximum potential gain. This calculation helps determine the extent to which students' skills have improved as a result of the intervention.

Results

Effectiveness of Horticultural Practicum in Enhancing Environmental Literacy

This research aims to assess the improvement of students' environmental literacy skills through a horticultural practicum. As part of the practicum, students were tasked with planting corn (Zea mays) using different types of fertilizers, including NPK, organic, granulated, and block compost. Over the course of one month, students monitored and recorded the growth of their plants. To measure their environmental literacy, tests were administered both before and after the practicum. By comparing these pretest and posttest results, the study seeks to evaluate the effectiveness of the horticultural practicum in enhancing students' environmental literacy competencies.

Impact of Fertilizer Types on Environmental Literacy

Different fertilizer treatments had varying effects on students' environmental literacy development. Organic fertilizers and block compost generally led to more favorable outcomes compared to NPK and granulated fertilizers. This may be attributed to the fact that organic-based treatments provide a more comprehensive and environmentally contextual learning experience. The table below presents a comparison of the four fertilizer types and their respective impacts on students' environmental literacy in the context of horticulture education.

Table 2. Comparison of Four Types of Fertilizers Used

Aspects	NPK Fertilizer	Organic Fertilizer	Granule Fertilizer	Compost Blocks
Composition	Synthetic chemicals (Nitrogen,	Natural materials (animal	Chemical-based, slow-	Fermented organic matter

	Phosphorus, Potassium). Quick effect.	manure, crop residues). Rich in microbes.	release granular form.	in compact block form.
Impact on Soil	May cause soil degradation if overused.	Improves soil structure and increases long-term fertility.	Reduces the risk of nutrient leaching.	Improves water retention and soil porosity.
Influence on Environmental Literacy	Provides understanding of chemical fertilizer impacts on the environment.	Promotes sustainable practices and ecological awareness.	Tends to be neutral regarding environmental literacy.	Enhances awareness of waste recycling and environmental sustainability.
Speed of Results	Rapid effects on plant growth.	Gradual but consistent results.	Moderate, depending on granule formulation.	Slower effects, but benefits last longer.

Enhancement of Environmental Literacy through Organic Fertilizer Use

Students who engaged in the practicum using organic fertilizers and compost blocks demonstrated a stronger grasp of sustainable horticultural practices such as maintaining soil fertility, recycling organic matter, and minimizing environmental harm compared to those who did not participate in the practicum. The hands-on use of these eco-friendly fertilizers also encouraged students to think more critically about sustainable agriculture. They were more capable of recognizing the benefits of natural fertilizers in contrast to chemical fertilizers, which are often linked to negative ecological consequences.

Environmental Literacy as a Holistic Competency

Environmental literacy encompasses not just knowledge, but also environmental awareness and the ability to act in alignment with sustainable principles. Within the scope of this study, the use of organic fertilizers and compost blocks provided students with meaningful experiential learning. Through direct interaction with environmentally sustainable techniques, students developed a deeper understanding of key ecological concepts such as nutrient cycling, organic waste management, and the broader environmental impacts of agriculture.

Practicum as an Effective Learning Method

The integration of fertilizer application in practical activities proved to be an effective educational tool for improving students' environmental literacy, particularly in the context of sustainable agriculture. This hands-on approach was more effective in conveying complex sustainability concepts than traditional learning without practicum. Previous studies also suggest that using contextually relevant learning materials related to environmental issues can enhance students' motivation and engagement.

Curriculum Development in Horticulture Education

The findings of this research can inform curriculum development in horticulture courses by promoting ecology-based instructional methods. These approaches not only support the

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cultivation of environmental literacy but also help students understand the direct relationship between agricultural practices and environmental sustainability.

Research Findings and Data Presentation

The results of this study are presented through students' environmental literacy scores, including outcomes from the prerequisite test and the independent sample t-test. The effect of different types of fertilizers on students' environmental literacy is summarized in the table below.

Table 3. Environmental Literacy Competencies

Competencies Tested	Students After Practicum	Students Without Practicum
Flow of Matter and Energy	81	78
Population, Community, and Ecosystem	69	52
Environment and Society	81	56
Environmental Issues	66	24
People, Resources, and Nature	69	41
Environment and Health	68	41
Earth System Interaction	86	81
Average	74	54

Impact of Fertilizer Application Practicum on Students' Environmental Literacy

The data presented in the table above indicates a notable improvement in various aspects of environmental literacy among students who participated in the fertilizer application practicum. On average, students who engaged in the practicum scored 74, whereas those who did not participate obtained an average score of only 54. Further analysis revealed that the practicum had the greatest impact on competencies related to *populations, communities, and ecosystems*. Students who participated in hands-on activities demonstrated a stronger understanding of the dynamic interactions between humans, populations, and ecosystems. This suggests that practical experience allows students to connect theoretical knowledge with real-world applications in the field.

In the *environment and society* domain, the practicum also significantly enhanced students' understanding of environmental challenges that affect communities. Participants became more aware of the importance of environmental protection and developed a stronger sense of responsibility in addressing ecological concerns. Additionally, the competency area of *environmental issues* showed marked improvement, indicating that the practicum successfully equipped students with deeper knowledge of critical issues such as climate change, pollution, and environmental degradation. In the area of *people and natural resources*, students gained a better understanding of human reliance on natural ecosystems and the importance of managing resources sustainably.

Although both groups performed relatively well in *Earth system interaction*, the practicum group achieved slightly higher scores, suggesting a more comprehensive grasp of Earth's interconnected processes due to direct engagement in the activity. Quantitatively, the average environmental literacy score for students who took part in the practicum was 74 ± 5.5, categorized as "moderate." In contrast, students who did not participate in the practicum scored 54 ± 8.9, which falls under the "very low" category. Results from the independent sample t-test produced a Sig. (2-tailed) value of 0.000, which is less than or equal to 0.05, indicating a statistically significant difference. This confirms that participation in the practicum had a

measurable effect on environmental literacy and that the type of fertilizer used contributed to this outcome.

Students who engaged in the practicum demonstrated higher environmental literacy because the learning process integrated practical, real-world applications. On the other hand, those without practicum experience had lower literacy due to a lack of contextual, environmentally focused instruction. Learning experiences that connect students with the environment can significantly enhance their environmental knowledge. In conclusion, the findings affirm that experiential learning, such as observing the growth of plants treated with various fertilizers, contributes meaningfully to the development of environmental literacy. The results also align with the definition of Environmental Education (EE), which emphasizes developing knowledge, awareness, skills, and responsible behavior regarding the interactions between humans and the environment across all dimensions of life.

Discussion

The findings of this study indicate that horticultural practicum activities effectively enhance students' environmental literacy. By engaging in hands-on learning such as planting Zea mays using different types of fertilizers students showed improvement in their understanding of ecological and sustainability concepts. Pretest and posttest comparisons confirmed this progress. Among the fertilizer types tested, organic fertilizers and compost blocks produced the most significant gains in environmental literacy. These natural fertilizers fostered deeper environmental awareness by providing students with a more relevant and sustainability-focused learning experience compared to NPK and granulated fertilizers. This suggests that incorporating environmentally friendly practices into agricultural education can strengthen students' knowledge, awareness, and responsible behavior regarding ecological issues.

This study demonstrates that the use of organic fertilizers and compost blocks in horticultural practicum significantly enhances students' environmental literacy. Students who participated in the practicum gained a better understanding of sustainable practices such as soil fertility management, organic waste recycling, and minimizing environmental damage. Their critical awareness of the ecological impact of chemical versus natural fertilizers also increased.

Environmental literacy, viewed as a combination of knowledge, awareness, and action, was more effectively developed through hands-on learning. Direct engagement with eco-friendly agricultural methods enabled students to internalize complex concepts like nutrient cycling and environmental impact more deeply than through theoretical instruction alone.

The practicum not only improved student understanding but also served as an effective educational strategy. Practical learning proved more impactful than conventional classroom approaches in fostering environmental awareness and responsibility. These findings suggest that integrating sustainability-based activities into horticultural education can play a vital role in curriculum development, aligning learning outcomes with real-world environmental challenges.

The findings of this study confirm that environment-based horticultural practicum significantly enhances students' environmental literacy, particularly when organic fertilizers and compost blocks are applied. This result aligns with Nasution (2021), who emphasized that environmental literacy develops more effectively through contextual and experiential learning rather than through theoretical instruction alone. The observed increase in students' understanding of ecological relationships and sustainability issues is also consistent with the framework of environmental literacy proposed by Szczytko et al. (2019), which highlights the integration of knowledge, attitudes, and environmentally responsible behavior. Furthermore, Yuniwati (2023) reported that direct engagement with gardening and horticultural activities

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strengthens students' awareness of environmental processes and resource management. These findings collectively suggest that hands-on agricultural practices play a critical role in fostering holistic environmental literacy.

The stronger impact of organic fertilizers and compost blocks compared to chemical fertilizers supports previous studies emphasizing the ecological benefits of organic inputs in agriculture. Research by Simanjuntak et al. (2013) and Priyono (2022) demonstrated that organic fertilizers improve soil structure and nutrient cycling, which provides a concrete context for students to understand sustainable agricultural systems. Similarly, Pahlepi et al. (2023) highlighted that reducing reliance on chemical fertilizers contributes to environmental preservation and promotes environmentally responsible behavior among farming communities. The present study extends these findings into an educational context, showing that exposure to organic fertilizer use also enhances students' environmental awareness and attitudes. This confirms that sustainability-oriented agricultural practices can serve as effective learning media in higher education.

In addition, the results corroborate studies that link environmentally contextual learning with improved student engagement and environmental responsibility. Latifah et al. (2023) found that gardening-based learning programs significantly foster green behavior and environmental concern among students, which is consistent with the improvements observed in this study. Safii et al. (2024) also reported that horticulture-based learning environments facilitate deeper understanding of ecological systems by connecting theory with real-world application. The increased environmental literacy among practicum participants further supports Zainal Arifin et al. (2023), who argued that sustainable agriculture education is essential for preparing environmentally responsible future generations. Overall, this study strengthens existing literature by demonstrating that fertilizer-based horticultural practicum is not only agronomically relevant but also pedagogically effective in enhancing students' environmental literacy.

Conclusion

This study highlights that practical experience with different types of fertilizers during horticulture practicum significantly enhances students' environmental literacy. By learning about the strengths and limitations of each fertilizer type, students are better equipped to make informed and responsible choices regarding sustainable agricultural practices. These findings can serve as a foundation for developing a curriculum that prioritizes hands-on activities and problem-based learning, enabling students to acquire knowledge and skills aligned with real-world environmental issues.

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