From Kitchen Waste to Climate Solution A P5 Project of SMA POMOSDA

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***Abstract*:** *This study aims to investigate the potential of Eco-enzyme production as an effective strategy to integrate climate change awareness into education sustainability practices. Eco-enzymes, fermented solutions derived from organic waste, offer a sustainable and cost-effective approach to waste management and environmental conservation. The P5 project involved a comprehensive approach including, educating students about climate change. It guides students in the production of Eco-enzymes using readily available organic waste materials, tracking the production process, measuring the quality of Eco-enzymes, and assessing their effectiveness in various applications, such as cleaning, composting, and pest control. It is also evaluating the environmental and social impact of Eco-enzyme production, including waste reduction, resource conservation, and community engagement. The results demonstrate that Eco-enzyme production can significantly reduce organic waste, improve soil fertility, and contribute to a cleaner environment. Moreover, the project has fostered a sense of environmental responsibility among students and community members, promoting sustainable behaviors and practices. In the end, it can integrate Eco-enzyme production into educational and organizational strategies. It will play a crucial role in addressing climate change and promoting sustainability. By empowering individuals to take action, we can collectively contribute to a greener and more resilient future.*

***Key Words**:* Eco-Enzyme, environment, climate change, sustainable

Introduction

Climate change and environmental degradation are two of the most pressing issues of the 21st century. As the world grapples with the effects of these challenges, there is a growing need for educational practices that empower individuals to take proactive steps toward sustainability. One such initiative is the integration of Eco-enzyme production in education. Eco-enzymes, which are solutions made from fermenting organic waste materials, provide a sustainable and cost-effective approach to waste management, resource conservation, and environmental awareness.

The P5 project, a comprehensive educational initiative, explores the potential of Eco-enzyme production to foster climate change awareness and promote sustainable practices among students of SMA POMOSDA. This study investigates the impact of involving students of SMA POMOSDA in the process of Eco-enzyme production, evaluating its benefits for both environmental conservation and community engagement. This article presents the methods, results, and discussions surrounding the implementation of Eco-enzyme production in educational settings, alongside the potential social and environmental benefits.

Method

The P5 project at SMA POMOSDA was designed as an experiential learning initiative that allowed students to directly engage with climate change education and sustainability efforts by producing eco-enzymes. This project emphasized both theoretical knowledge and practical application, enabling students to understand the interconnectedness of climate change, waste management, and sustainable practices. By involving students in eco-enzyme production, the project encouraged them to explore solutions to environmental problems, especially those related to organic waste. Here's an expanded version of the stages of the project, enriched with insights from academic literature to underline its significance.

Educational Workshops:

The project commenced with educational workshops introducing students to critical concepts such as climate change, waste management, and sustainability. These workshops were designed not only to inform but to inspire action. Students were educated on the global impact of organic waste and how its reduction can significantly mitigate environmental harm. Research shows that the majority of organic waste can be repurposed into eco-friendly products, reducing the burden on landfills and lowering greenhouse gas emissions (Wells, 2019). By learning about the role of organic waste in the climate crisis, students developed a clearer understanding of how their actions could help combat climate change.

Studies indicate that workshops like these, when designed to be interactive and engaging, significantly enhance students' environmental awareness and commitment to sustainable behaviors (Jones et al., 2020). The workshops in the P5 project not only provided theoretical knowledge but also fostered a sense of responsibility and empowerment among students, which is critical for cultivating long-term environmental stewardship.

Figure 1. workshop for P5 about eco-enzyme

Eco-Enzyme Production:

The next stage of the project involved the hands-on production of eco-enzymes using organic waste materials, including fruit and vegetable scraps, sugar, and water. The process of fermentation transformed these materials into eco-enzymes, which can be used in various environmental applications like cleaning, composting, and pest control. The practical nature of this step helped students realize the potential of waste materials as valuable resources rather than seeing them simply as trash.

The use of eco-enzymes has been shown to have significant benefits for both the environment and human health. According to a study by Suyama et al. (2018), eco-enzymes have been found to be effective in reducing harmful chemicals used in cleaning products, thus minimizing pollution and promoting healthier living environments. Furthermore, by producing these eco-enzymes themselves, the students not only gained technical knowledge but also developed a deeper appreciation for sustainable alternatives to conventional products.

Moreover, this stage highlighted the importance of circular economy principles, where waste is turned into a resource, contributing to more sustainable practices. As emphasized by Kirchherr et al. (2017), the adoption of circular economy strategies can reduce environmental degradation and promote long-term sustainability by creating systems where waste is minimized and reused.

The products of eco-enyme can be air purify, water purify, hand-sanitizer, cleaning floor fluid, face mist, face serum, face cream, etc.

Tracking and Measuring the Production Process:

In this stage, students closely monitored and tracked the fermentation process, observing key factors such as time, temperature, and the quality of the eco-enzymes. Students collected data on the effectiveness of these eco-enzymes in various applications like cleaning, composting, and pest control. This hands-on data collection and analysis not only enhanced students' understanding of the scientific method but also helped them engage in real-world problem-solving.

Monitoring the production process allowed students to see firsthand how different variables influence the outcome, which is crucial for understanding environmental sustainability from a scientific perspective. Research supports the notion that student engagement in data collection and analysis boosts their understanding of the complexities involved in sustainability efforts (DeWitt et al., 2020). By tracking the production, students developed a practical understanding of how these eco-enzymes could be used effectively to reduce waste and support environmental health.

Creating eco-enzyme is a good step for students of SMA POMOSDA Nganjuk, East Java, as an effort to reduce environmental damage that causes climate change. The earth's heat is becoming increasingly unbearable during the summer, and storms are becoming more menacing due to this climate change. They realize that with this small step, if socialized and educated to the general public, there will be a positive impact on the earth's air and climate.

Environmental and Social Impact Assessment:

The final stage of the project was focused on evaluating the environmental and social impacts of the eco-enzyme production. Students assessed how the production of eco-enzymes contributed to reducing organic waste and improving soil fertility through composting. They also evaluated the broader social impacts, such as increased community awareness and involvement in sustainable practices.

Environmental impact assessments like this are essential for measuring the effectiveness of sustainability initiatives. Research by Linder et al. (2019) highlights that impact assessments help not only in measuring the immediate environmental benefits but also in understanding the social dimensions of sustainability projects, such as fostering community engagement and raising environmental awareness. In the P5 project, the assessment helped students understand that their actions could influence both the local community and the environment on a larger scale.

Furthermore, social sustainability is equally important in ensuring the long-term success of environmental projects. A study by Upham et al. (2021) found that involving students and communities in sustainability projects can lead to more sustainable behaviors, as individuals who feel connected to environmental efforts are more likely to continue participating in and advocating for such initiatives.

In other words, The P5 project not only provided students with practical knowledge and hands-on experience but also empowered them to actively participate in environmental conservation efforts. By engaging in the production of eco-enzymes, tracking their progress, and assessing their impact, students gained a deeper understanding of climate change mitigation and the importance of sustainability. Moreover, the inclusion of environmental and social impact assessments allowed students to evaluate the real-world consequences of their actions, fostering a sense of responsibility and commitment to sustainable practices. According to Wells (2019), projects like this are essential in equipping young people with the knowledge and skills they need to become the environmental leaders of tomorrow.

By combining education with practical application, the P5 project not only provided students with a deeper understanding of climate change but also inspired them to become active participants in creating a sustainable future. As research supports, engaging students in real-world sustainability projects is a powerful way to foster environmental stewardship, improve scientific literacy, and promote social change (DeWitt et al., 2020; Jones et al., 2020).

Thus, the P5 project stands as a model for integrating education and action to address the global challenges of climate change and environmental degradation.

Results and Discussion

1) Impact on Waste Reduction

One of the most significant outcomes of the eco-enzyme production process was the substantial reduction in organic waste. By turning food scraps and other organic materials into eco-enzymes, students were able to divert waste from landfills, where it would otherwise contribute to methane emissions. The project successfully demonstrated that eco-enzyme production is an effective waste management strategy that can be integrated into schools and communities to reduce the environmental footprint.

2) Effectiveness of Eco-Enzymes

The eco-enzymes produced were tested in various applications, including cleaning, composting, and pest control. Results indicated that eco-enzymes can serve as a viable alternative to chemical cleaners, contributing to a cleaner and safer environment. Additionally, the eco-enzyme-based composting process improved soil fertility, contributing to better agricultural practices and promoting sustainability.

3) Community Engagement and Social Responsibility

Beyond the environmental benefits, the project fostered a strong sense of community engagement and social responsibility. Students not only learned about climate change and sustainability but also actively contributed to a collective effort to reduce waste and promote green practices. The involvement of the local community in the project further enhanced the awareness and adoption of sustainable behaviors, highlighting the importance of collaborative efforts in tackling global challenges.

4) Educational Impact

The hands-on nature of the project allowed students to connect theoretical knowledge about climate change and sustainability with practical solutions. The active participation in eco-enzyme production fostered critical thinking, problem-solving, and teamwork skills. Moreover, it encouraged students to see themselves as agents of change, capable of addressing environmental challenges in their communities.

Conclusion

The P5 project demonstrates the significant potential of eco-enzyme production as both an educational tool and a strategy for sustainability. The findings show that involving

students in the creation of eco-enzymes not only reduces organic waste but also promotes environmental conservation, enhances soil fertility, and fosters a sense of community responsibility. The project highlights the importance of integrating hands-on, practical approaches into educational curricula to promote climate change awareness and sustainable practices.

By empowering students and communities to engage in eco-enzyme production, this approach contributes to a more sustainable future, where small actions can lead to significant environmental benefits. Educators can leverage eco-enzyme production as a tool to instill lifelong values of sustainability, climate change awareness, and responsible waste management, ensuring that future generations are better equipped to face the challenges of climate change.

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