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Making Kokedama as an Implementation of Ecological Awareness at NSA Surabaya High School

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Abstract

The global environmental crisis is not just a warning, but a call to action, and education is key. NSA Surabaya High School addresses this challenge through the unique learning innovation of kokedama, a Japanese art of farming that combines aesthetics and sustainability. More than just the practice of planting, kokedama is a powerful medium to instill ecological awareness in the younger generation. With a hands-on method combined with affective reflection, students not only learn farming skills, but also develop a deep empathy for nature and a real sense of ecological responsibility. This finding proves that contextual education can be a concrete solution to instill environmental awareness, solution to instill environmental awareness from an early age. We recommend this activity as a revolutionary strategy to create a generation of high school students who not only care but are also ready to lead the change for the sustainability of our planet.

Keywords: Ecological Awareness, Kokedama Education, Sustainability in Learning, Contextual Environmental Literacy

INTRODUCTION

Environmental concerns in the modern age are more complex and urgent. Concerns such as global warming that leads to radical change in climate, elimination of the richness of life through deforestation and exploitation of natural resources, and pollution of the environment through plastic debris that is not easily decomposed, are real threats that endanger the sustainability of life on the globe earth (Masrinah et al., 2023; Nurzaelani, 2017). In such a context, education is the major player as a driver of change. However, instructional methods that are additive only in terms of stressing the cognitive or memorization of the principles of science are less effective in the building of a whole environmental consciousness (Masrinah et al., 2023; Handayani et al., 2024). There should be a change in the approach of educating, that is, educating that is able to reach the students'ffective and psychomotor levels. Such a thing means that the students are not only challenged to know the ecological principles, but also challenged to feel them in an emotional manner and implement them in practical actions. With such a method that encompasses the whole person, education is turned into a tactical tool of building a generation that is not only intelligent in a cognitive manner, but also affectionate as well as responsible for the preservation of nature (Leu, 2021).

Ecological consciousness is a key part of environmental protection, and it requires an in-depth education strategy that is more than abstract theory. Science studies assert that effective environmental education should integrate ecological concepts within the whole curriculum and apply them to students' immediate environments. Ecopedagogy, an education method that

emphasizes living close to nature, has proved effective in establishing ecological consciousness and character in learners (Yunansah & Herlambang, 2017). However, there are numerous challenges in the emergence of ecological consciousness, including limited teacher training, the non-availability of resources, and the curriculum's elimination of special environmental lessons (Hendrawan et al., 2020). In mitigation of these, teachers should apply various methods of instruction, multimedia interactivities, and transformative methods that build the minds of learners to critically evaluate and solve environmental problems (Desfandi & Maryani, 2017). In involving learners in practical ecological activities and establishing their emotional identification with the environment, education is in a position to fashion an environmentally sustainable generation.

The application of soil balls wrapped in coconut fibers, called kokedama, is gaining prominence as an environmentally friendly and aesthetically pleasing method of plant production without the use of pots (Wiyatasari, 2019; Panglipurningrum et al., 2024). The practice has been introduced in school and community levels, including PKK, for environmental education, sustainable livelihoods, and creative pedagogies (Fitdiawati & Retno, 2020; Arum et al., 2022). Kokedama is found to be used as an effective medium of ecological pedagogy, promoting students' awareness of the environment, and developing their fine motor skills (Fitdiawati & Retno, 2020). Kokedama has also been used for the promotion of the economic empowerment of community members, especially in the wake of the COVID-19 pandemic, through small-scale farming and the eradication of plastic waste in the use of pots (Panglipurningrum et al., 2024; Arum et al., 2022). The low-cost use and multifaceted uses of the kokedama make them adaptable to school and economic activities.

In SMA NSA Surabaya, the use of the kokedama is done in such a way that the student, in addition to learning the plant structure, the growing medium, and the process of the photosynthesis, is challenged to learn the value of sustainability, for instance, the use of sustainable material, the elimination of waste, and the preservation of species of the locality. More than that, through the activity, the students also have contextualized and integrated learning since they apply their motor skills, aesthetics, as well as value awareness. With the incorporation of the production of the kokedama in the learning, SMA NSA Surabaya has been able to develop a teaching climate that is not only educative, but also fosters strong ecological awareness in students in a creative and practical manner.

METHOD

A qualitative observational research design was employed in this study to determine the cognitive and emotional impact of ecological learning in the form of kokedama on 12th-grade

students of NSA Senior High School, Surabaya. The research was interested in how the students, in real time, behaved, interacted, and reflected during the learning process. Data were obtained from the field observations, students' reflections journals, and photo documentation of activities.

Activity Design

The activity of making kokedama in NSA Surabaya High School was designed in the form of a study project with the primary focus on the study of Biology. This method not only highlights the aspect of cognition through the theories of ecosystems, the structure of plants, and the conservation of the environment, but also incorporates practical practices that enable learners to implement the acquisition of knowledge in practical terms. In terms of implementation, the students are taught to prepare the kokedama in small groups, commencing from the choice of appropriate plants, the preparation of soil mix and organic manure, wrapping the pile of soil with coconut fiber and twine. This activity enables the students to work in cooperation, exercise their creativity, and be mindful of the use of environmentally sustainable materials. Following the practical, the students are invited to critically analyze through discussion or reflective journals their experience, the ecological value gained, and the influence of the practical on the mindset regarding the environment.

The observations spanned every phase of the activities—from socialization and theory introduction, through the crafting of the kokedama, until plant maintenance and reflections. The research team used a standardized observation sheet to record student behavior, engagement, cooperation, and environmental awareness demonstration. The student reflections, meanwhile, were studied through thematic coding in an attempt to unveil common patterns of ecological awareness and emotional investment.

Subject Research

12th grade Science 2 Nation Star Academy Senior High School Surabaya

Implementation Steps

Phase I: Socialization and Introduction to Ecology

The initial step of the learning activity of “Socialization and Introduction to Ecology” was the introduction of the theory of the ecosystem, the functions of plants, and the principle of ecological awareness. During this step, students are required to study the basic characteristics of the ecosystem as a combination of the biotic sectors (living organisms) and abiotic factors (non-living environmental conditions) that harmonize amongst themselves. The teacher introduces the fact that the ecosystem not only represents the relationship of living organisms and their environment, but also the need for sustaining the balance in such a way that the

ecosystem functions the best. Special priority is given to the action of plants as the primary producers in the food chain that produce oxygen, absorb carbon dioxide, and give habitat to hundreds of living organisms. Furthermore, the water cycle is also balanced and soil erosion is avoided by the plants.

In this class, students are also introduced to the principle of ecological awareness, or awareness of being responsible for the sustainability of the environment. The teacher makes the students understand that the activities of man have a significant effect on the ecosystem, whether negative or positive. Activities such as deforestation, water pollution, and improper waste disposal are clear dangers to the ecosystem. Conservation activities, rearing of forests, and careful use of resources will, however, help in sustaining the ecosystem in balance. The teachers are able to use pictorial media such as videos or pictures of natural ecosystems, and simulations that will reveal transformations of ecosystems due to man's activities. The students are, in the end, supposed to not only understand the theory, but also tend to develop a caring sensitivity towards the immediate environment.

Phase II: Making Kokedama

The second phase of the learning experience is called “Kokedama Making,” where students get hands-on by creating kokedama an eco-friendly Japanese plant art. This activity gives students the chance to put ecological concepts into practice while deepening their appreciation for the role of plants in our daily lives.

The process kicks off with students gathering the main ingredients: fertile humus soil and organic fertilizer. The teacher explains that humus forms from the breakdown of rich organic matter, and organic fertilizer is added to boost soil health without harming the environment. Students then mix the two thoroughly to create the perfect planting medium.

The next step is to form the soil mixture into a solid ball, where students choose local ornamental plants to be planted. The selection of local plants aims to highlight local wisdom while supporting the preservation of native flora. The plants were placed in the center of the soil ball, then the entire surface of the ball was coated with coconut fibers. Coconut fibers were chosen because they are natural, easy to decompose, and function as a protector and moisture absorber.

The final stage is to tie the coconut fiber-coated soil ball using natural ropes, such as hemp rope or pandan leaf fibers. The teacher instructs that the tying is done with a simple yet sturdy technique, so that the kokedama can hang or be placed without being easily damaged. In this process, students learn how each material used is ecologically and aesthetically integrated.

Figure 1. Making Kokedama Guide

Phase III: Maintenance and Reflection

The third stage of learning, "Care and Reflection," focuses on maintaining the kokedama that students have created while integrating this experience with the development of their environmental awareness. At this stage, students are taught to take responsibility for the plants they care for as well as reflect on the learning that has been acquired.

For several weeks, each student is asked to take care of their kokedama at home or at school. The teacher provides simple maintenance guidelines, such as how to water the kokedama using the soaking method to keep the soil moist without damaging the ball structure, ensuring the plants get enough sunlight, and monitoring plant growth. This care not only trains accuracy and responsibility, but also strengthens students' emotional connection with the plants they care for.

Figure 2. Making Kokedama

The students must maintain daily or weekly journal notes of the condition of the kokedama. These are the journals in which they record observations of the health of the plant, such as if the plant is forming leaves, root, or flowers, and they also record observations of challenges encountered, such as if the plant is droopy or if there are visiting insects. In addition, the students must record notes of the strategies employed in overcoming challenges encountered in taking care of the kokedama. The habit of observing the experiment allows them to gain a richer, first-hand experience of how plants grow and sustain themselves, besides sharpening their critical thinking, analytical, and problem-solving skills.

Once the care cycle is finished, students must generate a personal reflection of their experience. In the piece, they talk about how the process of preparing and taking care of the kokedama has made them appreciate the importance of taking care of the environment. They are also asked to talk about new facts they've learned such as the capabilities of decorative plants to neutralize air pollution, or the importance of working with all-natural, environmentally-friendly materials. Many of the students also take the opportunity to lay out plans for continuing their plant care practices or taking other actions that will assist in the preservation of the environment.

Data Collecting Technique

To gain a clearer sense of how ecopedagogical learning with kokedama affects students' ecological consciousness, the research employed a series of considered methods of data collection. Adopting a qualitative, observational method, the investigator incorporated a number of approaches in order to record both what students understood and how they experienced the process. This consisted of direct, in-class observations, scrutiny of students' reflective essays, and photographic and video documentation.

By employing such multi-angle (or triangulated) approach, the study could not only capture the students' actions in the lesson, but also gain an indication of their own reflections with demonstration of critical shifts of perception, feeling, and concern for the environment. This combination of methods strengthened the reliability of the findings and offered a well-rounded view of how ecopedagogical practices like kokedama making can shape students' environmental consciousness on multiple levels.

Table 1. Data Collecting Technique

Data Source	Technique	Instrument	Purpose
Observation	Field Notes	Observation Sheet	Capture student behavior during activity
Student Reflection	Journal Analysis	Reflective Journal	Assess cognitive and affective transformation
Documentation	Photo & Video	Smartphone Camera	Support visual evidence of engagement

A total of 22 students were observed. Their written reflections and kokedama journals were used as primary data sources for understanding the internalization of ecological values. Researchers categorized responses into cognitive (knowledge and awareness of ecology) and affective (empathy, responsibility, behavioral change) domains based on Bloom's revised taxonomy. Triangulation was applied by comparing direct observations with reflection content to validate the consistency of student responses.

Data Analysis Techniques

The collected data were analyzed using a qualitative descriptive approach, with a focus on thematic analysis to explore both the cognitive and emotional responses of the students. Observational notes were coded inductively to identify recurring patterns in behavior, student engagement, and interaction throughout the kokedama learning sessions. Concurrently, students' reflective journals were collected and sifted through key themes. These not only showed their grasp of ecological principles but also their own personal growth in the form of increased empathy for nature, increased sense of responsibility, and increased commitment to environmental sustainability.

To establish the credibility of the findings, a form of triangulation was used. This involved verification across multiple sources of classroom observations, students' reflections, and image evidence like video footage and pictures. The verification of sources allowed for the confirmation that students' claimed attitudes corresponded with their actions as witnessed. Furthermore, member checking was performed through obtaining a representative number of students to verify the findings of their reflections. This ensured that their voice was duly captured and maintained in the ultimate interpretation.

The whole process of analysis was oriented toward Bloom's revised taxonomy, in particular, the cognitive and the affective domain. This orientation assisted in making the process of learning adhere to the objectives of ecological education, not only considering the aspects of knowledge, but also the values and the attitude toward sustainability.

RESULTS AND DISCUSSION

The results of student journals and observations of the class yielded the same image: students showed remarkable increases in ecological consciousness and exhibited remarkable emotional engagement. The majority of students developed an appreciation of how their own actions counted in the broader ecological equation. During the sessions for crafting the kokedama, they showed enthusiasm, creativity, cooperation, and a wish to experiment in practical terms with ecological principles.

Kokedama as a Contextual Learning Tool for NSA High School

The centuries-old Japanese art, kokedama, offers aesthetics, but most significantly, it offers a method of contextual learning within the classroom. In bridging practical gardening skills with fine arts and emotional arts, the kokedama offers an interdisciplinary approach to learning that connects students with nature in multiple capacities.

Works such as Andini (2022) describe the integrative potential of kokedama: connecting practical experience with theory in the school classroom in a way that could deepen students' understanding of ecological principles. But others have been skeptical of whether scientific depth is attained by kokedama. Because so frequently it is focused on aesthetics and emotional impact, there is concern that it does not cover the entire breadth of biological facts needed in the sciences.

In addition, while earlier research like Saputra et al. (2019) proved that kokedama triggers the forming of emotional associations with the environment, its actual, long-term impact on students' environmental actions is a topic of ongoing discussion. Emotional associations, while irreplaceable, are in the end not enough to activate long-term environmental actions unless they are supported with strong, evidence-driven ecological knowledge.

All the same, separate researches (Fajriani et al., 2021) emphasize the potential of kokedama in terms of enhancing a more substantial and immersive learning environment. This is an indication that kokedama must not be considered as a primary teaching approach, but rather the supplementary component of a larger curriculum. In realizing its complete potential, instructors must integrate kokedama activities with more in-depth discussions regarding sustainability, biodiversity, and ecological systems.

In the process, kokedama could not only become an innovative gardening activity but also a transformative teaching method that ignites ecological literacy and sustainable environmental engagement.

Figure 3. Kokedama

Although kokedama has been described as an intra-educational exercise that enables core soft skills like imagination, patience, and responsibility (Astriani et al., 2022), the value for the entire student in developmental terms must be considered in more depth. The aesthetic value of students being able to create and produce their own version of kokedama does develop fine arts expression and imagination. A drawback that is identified, however, is that the task is actually so basic that imagination is curtailed. Absent the integration of other complexities, such as in design thinking or problem-solving, the exercise may not become anything more than recreational.

In maintenance watering daily, checking moisture, and maintenance of the plants students are disciplined and responsible. These day-to-day routines are good for the inculcation of good habits. But the important question is: Do such habits find translation to the rest of life? More importantly, are they retained beyond the experience of the class? A study done by Amalina et al. in 2022 places greater emphasis on group work in the form of kokedama, as this provides students for real opportunities for practicing communications and teamwork. However, the successful achievement of such outcome is greatly contingent on the quality of the setup of the exercise and the facilitation of the group. Ineffective group work will negate the benefit and turn the process the other way.

While kokedama has its limits, it truly offers a unique opportunity for character building, perfectly aligning with the aims of 21st-century education. To fully realize this, however, educators must thoughtfully design kokedama-based learning that moves beyond simple engagement. This means incorporating tasks that demand critical thinking, fostering reflective discussions, and delving deeper into concepts of sustainability. Only then can kokedama transcend being merely an enjoyable activity and become a genuinely transformative learning experience that supports holistic development.

Cognitive and Affective Transformation of NSA High School Students

The thought that hands-on experiences, such as kokedama, have the potential to revolutionize the way students come to understand ecological concepts is appealing, but we need to examine it critically. Having students work directly with soil, plants, and natural materials certainly provides a tangible, memorable experience. It reveals basic concepts, such as the important role that plants have in producing oxygen and taking in carbon dioxide. But the important question remains: just how deep is this understanding? Does kokedama-making actually provide students with broad-based ecological literacy, or do we just engage isolated facts in a more hands-on manner? Although students may develop a better understanding of plant life, their ability to relate such experiences to the larger systemic environment, human

effects, or global sustainability issues might be limited – unless teacher educators take specific care to close these gaps. Experiential learning of the kind represented by kokedama alone is not enough to achieve true cognitive transformation; it needs to be reinforced with substantial content, guided inquiry, and opportunities for questioning and reflecting on the important 'why' and 'how.' In short, kokedama can be valuable for environmental education, but its educational impact hinges entirely on its context and framing. With intentional planning and integration into a broader curriculum, it can support both knowledge building and personal growth.

Furthermore, while hands-on activities emphasize the importance of fertile soil and sustainable agricultural practices (Mahendra et al., 2019), their application in real-world contexts is not guaranteed. Experiential learning often relies heavily on the quality of facilitation and the integration of critical discussions. Without deliberate efforts to connect these experiences to broader ecological challenges, students may fail to see the systemic nature of environmental issues, limiting the activity's transformative potential.

Table 2. Activity Reflection

No.	Student Name	Activity Reflection	Cognitive Transformation Aspect	Affective Transformation Aspect
1	Student 1	Understanding the importance of ecological sustainability in daily life	Understanding basic ecosystem concepts, human-environment relations, and the impact of activities on ecological sustainability	Increasing awareness to reduce household waste
2	Student 2	Enhancing creativity by making kokedama from natural materials	Developing creative and innovative thinking skills in utilizing available natural resources	Feeling happy and proud of eco-friendly creations
3	Student 3	Realizing the potential of plants as eco-friendly decorative elements	Expanding knowledge about the use of ornamental plants in life	Motivated to maintain ornamental plants more frequently at home
4	Student 4	Recognizing the importance of collaboration in creating ecological solutions	Improving teamwork and communication skills	Developing empathy for friends' ideas and perspectives
5	Student 5	Appreciating art and nature through kokedama	Learning to integrate art and biology to produce valuable ecological creations	Becoming more appreciative of the beauty of nature
6	Student 6	Realizing that small actions can have significant impacts	Understanding the link between individual actions and global impacts	Motivated to take small steps to protect the environment
7	Student 7	Understanding the benefits of organic materials for greening	Gaining insights into the properties and benefits of organic planting media	Increasing responsibility in maintaining the school environment

No.	Student Name	Activity Reflection	Cognitive Transformation Aspect	Affective Transformation Aspect
8	Student 8	Improving understanding of the role of plants in maintaining ecosystems	Comprehending the importance of plants in the carbon cycle	Feeling more concerned about greening in the surrounding environment
9	Student 9	Learning the link between biodiversity and human well-being	Understanding the importance of biodiversity for ecosystem balance	Fostering a sense of responsibility for local biodiversity
10	Student 10	Developing ideas to turn waste into planting media	Learning to turn waste into something useful	Inspired to be more prudent in managing waste
11	Student 11	Learning the basics of arranging kokedama properly	Understanding the basics and benefits of kokedama	Boosting confidence in creative endeavors
12	Student 12	Fostering a love for nature through artistic creations	Gaining knowledge about nature-based aesthetics	Becoming more loving toward the surrounding nature
13	Student 13	Understanding how simple actions can reduce carbon footprints	Understanding the positive impacts of reducing carbon footprints	Gaining new enthusiasm for environmental preservation
14	Student 14	Discovering the aesthetic value of readily available materials	Learning to express creativity with local resources	Feeling connected to nature through art
15	Student 15	Identifying the long-term benefits of using organic planting media	Understanding the ecological benefits of using organic materials	Developing concern for the long-term environmental impact
16	Student 16	Realizing the connection between creativity and environmental conservation	Raising awareness of the relationship between creativity and sustainability	Feeling proud of creations that bring ecological benefits
17	Student 17	Feeling proud of eco-friendly creations	Understanding that art can be a tool for environmental preservation	Becoming more aware of environmental aesthetics
18	Student 18	Understanding the importance of maintaining urban environmental balance	Identifying the role of plants in reducing pollution	Increasing empathy for air pollution issues
19	Student 19	Becoming more creative in repurposing used items	Increasing understanding of recycling and sustainability	Feeling satisfied with creatively utilizing used items
20	Student 20	Expanding awareness of global environmental issues	Learning about global environmental issues and local actions that can be taken	Enhancing responsibility for global environmental sustainability
21	Student 21	Motivating oneself to contribute to local greening efforts	Understanding the positive impact of greening on the quality of life	Becoming more enthusiastic about participating in green activities

No.	Student Name	Activity Reflection	Cognitive Transformation Aspect	Affective Transformation Aspect
22	Student 22	Inspired to involve family in simple ecological activities	Improving the ability to explain environmental issues to others	Feeling happy to share knowledge with family about the environment

For instance, Student 4 wrote in her reflection journal: “I used to think plants were just decoration, but now I feel proud knowing I can help the environment by taking care of them.” This illustrates how practical experience catalyzed a change in perception. Likewise, Student 12 reflected: “Making kokedama was like building something with love for nature. It made me want to grow more plants at home and involve my family.”

The activity fostered significant cognitive advancements. Students reported a deeper comprehension of ecosystem balance, sustainability, and the role of individual actions in addressing global environmental challenges, reflecting an enhanced ecological understanding. Addressing global environmental challenges, reflecting an enhanced ecological understanding. Wonderful to see the level of creative thinking in the activity of kokedama. Participants were incredibly creative with recycled and natural materials. This didn't just show they might be able to make garbage look beautiful and be useful; it also indicated some genuine growth in their problem-solving abilities. What's really cool is how kokedama naturally blends subjects. Students were making connections between biology, environmental science, and art, which is great for enabling them to synthesize information from everywhere.

A pronounced evolution in student engagement was systematically observed. Participants who beforehand indicated passive tendencies then evidenced higher engagement, particularly for the important care and maintenance procedures for their kokedama. This upgraded engagement was found to be a direct outcome of the students perceiving the causal relation between the everyday routine and the well-being of the kokedama plants in their care, thus turning their involvement from an obliging chore to an expression of true concern. In addition, indicators of thriving intrinsic motivation were evident, as certain students self-initiated sourced additional plant materials from their personal environments and proactively engaged in group work involving colleagues on sustainable horticultural practices.

Aside from the cognitive improvements, students manifested significant emotional and behavioral transformations. Most expressed a renewed responsibility toward the environment and declared a keen interest in involving their families and communities in sustainable behaviors. The inherent artistic and meditative qualities of kokedama-making cultivated a deeper appreciation for the aesthetic and restorative facets of nature, highlighting its essential role to human well-being. All of the deep emotional connections entailed corresponding

behavioral responses, including a heightened attention to waste reduction and active attempts to complement the existing natural beauty of the immediate environment.

It's crucial to critically examine these outcomes. While students certainly demonstrated empathy and adopted eco-friendly habits, some critics question whether activities like kokedama-making actually test the critical thinking and higher-order cognitive abilities. Lacking careful pedagogical planning and further exploration, kokedama-making runs the risk remaining just a technical task instead of transforming into a forum for deep learning. To be long-term transformative in impact, the instructors must incorporate the experience-based activities in a curriculum that explicitly encourages analytical thought, sophisticated problem-solving, and robust discussions concerning broader environmental systems.

The claim that direct experience with nature leads to empathy and environmental concern (Kurniati, 2020) has been largely accepted but it is not without debate. Although such experiences do in fact create an emotional entrance to understanding, the long-term impact on attitudes and behavior being less definitive. Do empathetic feelings towards plants actually convert into ongoing ecological conscience? Or is it just a temporary sentimental reaction related to the innovativeness of the activity?"

For example, although students may temporarily see themselves as environmental stewards, lasting behavior change requires more than emotion. Emotional experiences need to be scaffolded by critical thinking and structured reflection. Without that, students may revert to old habits once the activity ends. Emotional engagement should be seen as the starting point, not the endpoint.

There’s also a risk of oversimplifying complex environmental challenges. Teaching students to “feel” for nature is important, but it must be accompanied by opportunities to analyze, critique, and act within the context of larger environmental systems. Emotional learning must be integrated with frameworks that promote environmental ethics, scientific understanding, and collective responsibility. Only then can it lead to meaningful and sustained stewardship.

The idea that activities like kokedama-making transform students into responsible environmental citizens (Budiman, 2024) is both inspiring and optimistic. Students participating in composting, planting, and awareness campaigns often exhibit a genuine desire to contribute positively to the planet. But we must ask: are these changes deeply rooted, or are they temporary behaviors shaped by the structure and supervision of a classroom activity?

While internalizing values such as responsibility and care is a key goal, behavioral change is not one-size-fits-all. Factors like home environment, access to green space, and cultural

norms play a major role in whether students can apply what they've learned. For instance, urban students may face limitations in composting or gardening, making it harder to translate school-based lessons into real-world practice. These disparities raise important questions about equity and accessibility in environmental education.

Moreover, placing a focus on individual action while important risks ignoring the broader systemic forces underlying environmental degradation. It is crucial to critically consider these results. Although student involvement in practices like the use of biodegradable pots or the diminishment of plastic usage is most definitely admirable, individual actions alone are unable to significantly offset macro-level issues like global deforestation, industrial pollution, or poorly constructed environmental policies. In turn, environmental education needs to move beyond a sole focus on individual responsibility, instead prompting students to understand their own agency within the context of group and systemic work toward the achievement of substantive environmental improvement.

NSA High School Students Self-Awareness and Ecological Responsibility Enhancement

Accusations that students who go to NSA High School have intensified their environmental responsibility through modest actions like the application of biodegradable substances instead of plastic (Mahrus, 2024) look encouraging. These initial actions, even as they offer a rock-solid teaching basis for the answer to the creation of non-biodegradable waste (Rahman et al., 2019), ought not be conceived as all-encompassing solutions.

A focus on micro-level behavioral change risks detracting from the attention that should be given to larger-scale environmental problems requiring systemic transformation, e.g., industrial pollution or lack of waste management infrastructure. These macro-scale problems essentially require intervention on the level of institutions and policies and should be engaged with vigorously on the understanding and eventual solution levels by the students.

Nevertheless, the incorporation of these small-scale sustainable habits into the curriculum constitutes a pivotal step in the ongoing progression of environmental education. However, educators must also ensure that these lessons foster critical ecological literacy the ability to question, analyze, and think deeply about environmental issues beyond surface-level actions. By doing so, schools can help students grow into not only environmentally conscious individuals, but also informed advocates for change. Are students merely being guided through pre-structured tasks, or are they also being encouraged to critically evaluate and question the systems that perpetuate environmental harm? To ensure lasting ecological responsibility, educational activities must move beyond symbolic gestures, equipping students with the tools

to engage in systemic advocacy and collaborate on transformative solutions for sustainable futures.

In addition, students also begin to appreciate the benefits of natural fertilizers compared to chemical fertilizers. Through hands-on processes, such as making fertilizer from organic waste or using compost, they learn how natural fertilizers not only enrich the soil but also reduce household waste (Marlina et al., 2024). These activities sensitize students to the importance of recycling and utilizing existing resources in a more thoughtful way (Lubis, 2024). This awareness developed into a positive habit, where some students even began to apply the use of natural fertilizers in their home environment as part of their responsibility to the environment (Pariani, 2021).

This activity also encourages students to appreciate the existence of local plants that are often overlooked. They learn that local plants are more adaptive to local environmental conditions, require less maintenance, and have an important role in maintaining the balance of the local ecosystem (Sari et al., 2023). This awareness motivates students to start planting and caring for local plants in their homes, as well as educating people around them about their benefits. Thus, this experience not only improves students' cognitive understanding, but also forms a character that cares more about environmental sustainability through real actions that they can do everyday (Pranata & Zubair, 2022).

Strengthening the Ecopedagogical Values of NSA High School Students

The assertion that environmental activities effectively instill a love for nature among students (Nafisah et al., 2020) highlights a crucial starting point, yet it must go beyond surface-level engagement. While direct interaction with plants fosters emotional connections and gratitude for natural resources (Hidayanti et al., 2018), the real question is whether these feelings translate into sustained behavioral change or remain as transient moments of appreciation. Emotional bonds, while significant, must be fortified with actionable steps and systemic understanding to create meaningful and lasting impact.

Similarly, while activities like kokedama-making promote cooperation through task-sharing and collaborative problem-solving (Adzani et al., 2024), the challenge lies in ensuring that these values are not confined to isolated educational exercises. A pertinent pedagogical question arises: How can educators effectively ensure that the collaborative spirit cultivated within the classroom environment transcends its boundaries and translates into tangible engagement in real-world environmental efforts? Without a deliberate and explicit connection between these experiential learning opportunities and broader societal challenges, the intrinsic value of cooperative learning risks being relegated to a mere perfunctory exercise in team-

building, rather than fostering a transformative skill set essential for addressing complex future challenges (Pratama et al., 2024).

Furthermore, the critical exploration of modern consumptive lifestyles embedded within such activity (Ismail & Sari, 2024) deserves extensive reinforcement within the curriculum. In place of simple comprehension of the deleterious impacts of single-use plastics or ineffective waste-management practices, students need to be empowered to take proactive intervention through the design of innovative solutions and strenuous advocacy. To adequately prepare students for the subtle environmental challenges of the coming decades, hands-on exercises such as kokedama-making need to be embedded within a teaching protocol that encourages critical investigation of systemic issues. It is not sufficient that students should be capable of recognizing environment issues; rather, they need to be empowered to design scalable solutions, critically assess policy interventions, and loudly champion dramatic change. Short of this longer-term and more integrated approach, such activity risks oversimplifying complex environmental narratives and potentially qualifying the preparedness of students to respond to the complex problems of global sustainability. The overriding pedagogic objective needs to be more than mere awareness-raising; it needs to be the generation of proactive agent-of-change students empowered with the skills, knowledge, and inclination to champion transformative change at a local and global level.

CONCLUSION

It is crucial to note that ecological learning does not necessarily require undue complexity or abstract theoretical constructs. Even simple-seeming hands-on practices like kokedama-making also have the potential to develop affective relationships and a more profound intellectual understanding of nature. In doing so, students gain practical knowledge about ecosystem responsibility that includes reducing the use of plastics, favoring natural materials, and creating sustainable plant care practices. More than just presenting basic ecological concepts, kokedama-making provides a fun, creative, and intrinsically rewarding experience that encourages students to take ownership of planetary custodianship.

SUGGESTIONS

To further extend the teaching potential of the kokedama, the inclusion of technology in the activity also presents tantalizing pedagogic possibilities. For instance, pupils might employ moisture sensors to precisely gauge the physiological health of their kokedama, or else access Augmented Reality (AR) software to visually extrapolate the broader ecosystem effects of

anthropogenic activity. These kinds of tech-enhanced activities have the potential to integrate conventional environmental learning with the latest STEM teaching and therefore offer a more immersive and forward-looking teaching paradigm. Through the judicious integration of creativity, sustainability, and innovation, the kokedama becomes a highly influential teaching platform both for learning about nature and for preparing the next generation to conserve it with passion and long-term vision.

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