



# Eco-Pedagogy in Inclusive Schools: Food Security as a Foundation for Sustainable Education

Nurhattati<sup>1\*</sup>, Rihlah Nur Aulia<sup>1</sup>, Ahmad Jauhari Hamid Ripki<sup>2</sup>, Raihan Syarif<sup>3</sup>, Fadhillah<sup>4</sup>

<sup>1</sup> Universitas Negeri Jakarta, Jakarta, Indonesia.

<sup>2</sup> STKIP Kusumanegara, Jakarta, Indonesia.

<sup>3</sup> Universitas Tarumanegara, Jakarta, Indonesia.

<sup>4</sup> Universitas Serambi Mekkah, Aceh, Indonesia.

Received: November 16, 2025

Revised: December 25, 2025

Accepted: January 30, 2026

Published: January 31, 2026

Corresponding Author:

Nurhattati

[nurhattati@unj.ac.id](mailto:nurhattati@unj.ac.id)

DOI: [10.29303/jppipa.v12i1.13934](https://doi.org/10.29303/jppipa.v12i1.13934)

 Open Access

© 2026 The Authors. This article is distributed under a (CC-BY License)



**Abstract:** This study examines how food security can serve as a pedagogical foundation for advancing eco-pedagogy in inclusive elementary education across two contrasting contexts: a nature-based private school and an Islamic elementary madrasa. Using a multi-site qualitative design, it applies participatory ethnographic methods through observations, semi-structured interviews, and school ethnography involving teachers, parents, leaders, and students, including those with special needs. The nature-based school operationalizes eco-pedagogy through hydroponics, organic waste management, and gardening, fostering ecological literacy, collaboration, and shared responsibility. The madrasa frames food security within Islamic commitments to justice, positioning it as both a goal of eco-activism and an expression of religiously grounded social responsibility. Together, these cases show that eco-pedagogy in the Global South extends beyond secular environmentalism and is enriched by faith-based ethics and community practices. The study concludes that embedding food security within inclusive school management broadens eco-pedagogy by situating sustainability education in diverse cultural and religious ecologies, highlighting inclusive schools as effective models of sustainable and socially just education.

**Keywords:** Eco-pedagogy; Food security; Inclusive education; Sustainability education.

## Introduction

The food crisis is one of the most pressing global challenges of the 21st century. The State of Food Security and Nutrition in the World report (Hultgren et al., 2025) notes that more than 2.3 billion people worldwide face moderate to severe food insecurity, with key factors including economic slowdown, limited access to nutritious food, social inequality, and vulnerability to environmental shocks. Economic drivers such as poverty and unemployment prevent many households from meeting their daily food needs, let alone maintaining a nutritious diet (Akbar et al., 2023). This situation is exacerbated by climate change, which disrupts cropping patterns, reduces yields, and triggers rising food prices (Kotz et al., 2024). In the field of

education, food insecurity has significant implications. School meal programs implemented by agencies such as the World Food Programme (WFP), as well as national governments, including Indonesia, serve as lifelines for millions of children in vulnerable communities. For many, these meals represent the only reliable source of daily nutrition, directly improving attendance, concentration, and long-term educational outcomes (Spill et al., 2024). Evidence from Romania further shows that providing hot meals in rural schools reduces dropout rates, enhances engagement, and supports the holistic development of children from low-income families (Guio, 2023).

Beyond food provision, schools can also play an active role in food production, distribution, and sustainable management, for instance, through

## How to Cite:

Nurhattati, Aulia, R. N., Ripki, A. J. H., Syarif, R., & Fadhillah. (2026). Eco-Pedagogy in Inclusive Schools: Food Security as a Foundation for Sustainable Education. *Jurnal Penelitian Pendidikan IPA*, 12(1), 458-467. <https://doi.org/10.29303/jppipa.v12i1.13934>

initiatives such as school gardening, hydroponics, or farm-to-school programs (Hoover et al., 2021). These initiatives not only address nutritional needs but also foster ecological literacy, resilience, and social responsibility among students. Within the field of environmental education, scholars highlight that food security education is increasingly framed through the lens of sustainable cultures, which emphasize interdependence among all living beings (Jones & Bear, 2025). Yet, contradictions remain, as some curricular documents still present hierarchical or anthropocentric views of human-nature relations. Thus, education cannot be separated from the issue of food security. Schools are not only spaces for knowledge transmission but also arenas for ensuring health, survival, and well-being. Within the framework of sustainable education, integrating food security into curricula and school management is a crucial step toward equipping students with ecological literacy, life skills, and social awareness. In this context, the concept of eco-pedagogy offers a critical approach to connect the global food crisis with educational practice, particularly in inclusive schools that serve diverse learners, including those with special needs.

Meanwhile, eco-pedagogy emerged as a critical extension of Freirean pedagogy, situating environmental issues within broader struggles for justice, equity, and human emancipation. Rooted in Paulo Freire's (Karpouzis et al., 2025) call for a pedagogy of planetary responsibility, Eco pedagogy emphasizes that education should cultivate critical ecological consciousness and challenge structures that perpetuate social and environmental oppression (Misiaszek, 2023). Rather than treating ecological education as a technical or apolitical endeavor, eco-pedagogy insists that learning about the environment must be connected to values of democracy, solidarity, and justice (Misiaszek, 2023; Orman, 2024). In practice, eco-pedagogy integrates environmental awareness, participatory learning, and social action. Sundin et al. (2024) highlights that schools can become laboratories for sustainability where students actively engage in ecological practices such as gardening, waste management, or local food production. Such practices are not merely instrumental; they embody ecological justice by linking survival skills with collective responsibility. Eco pedagogy therefore provides a framework for connecting food security with sustainable education—where producing, distributing, and consuming food is grounded in ethical relations with both human and non-human communities (Martin et al., 2024).

The relevance of eco-pedagogy becomes especially salient in inclusive schools, where diverse learners—including children with special needs—engage in both

the practical and ethical dimensions of ecological learning. In nature-based schools, Eco pedagogy often takes hands-on form, with strong emphasis on practice such as hydroponic farming, composting, and organic gardening. Here, sustainability is the ultimate goal, cultivated through experiential learning that nurtures ecological literacy and life skills (Cañón-vargas & Melomora, 2025). By grounding learning in practice, these schools operate eco-pedagogy as a pathway toward sustainable futures. In contrast, Islamic schools such as madrasas frame eco-pedagogy through religious and ethical discourses. Drawing on progressive interpretations of Islam, ecological justice is understood as a moral imperative grounded in the Quranic principles of balance (*mizan*) and stewardship (*khalifah*). While such schools may not always engage in extensive agricultural practice, they manifest eco-pedagogical principles through the governance of school canteens, the integration of food justice in free meal programs, and collaborations with local food economies. These practices highlight that eco-pedagogy is not confined to ecological technique but extends to ethical commitments that connect education, religion, and social justice (Misiaszek, 2023; Viktor, 2024).

Although there is a growing body of literature on eco-pedagogy and its relevance to sustainability education (Kwon & Kang, 2025), existing research tends to focus on Western or Global North contexts. Studies often highlight either practical ecological interventions—such as school gardening or waste management—or conceptual critiques of neoliberal education systems, but rarely together in culturally diverse settings. In the Global South, and particularly in Indonesia, research that connects food security practices with eco-pedagogical principles in inclusive education remains limited. Furthermore, the role of religiously inspired pedagogies, such as Islamic perspectives on ecological justice, has received little scholarly attention in relation to eco-pedagogy.

This gap is significant because food insecurity is a pressing issue in Indonesia, where schools are directly implicated not only in the distribution of meals but also in the cultivation of food literacy and survival skills. At the same time, inclusive schools must adopt eco-pedagogical practices to accommodate students with diverse needs, ensuring both equity and participation. Without examining how eco-pedagogy operates in these varied contexts—ranging from nature-based schools with strong practical orientations to madrasas embedding ecological justice through religious values, the theoretical and practical contributions of eco-pedagogy risk remaining incomplete. This study seeks to address existing gaps by investigating how food security can function as a pedagogical foundation for

promoting sustainability education in inclusive elementary schools. It specifically examines eco-pedagogy in two distinct school settings in Indonesia: a nature-based private elementary school and an Islamic madrasa. The research explores how food security initiatives—such as hydroponic farming, waste management, canteen governance, and free meal programs—support the development of ecological literacy, life skills, and social inclusion, including for students with special needs. Furthermore, it compares how ecological justice is operationalized in these contexts, contrasting hands-on, practical sustainability activities in the nature-based school with religiously grounded values of justice and stewardship in the madrasa. Finally, the study aims to contribute to the theoretical development of Eco pedagogy by situating it within Global South contexts and highlighting its intersections with faith-based values, inclusivity, and food security. By pursuing these objectives, the research enriches both the theoretical discourse on eco-pedagogy and provides practical strategies for schools in developing countries navigating the interconnected challenges of food insecurity, climate change, and inclusive education.

Eco-pedagogy is a critical pedagogical framework that integrates environmental consciousness, social justice, and participatory learning. Its intellectual roots lie in Darracott (2024) pedagogy of emancipation, which emphasizes the development of critical consciousness to challenge structural inequalities. Freire argued that education should be transformative, enabling learners to understand and act upon social and ecological injustices. Building on this, Darracott (2024) conceptualized eco-pedagogy as education that not only imparts knowledge about environmental issues but also cultivates values of equity, sustainability, and collective responsibility. Eco-pedagogy underscores that environmental literacy must be intertwined with social ethics, encouraging learners to critically engage with ecological, economic, and cultural dimensions of sustainability (Misiaszek, 2023). Christodoulou & Grace (2025) further emphasizes that schools are central sites for fostering ecological citizenship, where students can experience learning through both reflective and practical engagements with their environment.

In the context of inclusive education, eco-pedagogy provides a framework for addressing the diverse needs of learners while embedding sustainability principles in everyday school practices. It situates learning as a participatory process, where students co-create knowledge, engage in hands-on activities, and develop critical awareness about ecological justice. This approach challenges traditional hierarchies of knowledge and fosters empowerment, particularly for

marginalized groups, including children with special needs (Misiaszek, 2023). Food security is not only a matter of nutrition but also a pedagogical opportunity to teach life skills, social solidarity, and ecological responsibility. Integrating food-related practices in schools—such as gardening, waste management, and school-based food distribution—enhances students' understanding of sustainable food systems while fostering collaborative and ethical behaviour (Kempner et al., 2025). Studies have shown that participation in food production and management helps children acquire practical skills, develop problem-solving capabilities, and understand the socio-environmental implications of food insecurity (Strgar et al., 2025). Moreover, food security interventions in schools can strengthen social cohesion and collective responsibility, as students, teachers, and families collaboratively engage in activities that address local and global food challenges (Kanosvamhira, 2025).

This approach aligns directly with eco-pedagogical principles, in which learning is experiential and ethically grounded. By framing food security as both a social and environmental concern, schools can cultivate ecological literacy and foster a culture of care, resilience, and justice among learners. Inclusive education ensures that students with diverse abilities, including those with special needs, can fully participate in learning opportunities. Within an eco-pedagogical framework, inclusivity extends beyond access to information; it involves designing participatory learning environments that accommodate varied physical, cognitive, and social needs (Stephens et al., 2025). Food security initiatives in schools provide meaningful platforms for inclusion, enabling students with special needs to contribute to communal activities such as gardening, composting, and meal preparation. Such engagement not only develops practical life skills but also nurtures self-confidence, social integration, and a sense of shared responsibility, embodying the ethical and participatory principles central to eco-pedagogy (Aragón & Erdozain, 2025).

Most eco-pedagogy literature originates from Global North contexts, which may not fully account for socio-cultural, religious, and economic realities in the Global South. Decolonial perspectives argue that educational frameworks should be adapted to local knowledge systems, community-based practices, and spiritual values (Vandeyar, 2025). In Indonesia, for example, inclusive schools operate within both secular and spiritual frameworks. Nature-based schools emphasize experiential, practice-oriented eco-pedagogy with sustainability as the goal. In contrast, madrasas may embed eco-pedagogical principles within Islamic ethics, emphasising ecological justice through stewardship, communal welfare, and moral

responsibility, even when practical agricultural activities are limited. Such contextualised approaches highlight the need to integrate community-based, culturally grounded, and faith-informed perspectives into eco-pedagogy, particularly in settings where social, environmental, and economic challenges intersect (Mahdi et al., 2024). By bridging eco-pedagogy with food

security, inclusivity, and decolonial perspectives, this literature review establishes a theoretical foundation for examining how schools in diverse contexts—ranging from nature-based to Islamic inclusive schools—can operationalise sustainability education in ways that are both ethical and practical.

**Table 1.** Conceptual framework

Level	Components	Description / Examples	References
Core Concept	Eco-pedagogy	Critical pedagogy applied to environmental and social justice; emphasizes sustainability, participatory learning, ethical responsibility	(Cicchino et al., 2023)
Key Dimensions	Food Security Practices	School gardening, hydroponics, organic waste management, meal programs, local UMKM collaboration	(Putra, 2020)
	Inclusive Education	Participation of students with diverse abilities, life skills development, social integration & solidarity	(Kirana et al., 2025)
	Contextual Factors / Global South	Nature-based schools → practice-oriented; Madrasas → values-oriented, Islamic ethical framing; community-based education	(Puteri et al., 2025)
Mechanisms	Pedagogical Strategies	Experiential learning (hands-on), ethical & participatory governance, collaborative engagement (students, teachers, parents, community)	(Spill et al., 2024)
Outcomes	Student & School Impacts	Ecological literacy, life skills & survival competencies, social inclusion & solidarity, sustainable school practices	(Nugraha et al., 2022)

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

**Method**

This study used a multi-site qualitative research design to explore the operationalization of Eco pedagogy through food security practices in inclusive elementary schools. Two educational settings in Karawang, Indonesia, were selected: a nature-based private elementary school, emphasizing experiential and practice-oriented sustainability, and an Islamic madrasa, framing ecological justice through religious values. This selection provided comparative insights into how eco-pedagogy is applied in distinct

pedagogical and cultural contexts while addressing the shared challenge of promoting food security. Data were collected through participant observation, semi-structured interviews, and participatory ethnography. Observations focused on food security practices such as gardening, hydroponics, organic waste management, meal preparation, and canteen governance. In-depth semi-structured interviews were conducted with teachers, school leaders, parents, and students to understand their perspectives on eco-pedagogy and food security initiatives. Special attention was given to students with special needs to ensure inclusivity. The researcher actively participated in school activities, including gardening and meal programs, which provided a deeper understanding of how sustainability and ecological justice principles were enacted. Data

were analyzed thematically using iterative reading and coding of interview transcripts, field notes, and school documents. Triangulation across multiple data sources, interviews, observations, and document analysis – was used to ensure the reliability and validity of the findings. This approach identified patterns, contrasts, and unique practices that illustrate how eco-pedagogy is implemented in nature-based schools and madrasas, with a focus on inclusive practices for students with diverse abilities.

## Results and Discussion

The findings of this study demonstrate that food security, when embedded within inclusive school management, serves as a powerful mechanism for operationalizing eco-pedagogy across diverse educational contexts. By examining two distinct sites – a nature-based private elementary school and an Islamic madrasa – this research highlights that eco-pedagogy is a flexible, context-sensitive pedagogical approach capable of integrating practical activities, ethical-religious values, and inclusive principles in locally meaningful ways (Amaliati et al., 2024). In both contexts, food security was not merely a matter of feeding students; it was deeply intertwined with the cultivation of ecological awareness, social solidarity, and life skills, reflecting the broader objectives of sustainable education.

In the nature-based school, eco-pedagogy was operationalized primarily through hands-on, practice-oriented activities, including hydroponic farming, school gardening, and organic waste management. These activities functioned as living laboratories, enabling students to engage directly with ecological processes, understand the cycles of food production, and develop a sense of agency and responsibility toward the environment (Szentendrey, 2025). The practical orientation of these initiatives reflects a sustainability-first model, where experiential learning serves as the foundation for both environmental consciousness and life skills development.

Participation in these activities promoted ecological literacy, allowing students to connect theoretical knowledge with practical, observable outcomes. Moreover, the school's approach fostered collaboration and collective responsibility, as students, teachers, and parents co-managed gardens, composting projects, and recycling initiatives. This collaborative engagement extended beyond technical skills, creating a school culture that emphasized shared accountability for sustainability and food security. The integration of practical learning with communal responsibility

illustrates how eco-pedagogy can be embodied and participatory, rather than abstract or purely cognitive.

Importantly, students with special needs were actively included in these practical activities, providing them with opportunities to develop life skills, survival competencies, and social integration. Through involvement in planting, harvesting, and managing food-related projects, these students gained confidence, peer recognition, and a sense of contribution to the community, highlighting the potential of eco-pedagogy to support inclusive education (Kong & Chen, 2024). The case of the nature-based school exemplifies practice-driven eco-pedagogy, where sustainability education is experienced directly through action, engagement, and co-creation.

In contrast, the madrasa implemented eco-pedagogy through a values-oriented, ethical-religious paradigm, drawing on progressive Islamic principles such as justice ('adl), balance (mizan), and stewardship (khalifah) (Taufik et al., 2025). While technical agricultural practices were limited, food security was operationalized through ethical and organizational practices, including canteen governance, school meal programs, food waste management, and collaboration with local food enterprises (UMKM). These activities aligned with the principles of eco-justice, embedding environmental responsibility within a framework of moral and social obligations.

For students with special needs, participation in food-related activities was mediated by ethical and spiritual values, emphasizing compassion, dignity, and inclusion. Even in the absence of extensive technical practice, the madrasa's approach cultivated social cohesion, collective responsibility, and solidarity, demonstrating that eco-pedagogy can be operationalized through moral and religious commitments as effectively as through hands-on ecological interventions (Misiaszek, 2023). The madrasa exemplifies a values-driven model of eco-pedagogy, in which sustainability and social inclusion are inseparable from ethical and religious education.

The comparative analysis of the two schools demonstrates distinct but complementary pathways for operationalizing Eco pedagogy through food security and inclusive education. In nature-based school, the emphasis is on hands-on, practice-oriented activities, where students actively engage in gardening, hydroponics, and organic waste management. These experiential practices enhance ecological literacy, provide life skills and survival competencies, and foster collaboration among students, teachers, and parents. Students with special needs are fully included in these activities, which builds confidence, promotes peer solidarity, and strengthens participatory school culture.

Conversely, the Islamic madrasa frames Eco pedagogy within a values-driven, ethical-religious context, emphasizing justice, balance, and stewardship as guiding principles. Food security is operationalized through school meal programs, canteen governance, food waste management, and collaboration with local UMKM. Inclusion of students with diverse abilities is

mediated by moral principles such as compassion and respect, promoting social integration and collective responsibility. Although technical agricultural practices are limited, the madrasa demonstrates that Eco pedagogy can be effectively operationalized through ethical and community-based governance, reinforcing sustainability and social cohesion.

**Table 2.** Nature-Based School Elementary vs Islamic Elementary Madrasah

Dimension / Mechanism	Nature-Based School	Islamic Madrasah
Food Security Practices	School gardening, hydroponic farming, organic waste management; hands-on food production and management	Canteen governance, school meal programs, food waste management, collaboration with local UMKM; focus on ethical distribution rather than technical cultivation
Inclusive Education	Participation of students with diverse abilities in practical activities; development of life skills and survival skills; peer collaboration	Inclusion mediated through Islamic ethics (compassion, respect, dignity); life skills and social integration emphasized via moral and community-oriented activities
Contextual Factors / Global South	Practice-oriented, hands-on sustainability approach; local ecological systems as learning laboratories	Values-oriented, ethical-religious framing; community-based education emphasizing justice ('adl), balance (mizan), and stewardship (khalifah)
Pedagogical Strategies / Mechanisms	Experiential learning, collaborative projects, participatory engagement of students, teachers, and parents	Ethical and participatory governance, integration of religious values, community involvement, collaboration among students, teachers, and local stakeholders
Student & School Outcomes	High ecological literacy; practical competencies in food production; strengthened social collaboration; development of inclusive and participatory school culture	Social inclusion and solidarity rooted in ethical and religious principles; awareness of food justice; moral responsibility toward community; sustainable practices embedded in school governance

Together, these cases reveal that eco-pedagogy in the Global South is not monolithic but adaptable to local ecological, cultural, and religious contexts. While the nature-based school emphasizes practical, embodied learning, the madrasa prioritizes ethical and value-oriented engagement. Both approaches converge on key outcomes, including food security, life skills development, ecological and social literacy, and the promotion of inclusive, sustainable school practices. This highlights the potential of flexible, context-sensitive eco-pedagogy to integrate environmental, social, and educational goals, offering a model for inclusive and sustainable education in diverse settings.

A comparative analysis of the two cases highlights that eco-pedagogy is not a monolithic framework, but rather adaptable to diverse cultural, institutional, and environmental contexts. In the nature-based school, Eco pedagogy is practice-centered, emphasizing direct engagement with ecological systems as a pathway to sustainability, inclusion, and skill development. In the madrasa, eco-pedagogy is ethics-centered, where

sustainability emerges through the integration of moral, spiritual, and community-oriented practices. Despite these differences, both cases converge on shared outcomes: enhanced ecological literacy, life skills development, social inclusion, and community engagement, underscoring complementary pathways for embedding eco-pedagogy in schools (Balan et al., 2025).

From a Global South perspective, these findings challenge the Western-centric narrative of Eco pedagogy, which often privileges secular, technical, and environmentalist perspectives. By situating Eco pedagogy within local ecological, cultural, and religious contexts, schools in Indonesia illustrate pluralistic and contextually grounded approaches that expand the theoretical and practical horizons of Eco pedagogy. The cases demonstrate that eco-pedagogy in the Global South can integrate practical, ethical, and culturally relevant dimensions, allowing students to engage with food security and sustainability in ways that resonate

with their lived experiences (Lima et al., 2025; Misiaszek, 2023).

Hence, the findings contribute to eco-pedagogy both theoretically and practically. Theoretically, it expands the discourse by demonstrating that eco-pedagogy can encompass both practice-based ecological literacy and values-driven, ethical education. This pluralistic interpretation highlights the flexibility of eco-pedagogy to respond to diverse pedagogical, cultural, and religious contexts. Practically, the findings offer actionable insights for schools facing pressing challenges such as food insecurity and climate change. By embedding food security into inclusive education, schools can address environmental sustainability, strengthen social solidarity, and enhance participation for students with special needs (Fadli et al., 2026).

Inclusive schools are uniquely positioned to act as laboratories for sustainable futures, where education, environment, and social inclusion intersect. By aligning food security practices with eco-pedagogical principles, schools can cultivate ecological literacy, life skills, and collective responsibility while promoting the inclusion of students with diverse abilities. The dual approach—practical in nature-based schools, ethical-religious in madrasas—demonstrates that inclusive schools can simultaneously teach, empower, and model sustainable, socially just practices, offering adaptable strategies for other contexts in the Global South (Nugroho et al., 2025).

## Conclusion

This study demonstrates that integrating food security within inclusive school management provides a robust avenue for operationalizing eco-pedagogy in diverse educational settings. By comparing a nature-based private elementary school and an Islamic madrasa, the research highlights that eco-pedagogy is a flexible, context-sensitive framework capable of incorporating hands-on ecological practices, ethical-religious values, and inclusive strategies to enhance sustainability, social solidarity, and life skills. The nature-based school exemplifies practice-driven eco-pedagogy, where students engage directly with gardening, hydroponics, and organic waste management to develop ecological literacy, practical competencies, and collaborative skills. Meanwhile, the madrasa illustrates a values-driven, ethical-religious model, where eco-justice principles, school meal programs, food waste management, and community engagement cultivate moral responsibility, social cohesion, and inclusion of students with diverse abilities. The comparative analysis underscores that eco-pedagogy in the Global South is not monolithic; it is adaptable to local cultural, religious, and environmental

contexts, challenging Western-centric assumptions of sustainability education. Both models converge on key outcomes—enhanced ecological literacy, life skills development, social inclusion, and sustainable school practices—demonstrating complementary pathways for embedding eco-pedagogy in schools. Theoretically, the study expands the discourse on eco-pedagogy by showing how practice-based and values-oriented approaches can coexist and reinforce each other. Practically, it offers actionable insights for educators and policymakers to design inclusive, contextually grounded, and sustainability-oriented educational programs. Ultimately, the findings suggest that inclusive schools can act as laboratories for sustainable futures, where environmental stewardship, social justice, and education intersect to empower students and communities alike.

## Acknowledgments

The authors would like to express their sincere gratitude to the Directorate of Research, Technology, and Community Service (DRTPM) for providing financial support through the Fundamental Research Grant that made this study possible. The authors also extend their appreciation to Universitas Negeri Jakarta for granting the opportunity and institutional support to conduct this research.

## Author Contributions

Conceptualization, Nurhattati and Fadhillah; methodology, Nurhattati; software, Ahmad Jauhari Hamid Ripki; validation, Nurhattati, Ahmad Jauhari Hamid Ripki, and Raihan Syarif; formal analysis, Nurhattati and Rihlah Nur Aulia; investigation, Nurhattati and Ahmad Jauhari Hamid Ripki; resources, Nurhattati and Rihlah Nur Aulia; data curation, Rihlah Nur Aulia and Ahmad Jauhari Hamid Ripki; writing—original draft preparation, Nurhattati; writing—review and editing, Nurhattati, Ahmad Jauhari Hamid Ripki, and Raihan Syarif; visualization, Rihlah Nur Aulia; supervision, Nurhattati; project administration, Nurhattati; funding acquisition, Nurhattati. All authors have read and agreed to the published version of the manuscript.

## Funding

This research was funded by the Directorate of Research, Technology, and Community Service (DRTPM), Ministry of Education, Culture, Research, and Technology, Republic of Indonesia, through the Fundamental Research Grant scheme.

## Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

## References

- Akbar, A., Darma, R., Fahmid, I. M., & Irawan, A. (2023). Determinants of Household Food Security during

- the COVID-19 Pandemic in Indonesia. *Sustainability*, 15(5), 1–16. <https://doi.org/10.3390/su15054131>
- Amaliati, S., Rusydiyah, E. F., & Bakar, M. Y. A. (2024). Ecopedagogy and Environmental Literacy in Research Trends in Indonesia. *Qalamuna*, 16(2), 1083–1100. <https://doi.org/10.37680/qalamuna.v16i2.5359>
- Aragón, L., & Erdozain, B. (2025). Can school gardens contribute to resilient communities from a scientific and eco - social perspective in early childhood education? *Journal of Outdoor Environmental Education*, 7(67), 1–23. <https://doi.org/10.1007/s42322-024-00185-1>
- Balan, I. M., Trasca, T. I., Ocnean, M., Horablaga, A., Mateoc-Sirb, N., Salasan, C., Tiu, J. V., Radoi, B. P., Lile, R. A., & Firu Negoescu, G. A. (2025). Connecting SDG 2: Zero Hunger with the Other SDGs—Teaching Food Security and the SDGs Interdependencies in Higher Education. *Sustainability (Switzerland)*, 17(16), 1–22. <https://doi.org/10.3390/su17167496>
- Cañón-vargas, A. M., & Melo-mora, S. P. (2025). School gardens as a research setting for early childhood children to strengthen their environmental awareness and scientific skills. *Discover Education*, 4(1). <https://doi.org/10.1007/s44217-025-00785-z>
- Christodoulou, A., & Grace, M. (2025). Becoming ' Wild Citizens ': Children ' s Articulation of Environmental Citizenship in the Context of Biodiversity Loss. *Science & Education*, 34(3), 969–997. <https://doi.org/10.1007/s11191-024-00558-4>
- Cicchino, A. S., Balgopal, M. M., Weinberg, A. E., & Mcmeeking, L. B. S. (2023). Critical pedagogy of place to enhance ecological engagement activities. *Practice and Policy*, 37(October 2022), 1–10. <https://doi.org/10.1111/cobi.14023>
- Darracott, R. (2024). Ecopedagogy in Remote Digitally Facilitated Field Education Experiences : Embedding Ecosocial Work in Practice. *Social Science Studies*, 13(12). <https://doi.org/10.3390/socsci13120633>
- Fadli, Z., Ismail, I., Pattimura, U., Bosowa, U., & Puangrimaggalatung, U. (2026). Social Policy, Food Security, and Educational Motivation: Analyzing the Implementation of the Free Nutritious Meal Program in Urban Indonesia. *Baileo: Jurnal Sosial Humaniora*, 3(2), 407–425. Retrieved from <https://shorturl.asia/TnmR6>
- Guio, A. (2023). Free school meals for all poor children in Europe: An important and affordable target? *Children & Society*, 37(January), 1627–1645. <https://doi.org/10.1111/chso.12700>
- Hoover, A., Vandyousefi, S., Martin, B., Nikah, K., Cooper, M. H., Muller, A., Marty, E., Duswalt-epstein, M., Burgermaster, M., Waugh, L., Linkenhoker, B., & Davis, J. N. (2021). Barriers , Strategies , and Resources to Thriving School Gardens. *Journal of Nutrition Education and Behavior*, 53(7), 591–601. <https://doi.org/10.1016/j.jneb.2021.02.011>
- Hultgren, A., Carleton, T., Delgado, M., Gergel, D. R., Greenstone, M., Houser, T., Hsiang, S., Jina, A., Kopp, R. E., Malevich, S. B., Mccusker, K. E., Mayer, T., Nath, I., & Rising, J. (2025). Impacts of climate change on global agriculture accounting for adaptation. *Nature*, 642(February 2023). <https://doi.org/10.1038/s41586-025-09085-w>
- Jones, V., & Bear, C. (2025). Learning to care in the food system : Education for Sustainable Development resources , food education and the farming of animals for food. *Environmental Education Research*, 1–21. <https://doi.org/10.1080/13504622.2025.2504532>
- Kanosvamaha, T. P. (2025). Growing together: unveiling the potential of school-based community gardens to foster well-being, empowerment, and sustainability. *Urban Transformations*, 7(1). <https://doi.org/10.1186/s42854-024-00069-z>
- Karpouzis, F., Anastasiou, K., Lindberg, R., Walsh, A., Shah, S., & Ball, K. (2025). Systematic Review Effectiveness of School-based Nutrition Education Programs that Include Environmental Sustainability Components , on Fruit and Vegetable Consumption of 5 - 12YearOld Children : A Systematic Review. *Journal of Nutrition Education and Behavior*, 57(7), 627–642. <https://doi.org/10.1016/j.jneb.2025.02.008>
- Kempler, J. V., Margerison, C., Nanayakkara, J., & Booth, A. (2025). Examining the role of school food gardens , food waste systems and cooking facilities in experiential education : a cross-sectional survey of primary school teachers ' practices. *Archives of Public Health*, 83(285). <https://doi.org/10.1186/s13690-025-01761-7>
- Kirana, E., Zam, F., & Henjilito, R. (2025). Analysis of the Impact of Inclusive Education on the Social Development of Students with Special Needs in Primary Schools. *Journal of Foundational Learning and Child Development*, 27, 6–11. <https://doi.org/10.53905/ChildDev.v1i01.2>
- Kong, C., & Chen, J. (2024). School garden and instructional interventions foster children's interest in nature. *People Natur*, 6(May 2023), 712–732. <https://doi.org/10.1002/pan3.10597>
- Kotz, M., Kuik, F., Lis, E., & Nicke, C. (2024). Global warming and heat extremes to enhance inflationary pressures. *Communication Earth &*

- Environment*, 5(2024), 1–13.  
<https://doi.org/10.1038/s43247-023-01173-x>
- Kwon, S., & Kang, H. (2025). Exploring the relationship between sustainability and human rights: ecological transition education and its relevance to students' human rights in South Korean education. *Asia Pacific Education Review*, 26(3), 839–850. <https://doi.org/10.1007/s12564-025-10070-1>
- Lima, Oliveira, H. de, Silva, L. M. da, Tavares, L. R., Araújo, A. C. L. F. de, Moreira, L. P., Torres, V. de M. S., Oliveira, F. N. de, Ho, A. M.-H., Simões, D., & Vieira, G. B. M. & J. E. (2025). Association between hospital accreditation and healthcare providers' perceptions of patient safety culture: a longitudinal study in a healthcare network in Brazil. *Israel Journal of Health Policy Research*, 14(27), 1–10. <https://doi.org/10.1186/s13584-025-00690-8>
- Mahdi, H., Sari, S. W., Sari, S. I., & Nazwa, N. R. (2024). Green Islamic School: Integrating Environmental Education in the Islamic Education Curriculum. *Cendekiawan: Jurnal Pendidikan Dan Studi Keislaman*, 3(3), 565–574. <https://doi.org/10.61253/cendekiawan.v3i3.270>
- Martin, A. E., Haines, J., & Fraser, E. D. G. (2024). Development of the Food Systems Literacy Competencies Framework for youth: A modified Delphi study with experts. *Food Policy*, 128(August), 102702. <https://doi.org/10.1016/j.foodpol.2024.102702>
- Misiaszek, G. W. (2023). Ecopedagogy: Freirean teaching to disrupt socio-environmental injustices, anthropocentric dominance, and unsustainability of the Anthropocene. *Educational Philosophy and Theory*, 55(11), 1253–1267. <https://doi.org/10.1080/00131857.2022.2130044>
- Nugraha, R. G., Jalal, F., Program, P., & Jakarta, U. N. (2022). Improving Student' S Eco -Literacy Skills Through The Use Of The Eco-Literacy Module. *Indonesia Journal of Sicoal Research*, 4(3), 178–186. <https://doi.org/10.30997/ijsr.v4i3.231>
- Nugroho, U. E., Nugroho, A. S., & Hayat, M. S. (2025). Bridging Sustainability and Pedagogy: A Narrative Review of Education for Sustainable Development (ESD) Implementation in Indonesian Science Education. *Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 13(2), 348–374. <https://doi.org/10.33394/j-ps.v13i2.15116>
- Orman, T. F. (2024). Exploring youth eco-literacy through lived experiences. ' When you purchase a pair of jeans , you bear the burden of child labor in South Asia. *The Journal of Environmental Education*, 55(5), 363–377. <https://doi.org/10.1080/00958964.2024.2345354>
- Puteri, S. A., Sekarningrum, B., & Lesmana, A. C. (2025). Pembentukan Kesadaran Neurodiversitas dalam Pendidikan Inklusi Berbasis Alam melalui Tinjauan Interaksionisme Simbolik di Sekolah Alam Bandung. *Jurnal Ilmu Sosial Dan Humaniora*, 8(3), 505–520. <https://doi.org/10.37329/ganaya.v8i3.4757>
- Putra, L. V. (2020). Analysis of the Hydroponics Program in Instilling an Environmental Care Attitude for Elementary School Students. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan*, 4(3), 299–307. <https://doi.org/10.36312/e-saintika.v4i3.273>
- Spill, M. K., Trivedi, R., Thoerig, R. C., Balalian, A. A., Schwartz, M. B., Gundersen, C., Odoms-Young, A., Racine, E. F., Foster, M. J., Davis, J. S., & MacFarlane, A. J. (2024). Universal Free School Meals and School and Student Outcomes: A Systematic Review. *JAMA Network Open*, 7(8), e2424082. <https://doi.org/10.1001/jamanetworkopen.2024.24082>
- Stephens, C. G., Antwi, S. H., & Linnane, S. (2025). Universal Design for Learning ( UDL ): a framework for re-design of an Environmental Education ( EE ) outreach program for a more inclusive and impactful Science Festival event. *Discover Artificial Intelligence*, 4(217). <https://doi.org/10.1007/s44217-025-00660-x>
- Strgar, J., Torkar, G., Krajšek, S. S., & Torkar, G. (2025). The purpose of the school garden is more than just growing plants. *Journal of Biological Education*, 00(00), 1–13. <https://doi.org/10.1080/00219266.2025.2489512>
- Sundin, N., Malefors, C., Strotmann, C., Orth, D., Kaltenbrunner, K., Obersteiner, G., Scherhauser, S., Sj, A., Persson, C., Strid, I., & Eriksson, M. (2024). Sustainability assessment of educational approaches as food waste prevention measures in school catering. *Journal of Cleaner Production*, 481(25). <https://doi.org/10.1016/j.jclepro.2024.144196>
- Szentendrey, R. (2025). School Gardens as Commons : Fostering Relational Values for Biodiversity Through Participatory Environmental Education. *International Journal of the Commons*, 19(1), 431–443. <https://doi.org/10.5334/ijc.1539>
- Taufik, M., Kejora, B., Komariah, A., Herawan, E., & Sudaryah, A. (2025). Ekopesantren : An Ecology-Based Education Model with Local Wisdom Supports the Sustainable Development Goal ' s. *Al Islah: Jurnal Kependidikan*, 17, 291–306. <https://doi.org/10.35445/alishlah.v17i1.6246>
- Vandeyar, S. (2025). Decolonialisation of education : the pre-service teacher turn. *Teacher Development*, 29(2), 187–203.

<https://doi.org/10.1080/13664530.2024.2401872>

Viktor, A. (2024). Climate Change in Religious Education and the Importance of Hope : A Systematic Review of International Journal Articles 2000 - 2022 Climate Change in Religious Education and the Importance of Hope : A Systematic Review of International. *Religious Education*, 119(3), 191-209.

<https://doi.org/10.1080/00344087.2024.2340175>