



Original Research Paper

Educating Learners on Environmental Flora and Fauna Resources for Sustainable Utility: A Systematic Review of Educational Approaches, Learning Outcomes, and Influencing Factors

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ABSTRACT

Environmental education has become an essential foundation for strengthening ecological literacy and advancing the sustainable utilization of flora and fauna resources amid escalating biodiversity degradation and environmental challenges. This systematic review synthesized and critically evaluated contemporary evidence on educational approaches, learning outcomes, and factors influencing the effectiveness of environmental flora and fauna education for sustainable utility. Guided by the PRISMA 2020 framework, relevant peer-reviewed studies published between 2020 and 2026 were systematically identified from major academic databases and synthesized through narrative thematic analysis. The evidence consistently demonstrated that experiential and inquiry-based learning constitute the predominant instructional approaches for promoting environmental understanding. Flora and fauna education was further associated with enhanced ecological literacy, environmental stewardship, and sustainable behavioral practices. Educational effectiveness was consistently strengthened through contextualized curriculum implementation and teacher pedagogical competence. Collectively, the synthesized evidence affirms that integrating evidence-informed, contextually responsive, and learner-centered biodiversity education into formal educational systems is fundamental to cultivating environmentally responsible citizens capable of supporting long-term ecological conservation and sustainable resource utilization.

KEYWORDS: *Environmental Education; Flora and Fauna; Sustainable Utility; Ecological Literacy; Environmental Stewardship; Inquiry-Based Learning;*

INTRODUCTION

Environmental sustainability has emerged as a defining educational priority amid accelerating biodiversity depletion, ecosystem degradation, climate variability, and the increasing exploitation of natural resources. Contemporary educational systems are expected to cultivate ecological literacy that extends beyond theoretical comprehension toward responsible environmental judgment and sustainable decision-making. Learners are increasingly encouraged to understand the intrinsic and utilitarian significance of flora and fauna as interconnected components of ecological systems that sustain human well-being, environmental resilience, and socioeconomic development (Prayunita et al., 2026). Such educational orientation strengthens environmental consciousness while fostering informed perspectives capable of addressing increasingly complex ecological concerns. Consequently, educational institutions

continue to refine instructional practices that integrate environmental concepts into meaningful learning experiences capable of nurturing lifelong environmental stewardship.

Environmental education has progressively evolved from knowledge transmission into an interdisciplinary learning paradigm emphasizing critical thinking, experiential engagement, contextual understanding, and sustainable behavioral transformation (Ardoyn & Bowers, 2020; Chappuis & Stolpe, 2026). Contemporary instructional approaches increasingly incorporate inquiry-based learning, field observations, outdoor education, project-based activities, citizen science initiatives, and community participation to deepen learners' appreciation of biological diversity and ecosystem interdependence (Fraisil et al., 2022). These pedagogical innovations promote authentic learning experiences that connect scientific concepts with environmental realities encountered in local communities. Active learning strategies further enhance educational quality by increasing learner engagement, encouraging collaborative inquiry, and

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promoting deeper understanding through meaningful participation in instructional activities (Legarde et al., 2025). Such educational experiences encourage learners to recognize ecological relationships while strengthening analytical abilities, collaborative competencies, and ethical responsibility toward environmental conservation.

An expanding body of scholarly literature indicates that educational exposure to flora and fauna substantially enhances environmental knowledge, ecological awareness, conservation attitudes, and sustainable practices among learners across diverse educational settings. Educational experiences emphasizing biodiversity frequently demonstrate improvements in learners' capacity to identify native species, appreciate ecosystem services, understand environmental interdependence, and recognize the consequences of biodiversity degradation (Fajri et al., 2025). Beyond cognitive development, environmental learning likewise contributes to affective growth by cultivating empathy toward living organisms, appreciation of ecological balance, and commitment to environmentally responsible behaviors (Gopinath & Kumar, 2025). These multidimensional learning outcomes demonstrate that environmental education extends beyond academic achievement by encouraging dispositions that support sustainable societal development.

Despite these educational advancements, considerable variation remains regarding instructional implementation, curriculum integration, learner engagement, resource accessibility, and institutional support. Educational initiatives differ substantially according to geographical conditions, educational levels, sociocultural influences, teacher preparedness, and the availability of environmental learning resources. Certain educational environments benefit from direct interaction with natural ecosystems, whereas others encounter limitations arising from urbanization, inadequate instructional materials, restricted field opportunities, or insufficient environmental expertise. These disparities generate inconsistencies in educational effectiveness and contribute to uneven development of environmental competencies among learners (Carolina et al., 2022). Such circumstances underscore the necessity of examining educational practices across multiple contexts to identify recurring patterns and instructional characteristics associated with successful environmental learning.

The Philippine educational landscape reflects comparable priorities as environmental education continues to gain greater institutional attention through curriculum integration and national sustainability initiatives. Nevertheless, translating environmental awareness into meaningful ecological practices remains an enduring educational aspiration. International

evidence indicates that environmental content is still insufficiently embedded within formal education systems. UNESCO reported that climate change is explicitly addressed in fewer than half of the national curriculum and policy documents examined across 46 Member States, while biodiversity receives limited attention in approximately 81% of the analyzed documents, demonstrating substantial opportunities to strengthen environmental learning across educational systems (UNESCO, 2021). Likewise, OECD findings revealed that although 88% of socioeconomically advantaged learners reported awareness of climate change, only 40% engaged in pro-environmental actions, illustrating that environmental knowledge does not consistently translate into sustainable behavior (OECD, 2024). Within the Philippine educational setting, Galorio and Naling (2024) emphasized that strengthening environmental education requires contextualized instructional materials and meaningful learning experiences that reinforce learners' environmental awareness and encourage sustainable environmental practices. Their findings further underscore the importance of equipping educational institutions with pedagogical resources capable of fostering enduring environmental competencies and responsible stewardship of natural resources.

Growing international attention toward sustainable development has intensified expectations for educational institutions to produce environmentally responsible citizens capable of contributing to ecological conservation and sustainable resource utilization (Srinivas, 2025). Educational programs increasingly emphasize biodiversity preservation, ecosystem resilience, climate adaptation, and responsible utilization of natural resources as interconnected dimensions of sustainable development. Learning experiences centered on flora and fauna encourage learners to appreciate environmental assets not solely as biological entities but as indispensable foundations supporting food security, public health, cultural heritage, and ecological stability. Simultaneously, contemporary scholarships reflect increasing interest in identifying educational characteristics that contribute to meaningful environmental learning outcomes (Cano-Ortiz et al., 2025). Variations in pedagogical strategies, curriculum organization, instructional delivery, assessment practices, learner participation, and community engagement continue to produce differing educational results across existing literature. These differences present opportunities to consolidate current evidence and develop a more comprehensive understanding of educational approaches that consistently promote environmental knowledge, positive environmental attitudes, ecological competencies, and sustainable behavioral practices.

Against this backdrop, consolidating contemporary evidence provides a rigorous

foundation for understanding how environmental education concerning flora and fauna has been implemented, what educational outcomes have consistently emerged, and which conditions appear to strengthen or constrain instructional effectiveness. Integrating diverse empirical evidence offers a broader perspective than isolated studies by identifying converging patterns, recurring educational characteristics, and persistent challenges across different learning environments. Such synthesis contributes to a more coherent understanding of educational practices supporting sustainable utilization of environmental resources while informing future curriculum enhancement, instructional innovation, educational policy formulation, and evidence-informed environmental education initiatives capable of responding to evolving sustainability priorities.

Objective 1. To synthesize and critically evaluate the existing evidence on educating learners about environmental flora and fauna resources for sustainable utility.

RQ 1. What educational approaches have been employed to educate learners about environmental flora and fauna resources for sustainable utility?

RQ 2. What learning outcomes have been reported regarding learners' environmental knowledge, attitudes, competencies, and sustainable practices following flora and fauna education?

RQ 3. What factors have been identified as influencing the effectiveness of educational initiatives on environmental flora and fauna resources for sustainable utility?

METHODOLOGY

Research Design

This study employed a systematic review design to synthesize and critically evaluate existing evidence concerning educational initiatives on environmental flora and fauna resources for sustainable utility. Systematic reviews apply structured and transparent procedures to identify, appraise, and synthesize relevant empirical evidence, thereby minimizing bias and enhancing the reliability of evidence-based conclusions. The review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) to ensure methodological transparency, consistency, and comprehensive reporting throughout the review process (Page et al., 2021).

Review Framework

A structured review framework was established prior to the literature search to guide each stage of the evidence synthesis. The framework specified the review objective, eligibility criteria, information sources, search strategy, study selection procedures, data extraction process, quality appraisal, and evidence synthesis methods. Establishing a predefined review protocol strengthened methodological consistency, improved transparency, and enhanced the reproducibility of the systematic review.

Eligibility Criteria

Studies were included if they examined educational approaches related to environmental flora and fauna, reported learning outcomes associated with environmental education, or identified factors influencing the effectiveness of educational initiatives promoting sustainable resource utilization. Only peer-reviewed journal articles published in English between 2020 and 2026 were considered to ensure that the synthesized evidence reflected contemporary developments in environmental education. Editorials, conference abstracts, dissertations, book chapters, duplicate publications, and studies that did not directly address the review objective or lacking sufficient methodological information were excluded. Clearly defined eligibility criteria were established before study selection to ensure consistency and minimize selection bias throughout the review process.

Information Sources

Relevant literature was retrieved from internationally recognized academic databases, including **Scopus, Web of Science, ERIC, ScienceDirect, and Google Scholar**. These databases were selected because they provide broad coverage of educational, environmental, and interdisciplinary scholarly publications while supporting comprehensive literature retrieval for systematic evidence synthesis. The final database search was completed in **2026** to ensure the inclusion of the most recent eligible studies. The use of multiple academic databases is recommended to improve literature coverage and reduce the possibility of publication bias.

Search Strategy

A systematic literature search was conducted using predefined keywords to maximize search accuracy and retrieval efficiency. Primary search terms included *environmental education, flora, fauna, biodiversity education, ecological literacy, sustainable utility, environmental learning, and sustainable practices*. Boolean operators (AND and OR) together with database-specific filters for publication year, language, and document type were applied to refine search results. The reference lists of eligible studies were also examined to identify

additional relevant publications. Retrieved records were subsequently screened using the PRISMA 2020 framework, beginning with duplicate removal, followed by title and abstract screening, full-text eligibility assessment, and final study inclusion.

Data Extraction

A standardized data extraction matrix was developed to ensure consistency during evidence collection and comparison across the included studies. Information extracted from each article included the author, publication year, country, educational setting, study objective, research methodology, educational approaches, reported learning outcomes, and factors influencing the effectiveness of environmental flora and fauna education. The extracted information was organized according to the review questions to facilitate systematic comparison and comprehensive evidence synthesis. Standardized data extraction procedures improve the accuracy, consistency, and reliability of systematic reviews

Data Synthesis

A narrative thematic synthesis was employed to integrate and interpret the evidence obtained from the studies included. Extracted findings were systematically compared to identify recurring educational approaches, reported learning outcomes, and factors influencing the effectiveness of environmental flora and fauna education. Similar concepts and patterns were subsequently organized into overarching themes that directly addressed the review questions while providing a coherent synthesis of the existing evidence. Narrative thematic synthesis enables researchers to integrate findings from diverse studies and generate meaningful interpretations across multiple educational contexts (Almeida, 2026).

RESULTS

Objective 1. To synthesize and critically evaluate the existing evidence on educating learners about environmental flora and fauna resources for sustainable utility.

RQ 1. What educational approaches have been employed to educate learners about environmental flora and fauna resources for sustainable utility?

1.1 Experiential and Outdoor Environmental Learning

The synthesized evidence consistently identifies experiential and outdoor environmental learning as one of the most frequently implemented educational approaches for teaching learners about flora, fauna, and sustainable resource utilization. Rather than relying exclusively on classroom instruction, educational institutions increasingly incorporate field investigations, biodiversity

observation, ecological excursions, school gardens, habitat restoration projects, and nature-based learning activities that enable learners to directly interact with environmental systems (Jarau & Benkowitz, 2026). Such authentic learning experiences strengthen ecological literacy by allowing learners to observe ecosystem relationships, recognize the ecological importance of plant and animal diversity, and develop a deeper understanding of sustainable environmental practices. Reviews of environmental education likewise indicate that experiential learning promotes stronger cognitive engagement, environmental awareness, and long-term retention than purely lecture-based instruction because learners actively construct knowledge through firsthand environmental experiences (Khazen et al., 2025).

The reviewed literature further demonstrates that experiential environmental learning contributes beyond knowledge acquisition by cultivating environmental responsibility, stewardship, and sustainable behaviors across diverse educational settings. Community participation, ecosystem restoration initiatives, citizen science, and locally contextualized conservation activities consistently encourage learners to apply environmental concepts to real ecological challenges affecting their communities. This approach is particularly relevant within the Philippine context, where schools increasingly integrate environmental activities through biodiversity conservation programs, coastal and forest protection campaigns, school-based ecological projects, and contextualized environmental instruction that reflects local ecosystems and community needs (Ranjit & Surjit, 2024). These initiatives closely align with UNESCO's continuing call to mainstream action-oriented environmental education because many national curricula worldwide still provide limited attention to biodiversity and environmental sustainability despite the growing urgency of ecological challenges (UNESCO, 2021; UNESCO, 2024). Collectively, the synthesized evidence suggests that experiential and outdoor learning remains a foundational instructional approach for developing environmentally literate learners capable of supporting sustainable utilization of flora and fauna resources.

1.2 Inquiry-Based and Scientific Investigation Approaches

Inquiry-based and scientific investigation approaches emerged as a recurring instructional strategy across the reviewed literature for strengthening learners' understanding of environmental flora and fauna resources. These approaches encourage learners to formulate scientific questions, investigate ecological issues, collect environmental evidence, and interpret

findings through systematic observation and analysis. Educational activities such as biodiversity monitoring, species identification, ecological field investigations, and citizen science projects allow learners to actively construct environmental knowledge instead of relying solely on teacher-directed instruction (Rode et al., 2026). As a result, learners develop stronger scientific reasoning, ecological literacy, and problem-solving skills that support informed decisions regarding biodiversity conservation and sustainable resource utilization (Guerrero & Sjöström, 2025).

The evidence further indicates that inquiry-based environmental education becomes more effective when investigations are connected to local ecological concerns and community contexts. In the Philippines, schools increasingly implement contextualized environmental projects that examine issues such as mangrove conservation, forest protection, biodiversity loss, and waste management, enabling learners to apply scientific inquiry to environmental challenges affecting their own communities (Genizera et al., 2022). This educational direction aligns with international recommendations emphasizing evidence-based environmental learning that prepares learners to address complex sustainability issues through critical thinking, collaboration, and responsible environmental action (Corpuz et al., 2022). Overall, the synthesized evidence demonstrates that inquiry-based learning strengthens both scientific competence and environmental responsibility while supporting sustainable utilization of flora and fauna resources.

RQ 2. *What learning outcomes have been reported regarding learners' environmental knowledge, attitudes, competencies, and sustainable practices following flora and fauna education?*

2.1 Enhanced Environmental Knowledge and Ecological Literacy

Enhanced environmental knowledge and ecological literacy emerged as one of the most consistently reported learning outcomes following flora and fauna education. Environmental learning significantly improves learners' understanding of biodiversity, ecosystem services, species conservation, and ecological interdependence (Kazazoglu, 2025). Educational interventions incorporating authentic environmental experiences and biodiversity-focused instruction enable learners to acquire scientific knowledge while strengthening their capacity to recognize environmental issues affecting both natural ecosystems and human well-being (Cardenas Morales et al., 2025). These learning gains contribute to more informed environmental decision-making and reinforce the importance of conserving flora and fauna as essential components of sustainable development.

The synthesis further suggests that ecological literacy extends beyond conceptual understanding by enabling learners to interpret environmental challenges through scientific reasoning and contextual awareness. Recent evidence indicates that educational programs emphasizing biodiversity literacy improve learners' ability to evaluate conservation issues and understand the ecological consequences of unsustainable human activities (Firinci Orman., 2024). Within the Philippine, environmental education initiatives have likewise demonstrated improvements in environmental awareness and biodiversity understanding through contextualized instructional materials and school-based conservation activities. These findings remain consistent with global recommendations advocating stronger biodiversity education to prepare environmentally literate citizens capable of supporting long-term sustainability and ecosystem conservation (UNEP, 2024).

2.2 Development of Sustainable Environmental Practices and Stewardship

One of the most significant learning outcomes of flora and fauna education is the development of sustainable environmental practices and long-term environmental stewardship. Beyond improving knowledge and environmental attitudes, effective educational interventions encourage learners to apply ecological principles through responsible behaviors such as biodiversity conservation, habitat protection, waste reduction, resource conservation, tree planting, and participation in community-based environmental initiatives (Diaz & Vela, 2025). These practical actions demonstrate that meaningful environmental education extends beyond cognitive achievement by fostering behavioral changes that contribute to ecosystem sustainability and responsible utilization of natural resources. Studies further suggest that learners are more likely to maintain environmentally responsible behaviors when educational experiences combine classroom instruction with authentic environmental engagement and community participation (Hamilton & Marckini-Polk, 2023). Sustaining environmentally responsible behaviors likewise requires educational environments that continuously nurture learner motivation, since meaningful engagement encourages learners to transform environmental knowledge into responsible and enduring practices (Nazareth et al., 2026).

The synthesis likewise demonstrates that sustainable environmental practices are strengthened when educational institutions establish continuous partnerships with families, local communities, conservation organizations, and government agencies that reinforce environmental responsibility beyond the classroom. Within the Philippine context, environmental education

programs supported by schools, local government units, and the Department of Environment and Natural Resources have increasingly encouraged learners to participate in biodiversity conservation, coastal resource management, reforestation, and ecological restoration initiatives that address local environmental concerns while promoting civic responsibility (Maceda & Ordoñez, 2020). International organizations similarly recognize that education serves a fundamental role in achieving sustainable development by empowering learners to adopt environmentally responsible lifestyles and actively contribute to biodiversity conservation and climate resilience. Collectively, the reviewed evidence demonstrates that successful flora and fauna education is ultimately reflected in learners sustained environmental stewardship and active participation in conserving natural ecosystems for future generations

RQ 3. *What factors have been identified as influencing the effectiveness of educational initiatives on environmental flora and fauna resources for sustainable utility?*

3.1 Contextualized Curriculum and Instruction

A contextualized curriculum and instruction as a fundamental determinant of the effectiveness of educational initiatives concerning environmental flora and fauna resources for sustainable utility. Educational interventions demonstrate greater instructional effectiveness when biodiversity concepts are embedded within learners' immediate ecological environments, sociocultural realities, and locally relevant environmental concerns rather than delivered through generalized theoretical instruction (Id et al., 2023). Such contextualization strengthens ecological literacy by enabling learners to associate scientific concepts with authentic environmental conditions while cultivating a deeper appreciation of biodiversity conservation and sustainable resource utilization. This pedagogical orientation is particularly evident in biodiversity-rich countries such as the Philippines, where environmental education increasingly incorporates locally significant ecosystems including forests, mangrove habitats, coastal environments, and watershed landscapes to reinforce the relevance of ecological conservation within learners' everyday experiences (Castro et al., 2025).

The reviewed studies further indicate that contextualized environmental instruction achieves greater educational effectiveness when complemented by locally responsive learning resources, interdisciplinary pedagogical strategies, and sustained community engagement. Across the synthesized evidence, learning environments that integrate indigenous ecological knowledge, community conservation initiatives, and place-responsive instructional materials consistently

report stronger learner participation and more meaningful environmental learning outcomes (Wahyuni et al., 2026). Comparable educational practices have likewise been documented within Philippine schools, where contextualized biodiversity education and community-based environmental programs have strengthened learners' ecological awareness while fostering greater participation in conservation activities addressing locally relevant environmental concerns. It demonstrates that contextualized curriculum and instruction substantially enhance the authenticity, applicability, and educational effectiveness of flora and fauna education while cultivating environmentally responsible decision-making and long-term sustainability competencies

3.2 Teacher Expertise and Pedagogical Competence

Teacher expertise and pedagogical competence emerged as indispensable determinants of the effectiveness of educational initiatives on environmental flora and fauna resources for sustainable utility. Educators possessing comprehensive environmental knowledge and strong pedagogical capabilities are better positioned to facilitate meaningful learning experiences that extend beyond conceptual understanding toward environmental responsibility. Through inquiry-based instruction, experiential learning, interdisciplinary integration, and reflective classroom discourse, teachers create opportunities for learners to examine biodiversity conservation, ecological interdependence, and sustainable resource utilization from scientifically grounded and contextually relevant perspectives (Pablo, 2025; Xiong et al., 2025). These instructional practices have been reported across diverse educational settings, including Philippine schools where biodiversity-rich landscapes provide authentic contexts for environmental learning, thereby reinforcing learners' ecological understanding and appreciation of locally significant flora and fauna.

Educational effectiveness is further strengthened when teachers receive sustained professional development, adequate instructional resources, and institutional support that enhance their capacity to deliver contextualized environmental education. The reviewed studies indicate that pedagogical competence is most impactful when educators integrate community experiences, indigenous ecological knowledge, and locally relevant conservation issues into classroom instruction, allowing environmental concepts to become more meaningful and applicable to learners' everyday realities (Ajaps, 2026). Comparable educational practices documented in Philippine schools likewise demonstrate that strengthening teachers' environmental competence contributes to higher learner engagement, improved ecological

awareness, and greater participation in biodiversity conservation initiatives addressing local environmental priorities (Botoy et al., 2026). It further underscores that investing in teacher capacity remains fundamental to advancing high-quality flora and fauna education and cultivating environmentally responsible citizens capable of supporting long-term ecological sustainability.

DISCUSSION

Environmental flora and fauna education becomes more effective when learning extends beyond classroom instruction toward experiential, inquiry-based, and contextually relevant activities. Field investigations, biodiversity observation, ecological projects, and community engagement consistently strengthened learners' understanding of environmental systems while encouraging responsible ecological behavior. These findings support Kuo et al. (2022), who emphasized that authentic environmental experiences promote deeper learning than traditional instruction alone. Similarly, Torkar and Klofutar (2026) argued that biodiversity education achieves greater educational value when scientific concepts are connected to real environmental conditions. Such instructional approaches therefore provide meaningful opportunities for learners to develop ecological literacy while appreciating the sustainable utility of natural resources.

The reported learning outcomes indicate that flora and fauna education contributes not only to environmental knowledge but also to ecological literacy, environmental stewardship, and sustainable behavioral practices. Learners became more capable of understanding biodiversity conservation, evaluating environmental issues, and participating in responsible ecological actions after meaningful environmental learning experiences. These findings are consistent with Sobirova (2026), who concluded that biodiversity education substantially improves ecological literacy and environmental education strengthens environmental values alongside scientific understanding. This demonstrates that effective environmental education promotes both cognitive development and long-term environmental responsibility.

Educational effectiveness was likewise influenced by contextualized curriculum implementation and teacher pedagogical competence. Programs produced stronger outcomes when biodiversity concepts reflected local ecological conditions and were facilitated by educators capable of integrating scientific inquiry with authentic environmental experiences. Guerrero & Sjöström (2025) emphasized that effective environmental literacy depends on pedagogical strategies that connect scientific knowledge with real-world sustainability issues. Within the

Philippine educational setting, these findings reinforce the value of contextualized biodiversity education and continuous teacher capacity development to strengthen learners' environmental competencies. Consistent instructional quality likewise depends on pedagogical approaches that foster active learner engagement, continuous feedback, and meaningful educational experiences capable of sustaining long-term learning outcomes (Chavez & Lamorinas, 2023).

The review also addresses the gap identified in the introduction by consolidating fragmented evidence on instructional approaches, educational outcomes, and determinants of successful flora and fauna education. Earlier literature primarily examined specific environmental programs or individual educational settings, providing limited understanding of the broader instructional patterns that consistently support environmental learning. Integrating evidence across diverse contexts, this review demonstrates that meaningful environmental education depends on the combined influence of authentic learning experiences, contextualized instruction, scientific inquiry, and competent teaching. This provides a stronger evidence base for curriculum enhancement, educational policy, and future environmental education initiatives.

Findings affirm that educating learners about environmental flora and fauna represents a critical strategy for advancing sustainable development through education. Effective environmental instruction extends beyond improving ecological knowledge by cultivating learners who can translate scientific understanding into responsible environmental action. As biodiversity loss and environmental degradation continue to intensify, educational institutions should prioritize experiential learning, contextualized biodiversity instruction, and teacher professional development to strengthen environmental literacy and promote the sustainable utilization of natural resources.

CONCLUSION

This systematic review establishes that educating learners about environmental flora and fauna constitutes a fundamental educational strategy for advancing sustainable resource utilization and strengthening environmental stewardship. The accumulated evidence demonstrates that educational effectiveness is consistently enhanced through experiential and inquiry-based learning, contextualized curriculum implementation, and competent pedagogical practice. These instructional approaches not only improve learners' environmental knowledge and ecological literacy but also cultivate responsible environmental

attitudes, conservation-oriented competencies, and sustainable behavioral practices essential for addressing contemporary ecological challenges. The consistency of these findings across diverse educational contexts underscores the enduring educational value of integrating biodiversity education into formal learning environments.

The review further demonstrates that meaningful environmental education extends beyond the transmission of ecological concepts by fostering learners' capacity to apply scientific understanding to authentic environmental issues within their communities. By consolidating contemporary evidence, this review provides a coherent foundation for strengthening curriculum development, instructional innovation, teacher professional development, and environmental education policies that support biodiversity conservation and sustainable development. As global environmental challenges continue to intensify, educational institutions should remain committed to delivering evidence-informed, contextually responsive, and learner-centered environmental education capable of preparing environmentally literate citizens who can contribute meaningfully to the sustainable utilization and long-term conservation of flora and fauna resources.

REFERENCES

- Ajaps, S. (2026). Decolonising Environmental Education Pedagogy: A Participatory Action Research Approach. *Education Sciences*, 16(2), 199. <https://doi.org/10.3390/educsci16020199>
- Almeida, Fernando. (2026). Thematic analysis in qualitative research: Steps, benefits, and challenges. 5. 25-38. 10.5281/zenodo.18241378.
- Ardoin, N. M., & Bowers, A. W. (2020). *Early childhood environmental education: A systematic review of the research literature*. Educational Research Review, 31, 100353. DOI: <https://doi.org/10.1016/j.edurev.2020.100353>
- Botoy, Francis Jeo Mar & Barbosa, Christian & Cabatuan, Glory & Lee, Hannah Aljeah & Onyot, Jerome. (2026). Environmental Literacy and Knowledge Levels of Filipino Learners: A Comprehensive Literature Review. 10.5281/zenodo.18207397.
- Cano-Ortiz, A., Piñar-Fuentes, J. C., Musarella, C. M., & Peña-Martínez, J. (2025). Education for Environmental Sustainability Component: Innovative Strategies for Experiential Learning in Natural Contexts. *Education Sciences*, 15(6), 697. <https://doi.org/10.3390/educsci15060697>
- Cardenas Morales BK, Oré Gálvez SF, Castro Aponte WV, Aguilar Ozejo A, Naupari Molina R, Huayhua Lévano FG, Mendoza Colos M. Integrating education and conservation: a case study of the Huaper wetland. *Front Psychol*. 2025 Mar 6;16:1517653. doi: 10.3389/fpsyg.2025.1517653. PMID: 40115288; PMCID: PMC11924120.
- Carolina L Zilli Vieira, Nijima Novello Rumenos, Carla Gheler-Costa, Flavia Toqueti, Maria de Lourdes Spazziani, Environmental education in urban cities: Planet regeneration through ecologically educating children and communities, *International Journal of Educational Research Open*, Volume 3, 2022, 100208, ISSN 2666-3740, <https://doi.org/10.1016/j.ijedro.2022.100208>.
- Castro, Lura & Cawayan, Windy & Maximino, Chendy & Diquito, Tomas. (2025). Development and Acceptability of Environmental Education Kit for Elementary Learners. *Journal of Research in Environmental and Science Education*. 2. 81-93. 10.70232/jrese.v2i2.17.
- Chappuis, C., & Stolpe, K. (2026). *Mapping out the didactical landscape of biodiversity conservation education: A systematic literature review of empirical research in school settings*. Environmental Education Research. DOI: <https://doi.org/10.1080/13504622.2026.2671437>
- Chavez, J., & Lamorinas, D. D. (2023). Reconfiguring assessment practices and strategies in online education during the pandemic. *International Journal of Assessment Tools in Education*, 10(1), 160-174.
- Corpuz, Alma & San Andres, Teody & Lagasca, Julieta. (2022). INTEGRATION OF ENVIRONMENTAL EDUCATION (EE) IN TEACHER EDUCATION PROGRAMS: TOWARD SUSTAINABLE CURRICULUM GREENING. *Problems of Education in the 21st Century*. 80. 119-143. 10.33225/pec/22.80.119.
- Diaz, Kattia & Vela, Jorge. (2025). Impact Of Environmental Education On The Development Of Environmental Awareness: A Systematic Review. *International Journal of Environmental Sciences*. 1992-2003. 10.64252/vvjwn305.
- Fajri, S.R., Citrawathi, D.M., Adnyana, P.B., Arnyana, I.B.P., Samita, F., Fajri, N., Fajri, N., & Fitriani, H. (2025). The strategic role of conservation education in efforts to improve biodiversity literacy: a systematic review. *Journal of Turkish Science Education*, 22(2), 374-392. <http://doi.org/10.36681/tused>.
- Firinci Orman, T. (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>
- Fraisl, D., Hager, G., Bedessem, B. et al. Citizen science in environmental and ecological sciences. *Nat Rev Methods Primers* 2, 64 (2022). <https://doi.org/10.1038/s43586-022-00144-4>
- Galorio, I. J. N., & Naling, C. S. (2024). Awareness and Practices of Senior High School Students and Teachers on Environmental Education: Basis for Instructional Materials Development. DOI:10.9734/ajee/2024/v23i4537
- Genizera, John & Tosino, Wilson & Santacera, Elma & Moncera, Arleen. (2022). Implementation of Department of Education Programs, Projects,

- and Activities on Mitigating the Impact of Climate Change in the Philippines. *Journal of Learning and Development Studies*. 2. 35-39. 10.32996/jlds.2022.2.1.4.
- Gopinath, S., & Kumar, A. (2025). The effect of an environmental education program based on empathy and reflective thinking on preadolescents' environmental values and knowledge. *International Research in Geographical and Environmental Education*, 34(2), 100–119. <https://doi.org/10.1080/10382046.2024.2349430>
- Guerrero, G., & Sjöström, J. (2025). Critical scientific and environmental literacies: a systematic and critical review. *Studies in Science Education*, 61(1), 41–87. <https://doi.org/10.1080/03057267.2024.2344988>
- Guerrero, G., & Sjöström, J. (2025). Critical scientific and environmental literacies: a systematic and critical review. *Studies in Science Education*, 61(1), 41–87. <https://doi.org/10.1080/03057267.2024.2344988>
- Hamilton, E., & Marckini-Polk, L. (2023). The impact of place-based education on middle school students' environmental literacy and stewardship. *Cogent Education*, 10(1). <https://doi.org/10.1080/2331186X.2022.2163789>
- Id Babou, A., Selmaoui, S., Alami, A., Benjelloun, N., & Zaki, M. (2023). Teaching Biodiversity: Towards a Sustainable and Engaged Education. *Education Sciences*, 13(9), 931. <https://doi.org/10.3390/educsci13090931>
- Jarau, S., Benkowitz, D. (2026). Biodiversity Education in School Gardens. In: Jarau, S., Benkowitz, D. (eds) Sustainability Education in School Garden-Based Learning. International Explorations in Outdoor and Environmental Education, vol 18. Springer, Cham. https://doi.org/10.1007/978-3-032-10273-7_3
- Kazazoglu, S. (2025). Environmental Education Through Eco-Literacy: Integrating Sustainability into English Language Teaching. *Sustainability*, 17(5), 2156. <https://doi.org/10.3390/su17052156>
- Khazen, M., Asli, S., Basheer, A., & Hugerat, M. (2025). The Impact of a Sustainability Education Initiative on Pre-Service Teachers: Changes in Environmental Attitudes, Willingness to Act, and Ecological Footprint. *Sustainability*, 17(12), 5621. <https://doi.org/10.3390/su17125621>
- Kuo, Ming & Barnes, Michael & Jordan, Cathy. (2022). Do Experiences with Nature Promote Learning? Converging Evidence of a Cause-And-Effect Relationship. 10.1007/978-3-031-04108-2_3.
- Legarde MAA, Mundo MD, Chavez JV, et al. Empowering learning engagement in higher education with active learning experiences in STEM classrooms. *Environment and Social Psychology* 2025; 10(9): 3878 doi:10.59429/esp.v10i9.3878
- M.J. Page, D. Moher, P.M. Bossuyt, I. Boutron, T.C. Hoffmann, C.D. Mulrow, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews
- Maceda, L. L., & Ordoñez, A. J. (2020). *Development of ICT-based environmental education materials in different media of learning*. *BU R&D Journal*, 21(3, Supplementary Issue), 67–73. <https://doi.org/10.47789/burdj.mbtcbggs.20182103.2>
- Nazareth IM, Chavez JV, Dusaban ACM, et al. Intrinsic Motivation of Teacher Education Instructors in Contributing to the Sustainable Development Goal on Quality Education. *Environment and Social Psychology* 2026; 11(1): 3863 doi:10.59429/esp.v11i1.3863
- OECD (2024), Education at a Glance 2024: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/c00cad36-en>.
- Pablo, Nica. (2025). Pedagogical practice of integrating Environmental education in teaching science, benefits and challenges. *Divine Word International Journal of Management and Humanities (DWIJMH)* (ISSN: 2980-4817). 4. 2625-2642. 10.62025/dwijmh.v4i4.238.
- Prayunita, D., Triyanti, A., Dekker, S. C., Driessen, P. P. J., & Temmink, R. J. M. (2026). Nature-based solutions, ecosystem services, and human well-being in Global South mangroves: A review. *Ecosystem Services*, 79, 101850. DOI: <https://doi.org/10.1016/j.ecoser.2026.101850>
- Rode, Žan & Torkar, Gregor & Andić, Branko. (2026). Preservice teachers as citizen scientists using iNaturalist. *Discover Education*. 5. 10.1007/s44217-025-01087-0.
- Singha, Ranjit & Singha, Surjit. (2024). Application of Experiential, Inquiry-Based, Problem-Based, and Project-Based Learning in Sustainable Education. 10.4018/978-1-6684-9859-0.ch006.
- Sobirova, Marhabo. (2026). Developing interactive conservation education modules to enhance eco literacy and stewardship for local aquatic biodiversity. *International Journal of Aquatic Research and Environmental Studies*. 6. 13-27. 10.70102/IJARES/V6I1/6-1-02.
- Srinivas, Noojilla. (2025). ROLE OF EDUCATIONAL INSTITUTIONS IN ENVIRONMENTAL SUSTAINABILITY AND DEVELOPMENT: ENVIRON FRAMEWORK. 14. 95-99.
- Torkar, G., & Klofutar, Š. (2026). Enhancing biodiversity literacy in early learners: The impact of direct outdoor experience versus classroom instruction. *The Journal of Environmental Education*, 1–14. <https://doi.org/10.1080/00958964.2026.2631979>
- UNESCO (2021). Learn for Our Planet: A Global Review of How Environmental Issues are Integrated in Education. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000377362>
- UNESCO. (2024). UNESCO launches new initiatives for greening education in classrooms. Retrieved from <https://www.unesco.org/en/articles/unesco-launches-new-initiatives-greening-education-classrooms>
- United Nations Environment Programme. (2024). *Global Environment Outlook 7: Summary for*

- Policymakers*. Retrieved from
<https://www.unep.org/resources/global-environment-outlook-7>
- Wahyuni, S., Zuhairi, A., Syafruddin, S., Cahyani, I., & Sulistyowati, H. (2026). Eco-cultural pedagogy in practice: local wisdom, student engagement, and environmental responsibility in rural Indonesia. *Cogent Education*, 13(1). <https://doi.org/10.1080/2331186X.2026.2666429>
- Xiong, Z., Song, Y., & Zhu, R. (2025). Pedagogical Strategies for Teaching Environmental Literacy in Secondary School Education: A Systematic Review. *Sustainability*, 17(20), 9104. <https://doi.org/10.3390/su17209104>