Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516

SLR STUDY: CULTIVATING ECOLOGICAL AWARENESS THROUGH PROJECT-BASED SCIENCE LEARNING

Faiqotul Isma Azizah[1], Saihan [2], Mu'allimin [3]
Elementary School Teacher Education, Postgraduate Masters, UIN Kiai Haji Achmad Siddiq Jember, Indonesia
Email: faiqisma07@gmail.com

Abstract

This study aims to explore the effectiveness of project-based science and social science (IPAS) learning in instilling ecological awareness from an early age. The focus of the study is to understand how the project-based learning approach can improve students' understanding of environmental conservation and identify challenges and supporting factors in its implementation. This study uses a library research method with a qualitative approach. Data were collected from primary and secondary sources such as scientific journals, textbooks, research reports, and curriculum documents. Data analysis was carried out through literature studies, content analysis, and triangulation to ensure the accuracy of the findings. The research process includes source collection, document selection, data extraction, and information synthesis. The results of the study indicate that project-based science and social science learning is effective in improving students' ecological awareness through practical activities such as tree planting, recycling, and environmental observation. However, its implementation faces obstacles such as lack of resources, teacher training, and integration with the curriculum. Educators have mixed views, with some supporting this approach because it is considered contextual, while others complain about the lack of support. In addition, there were protests from the community who considered project activities to interfere with academic focus. Student academic outcomes also varied, with some schools reporting significant improvements, while others showed no significant changes. In conclusion, project-based learning has great potential to increase ecological awareness, but its success depends on the support of teachers, schools, and communities, as well as good integration with the cycle.

Keywords: *Ecological Awareness, Science Learning*

INTRODUCTION

Environmental issues have become a multidimensional global problem, encompassing climate change, deforestation, air and water pollution, and biodiversity degradation. The impacts of these issues not only physically damage ecosystems but also have far-reaching

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

social, economic, and health consequences for humanity. The Intergovernmental Panel on Climate Change (IPCC, 2023) report confirms that greenhouse gas (GHG) emissions continue to increase due to human activities, particularly from industry, transportation, and the combustion of fossil fuels. The accumulation of GHGs in the atmosphere accelerates global warming, which in turn triggers extreme climate changes such as storms, floods, droughts, and the melting of polar ice caps, contributing to sea level rise. This phenomenon further reinforces the reality that the environmental crisis is not a future issue, but rather a real, ongoing challenge that urgently requires systematic and collaborative cross-sectoral address.

Unfortunately, amidst this urgency, a major obstacle to environmental conservation efforts remains: low ecological awareness across all levels of society. This situation is even more concerning when low awareness is found among the younger generation, who will face the long-term impacts of the current environmental crisis. Ecological awareness is a form of understanding and sensitivity to the surrounding environmental conditions, reflected in sustainable attitudes and behaviors in daily life (Ardoin et al., 2020). This low awareness leads to low active participation among the younger generation in environmental conservation efforts, even though they play a strategic role as agents of change in the future. UNESCO (2019) states that success in overcoming the environmental crisis depends heavily on how current and future generations are prepared through education that equips them with sustainable values. In this context, early environmental education is crucial as a long-term strategy for shaping ecological awareness and behavior. Environmental education not only aims to instill knowledge about ecosystems, pollution, or climate change but must also be directed at fostering awareness, a sense of responsibility, and a willingness to actively participate in maintaining the sustainability of the earth (Stevenson et al., 2021). Instilling these values needs to begin at an early age, as childhood is a crucial stage in character and habit formation. According to research by Boeve-de Pauw and Van Petegem (2020), educational approaches that involve hands-on experience, emotional engagement, and critical reflection on environmental issues have proven more effective in fostering environmentally friendly behavior than purely theoretical learning. The importance of early environmental education is further reinforced by innovative pedagogical approaches, such as project-based learning, which encourages students to actively engage in solving real- world problems in their environment. This method provides space for

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

students to develop critical thinking skills, collaborate, and take initiative in designing solutions to ecological problems they identify. Therefore, environmental education, strategically integrated into the school curriculum, serves not only as a means of transferring knowledge but also as a vehicle for developing sustainable ecological character. Consistent implementation of this approach will create a generation that not only understands the importance of environmental sustainability but also possesses the willingness and ability to take concrete action to protect it.

In an effort to increase students' ecological awareness, innovative pedagogical approaches are an urgent need in the education system. One method that is gaining increasing attention is Project-Based Learning (PjBL). PjBL is a constructivist learning approach that positions students as the primary actors in the learning process, where they construct knowledge through direct involvement in solving real-world problems relevant to their lives. This approach is well suited to the complex, contextual characteristics of environmental issues, which demand collaborative solutions. Belland et al. (2020) state that PjBL has great potential in fostering students' in-depth understanding of a topic because they learn through direct experience, not just from theoretical explanations from teachers. In the context of environmental education, PjBL is an effective means of bridging ecological knowledge and concrete action. Environmental-based projects such as waste recycling, water conservation, tree planting, or observing local biodiversity encourage students not only to recognize problems but also to develop applicable strategies for solving them. Furthermore, this approach develops various 21st-century skills, such as critical thinking, teamwork, creativity, and environmental literacy. When students are involved in environmental projects whose impact they directly feel, the learning process becomes more meaningful and emotionally and cognitively memorable (Thomas, 2022).

An empirical study in Indonesia conducted by Suryanti et al. (2021) confirmed the effectiveness of Project-Based Learning (PjBL) in fostering ecological awareness. The study showed that students participating in a conservation project-based learning program experienced significant improvements in their understanding of environmental issues and their commitment to engaging in concrete actions for nature conservation. This demonstrates that direct experience in a local context can foster students' personal connections to their environment, ultimately motivating them to become change agents. However, the application of Project-Based Learning (PjBL) in environmental education is

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

not evenly distributed across all levels of education. Most PjBL literature and practices are concentrated in secondary and higher education. According to Krajcik and Shin (2022), research and implementation of Project-Based Learning (PjBL) at the elementary school level are still limited, particularly in Natural and Social Sciences (IPAS) subjects, which serve as the foundation for developing environmental literacy from an early age. However, elementary education is a crucial phase in the formation of long-term values and behaviors. The low implementation of Project-Based Learning (PjBL) at the elementary level is partly due to limited resources, a lack of teacher training, and the lack of curriculum guidelines integrated with the project approach. Teachers at the elementary level often experience difficulties in designing projects that are appropriate to the level of cognitive development of children and related to the established learning outcomes.

This situation demonstrates a gap between potential and practice, and also indicates an urgent need for the development of a PjBL model that is adaptive to the context of elementary education, particularly in science learning. By developing a curriculum that allows elementary school students to explore environmental issues through simple yet meaningful projects, there will be an opportunity to instill sustainability values earlier and more strongly. Future research is urgently needed to address this challenge, both in the form of developing learning designs, teacher training, and evaluating the effectiveness of this approach in increasing ecological awareness in elementary school children.

The main challenges in implementing PjBL in elementary schools include the lack of curriculum adjustment, limited resources, and teachers' ability to design projects that are appropriate to the characteristics and cognitive abilities of young children (Yusoff et al., 2020). This situation indicates a gap between research and practice that needs to be bridged. Therefore, further research is important to develop a PjBL model that is contextual and adaptive to the needs of science and education learning at the elementary school level. The novelty of this study lies in its focus on developing a PjBL approach for environmental education at the elementary level, which has not been widely explored before, and its orientation towards instilling sustainable ecological awareness from an early age. This research is expected to contribute to designing environmental education strategies that are more effective, interactive, and relevant to the challenges of the times, so that the younger generation is truly prepared to become agents of change for a more sustainable future for the earth.

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

RESEARCH METHODS

Research Subject/Object

The object of this research consists of academic documents and educational policies relevant to environmental conservation and the Project-Based Learning (PjBL) approach. The documents analyzed include scientific journals examining the effectiveness of PjBL and environmental education (Santana et al., 2021; Lim & Lee, 2020), textbooks and scientific articles on Natural and Social Sciences (IPAS) learning methods, research reports from national and international institutions such as UNESCO, the IPCC, and the Ministry of Education, as well as national and regional curricula that incorporate environmental themes. Furthermore, case studies and good practices from the implementation of project- based learning at the elementary level were analyzed. Selecting documents as the unit of analysis allowed researchers to explore in depth how ecological awareness values are embedded in elementary education through the PjBL approach (UNESCO, 2020; Thomas, 2021).

Data collection technique

Data collection was conducted using a systematic and continuous library research method. This process included identifying sources through databases such as Scopus, Google Scholar, ERIC, and educational organization portals; selecting documents based on credibility, relevance, and novelty (published within the last 5–10 years); and extracting important information related to ecological awareness, the application of Project-Based Learning (PjBL), and the implementation of Science and Environmental Studies (IPAS). The collected data were then classified according to key topics such as the definition, objectives, methods, challenges, and outcomes of project-based learning implementation in environmental education (Fink, 2019; Rizal et al., 2021).

Data Analysis Techniques

Data analysis was conducted qualitatively using content analysis and thematic descriptive approaches. The steps included a thorough reading of the documents, coding relevant units of meaning, and grouping them based on key themes such as PjBL implementation strategies, student conservation activities, and curriculum support for environmental education. The analysis results were then synthesized to identify relationships between themes and interpreted to form in-depth theoretical conclusions (Creswell & Poth, 2018; Boffey & Windle, 2022).

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

Data Validity Test

The validity of the data in this study was ensured through a source triangulation strategy, which involved comparing and consolidating information from various types of documents, such as journals, curricula, and policy reports, to ensure data consistency. Validity was also maintained by using only credible sources from official institutions and reputable journals. An audit trail was implemented by transparently recording the literature selection and analysis process, while peer debriefing was conducted by discussing findings with colleagues or supervisors to minimize interpretation bias (Bryman, 2016; Zhang & Wang, 2023).

RESULTS AND DISCUSSION

1. Context and Importance of Ecological Awareness from an Early Age

Ecological awareness reflects a holistic and in-depth understanding of the interconnectedness between humans and the environment. It extends beyond factual knowledge of environmental issues such as pollution, deforestation, or climate change, but encompasses emotional, attitudinal, and behavioral dimensions that demonstrate a sense of responsibility for maintaining ecosystem sustainability (Wals et al., 2020). In this context, individuals with ecological awareness consider the ecological impact of their actions and strive to reduce their ecological footprint. According to Tilbury (2021), ecological awareness is the foundation of education for sustainable development (ESD) because it involves critical reflection on the values, lifestyles, and social and economic systems that influence current global environmental conditions. Therefore, fostering ecological awareness from an early age is not only a moral responsibility but also a strategic necessity in addressing the increasingly complex environmental crisis.

2. Project-Based Learning (PjBL) as an Effective Approach in Environmental Education

Project-Based Learning (PjBL) places students at the center of learning by giving them direct responsibility for designing, developing, and completing projects rooted in real-world problems. This approach allows students not only to "learn about something," but also to "learn by doing something" that is meaningful in the context of their lives. This fosters active engagement, curiosity, and ownership of the learning process (Holm, 2022).

Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516

According to Bell (2020), Project-Based Learning (PjBL) is highly effective in bridging theory and practice. When students are confronted with real-world problems, they are forced to integrate diverse knowledge, think critically, collaborate, and evaluate solutions reflectively. Thus, learning is no longer fragmented but rather holistic, contextual, and applicable.

3. Integration of Science Learning and Environmental Conservation

Natural and Social Sciences (IPAS) is an innovation in basic education that integrates the two main disciplines of science and social studies to understand various phenomena more holistically and contextually, including environmental issues. This integrative approach enables students to see the interconnectedness of ecological, social, and economic aspects within a holistic learning environment. This is important because environmental issues, such as climate change, pollution, and natural disasters, are not only related to natural processes but are also influenced by social behavior and the surrounding economic system (Setiawan et al., 2021). By integrating these aspects, IPAS can develop students' systemic thinking skills and strengthen ecological awareness from an early age. When IPAS is combined with a Project-Based Learning (PjBL) approach, learning becomes more active, meaningful, and relevant to real life.

Students not only learn environmental concepts theoretically but also engage directly in concrete actions, such as creating a school garden, mapping environmental disaster risks around their homes, or conducting a waste audit at school. These activities create authentic and emotional learning experiences, strengthening understanding and fostering environmental awareness. They also learn to collaborate, make decisions, and take responsibility for the impact of their actions on the environment (Putri et al., 2022).

The Independent Curriculum further strengthens the implementation of project-based science by providing flexible space through contextual and interdisciplinary learning themes. Themes such as "Sustainable Lifestyle" and "Climate Change" provide a strong thematic framework for students to connect learning materials to the environmental realities they face daily (Kemendikbudristek, 2022). Through these themes, students are encouraged to reflect on consumption behavior, recognize its ecological impact, and design applicable and positive solutions. This approach also aligns with strengthening the Pancasila student profile, which emphasizes the values of mutual cooperation, independence, and sustainability.

Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516

4. The Process of Instilling Ecological Values through Projects

Instilling ecological values in Project-Based Learning (PjBL)-based Natural and Social Sciences (IPAS) learning is a comprehensive and transformative process. This process focuses not only on cognitive achievement but also extends to students' affective and psychomotor domains through systematic and contextual stages. These stages are designed to build meaningful ecological understanding and foster responsible attitudes and actions toward the environment. The first stage is the exploration of relevant and contextual environmental issues. In this phase, students are invited to identify real-world environmental issues occurring around them, such as river pollution, plastic waste at school, or drought during the dry season. This process not only raises awareness of the problem but also fosters a sense of ownership and urgency to directly engage in solutions (Adams et al., 2020).

Students learn that environmental issues are not merely global phenomena far removed from their lives, but everyday problems that require shared attention and responsibility. The next stage is value reflection, where students are invited to reflect on the impact of human behavior on nature. Through discussions, case studies, and narratives of experiences, students develop empathy for other living things and begin to understand the importance of environmental ethics. This reflection is crucial for fostering self-awareness that individual and collective actions can impact ecosystem balance. Next, students engage in collaboration and decision-making within groups. This stage fosters the ability to work together, express opinions, and devise solutions to identified environmental problems. In this process, values such as collective responsibility, social awareness, and critical thinking skills begin to develop naturally.

Collaboration also provides a platform for building solidarity and a shared commitment to positive change. The core stage of PjBL is concrete action. Students carry out environment-based projects such as water conservation, processing organic waste into compost, reforesting schools, or energy-saving campaigns. These activities provide students with opportunities to apply their knowledge in concrete practices while strengthening their emotional attachment to the environment they care for directly. Through these activities, practical skills and a deeper and more personal ecological awareness are developed (Harahap & Manik, 2023). The final stage is evaluation and critical awareness, where students reflect on the results of their projects. They are encouraged to evaluate the impact of their actions on the surrounding environment, identify successes and challenges, and formulate lessons learned that can

Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516

be carried forward. This process not only strengthens metacognitive skills but also fosters a sense of agency , the belief that they can make a real contribution to environmental protection (Hernández-Barco et al., 2021).

5. Challenges and Implementation Strategies

The implementation of the Project-Based Learning (PjBL) approach to instill ecological awareness is not without its structural and pedagogical challenges. One major obstacle is time constraints in the learning process. A dense curriculum and pressure to achieve academic targets often make it difficult for teachers to allocate sufficient time for medium- or long-term environmental projects. Furthermore, many teachers face limited competency in project-based pedagogy, including effective project planning, implementation, and evaluation. A lack of understanding of PjBL principles can make project implementation merely an additional task, rather than an integral part of a meaningful learning process (Lee et al., 2021).

Furthermore, a lack of resource support, such as teaching aids and contextual learning media, along with budget constraints and school policies that do not yet support project-based learning, also present obstacles. Schools that lack an ecological vision tend to be less likely to facilitate action-based and environmentally oriented learning programs. However, various strategies can be employed to overcome these challenges. Continuous teacher training is key to enhancing educators' capacity to design and implement PjBL effectively. This training focuses not only on technical aspects but also on strengthening ecological values and a collaborative approach to learning.

Collaboration with local communities, such as environmental NGOs, relevant agencies, or community leaders, can be an additional resource that enriches students' learning experiences and strengthens the project's relevance to real-world contexts. Furthermore, technology integration can also be an effective solution, for example, using environmental mapping applications, online platforms for project documentation, or interactive media that can facilitate collaborative learning across classes or schools (Ramirez et al., 2022; Wahyuni et al., 2023).

6. Impact of Project-Based Science Learning on Ecological Awareness

Various studies have shown that the application of Project-Based Learning (PjBL) in Natural and Social Sciences (IPAS) learning has a significant impact on increasing students' ecological awareness. Through active involvement in projects related to environmental issues, students not only gain a deeper conceptual

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

understanding of ecosystems, climate change, and recycling but also develop emotional sensitivity to the natural conditions and living things around them. Activities such as waste audits, composting, school greening, and plastic reduction campaigns provide meaningful, hands- on experiences that enable students to concretely internalize ecological values (Yilmaz et al., 2020).

Furthermore, this approach has proven effective in shaping concrete ecological behaviors, such as the habit of bringing their own water bottles, sorting waste, conserving water and electricity, and maintaining a clean classroom and school environment. Furthermore, students also show increased empathy for other living things, awareness of the limitations of natural resources, and the emergence of a sense of responsibility and leadership in encouraging peers to protect the environment (Fauziah et al., 2023). These environmentally based projects serve as learning tools that not only enrich cognitive aspects, but also build moral and social commitment to consistently behave in an environmentally friendly manner.

Discussion

Ecological awareness is an essential foundation in education for sustainable development because it enables students to understand the interconnectedness between humans and the environment and encourages them to develop responsible attitudes and behaviors toward environmental sustainability (Adams et al., 2020; Tilbury, 2021). One effective approach to instilling this awareness is *Project-based Learning* (PjBL), which actively engages students in real-world projects related to environmental issues, thus encouraging them to develop conceptual understanding and emotional sensitivity to ecological issues (Bell, 2020; Fauziah et al., 2023; Yilmaz et al., 2020). The integration of Natural and Social Sciences (IPAS) subjects with environmental conservation themes also serves as a holistic learning strategy because it combines ecological, social, and economic aspects within a single learning process (Setiawan et al., 2021; Hernández-Barco et al., 2021).

The process of instilling ecological values through Project-Based Learning (PjBL) can be carried out through systematic and contextual stages, such as environmental problem exploration, value reflection, collaboration and decision-making, concrete action, and critical evaluation (Harahap & Manik, 2023; Holm, 2022). Although the implementation of Project-Based Learning (PjBL) in science learning faces several

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

challenges, such as limited time, teacher competency, and resources, these challenges can be overcome through strategies such as teacher training, collaboration with local communities, and the use of technology (Lee et al., 2021; Wahyuni et al., 2023; Ramirez et al., 2022). Consequently, project-based science learning can significantly increase students' ecological awareness, both in terms of conceptual understanding, emotional sensitivity, and actual ecological behavior (Putri et al., 2022; Wals et al., 2020). Thus, the implementation of PjBL in science learning can be a strategic solution to increase students' ecological awareness and shape them into agents of change who are responsible for the environment (Kemendikbudristek, 2022).

CONCLUSION

This study confirms that instilling ecological awareness from an early age is a strategic necessity in addressing the increasingly complex environmental crisis. Key findings indicate that the Project-Based Learning (PjBL) approach in Natural and Social Sciences (IPAS) learning is able to comprehensively integrate students' cognitive, affective, and psychomotor aspects. Students not only understand environmental concepts theoretically but also engage in meaningful and contextualized concrete actions, such as waste audits, reforestation, or water conservation. The learning process, which includes problem exploration, value reflection, collaboration, concrete action, and critical evaluation, has proven effective in shaping responsible ecological behavior, increasing emotional sensitivity to the environment, and fostering a sense of ownership of surrounding ecological issues. The novelty of this study lies in the synergy between IPAS learning and the PjBL approach within the context of the Independent Curriculum, which provides thematic and cross-disciplinary flexibility. This approach strengthens the relevance of learning to real life and aligns with the strengthening of the Pancasila student profile. Project-based IPAS learning not only builds individual ecological awareness but also encourages collective participation in building an environmentally conscious school culture. However, this study has limitations in implementation, particularly related to practical challenges such as time constraints, teacher competency, and school resource and policy support. Therefore, further research is needed to examine more concrete supporting strategies, including best-practice-based teacher training, multisectoral collaboration, and the use of technology to address implementation challenges across various educational contexts.

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

BIBLIOGRAPHY

Belland, B. R., Kim, C. M., & Hannafin, M. (2020). *Project-Based Learning in STEM Education: Theoretical Underpinnings and Empirical Evidence* . Journal of STEM Education Research, 3(2), 123–139. https://doi.org/10.1007/s41979-020-00021-4

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2023: Synthesis Report* . https://www.ipcc.ch/report/sixth-assessment-report-synthesis-report/

Krajcik, J., & Shin, N. (2022). *Project-Based Learning: A Proven Approach to Learning STEM* . Science and Children, 59(7), 18–23.

Suryanti, T., Susilo, H., & Suwono, H. (2021). *Implementation of Project-Based Learning Model to Increase Environmental Awareness of Elementary School Students* . Indonesian Journal of Science Education, 10(1), 45–54. https://doi.org/10.15294/jpii.v10i1.27950

UNESCO. (2019). *Education for Sustainable Development: A Roadmap* . https://unesdoc.unesco.org/ark:/48223/pf0000374802

Yusoff, SB, Mahmud, Z., & Wahab, NA (2020). *Teachers' Challenges in Implementing Project-Based Learning Among Primary School Students in Malaysia* . Journal of Education and Learning, 14(1), 45–53. https://doi.org/10.11591/edulearn.v14i1.14236

Santana, D.B., et al. (2021). The impact of Project-Based Learning on environmental awareness. Environmental Education Research, 27(4), 512–529.

Lim, C. P., & Lee, J. (2020). Sustainability education in primary schools through PBL: A review of strategies. Journal of Cleaner Production, 250, 119535.

UNESCO. (2020). Education for Sustainable Development: A Roadmap. Paris: UNESCO Publishing.

Rizal, M., Syamsurizal, S., & Fauzi, A. (2021). Application of project-based learning model in science to increase ecological awareness of elementary school students. Indonesian Science Education Journal, 10(1), 44–52.

Zhang, Y., & Wang, L. (2023). Ensuring validity in qualitative educational research: A systematic approach. International Journal of Qualitative Studies in Education, 36(2), 123–139.

Boffey, R. M., & Windle, J. (2022). Thematic analysis in environmental education: Strategies and challenges. Teaching and Teacher Education, 109, 103579.

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

Wals, AEJ, et al. (2020). Learning for sustainability in times of global uncertainty.Environmental Education Research, 26(4), 511–529.

UNESCO. (2020). Education for Sustainable Development: A Roadmap. Paris: UNESCO. IPBES. (2022). Global Assessment Report on Biodiversity and Ecosystem Services.

Thomas, J. W. (2021). Project-Based Learning: A Guide to Standards-Focused Project Work for the 21st Century. Buck Institute for Education.

Bell, S. (2020). Project-Based Learning for the 21st Century: Skills for the Future. The Clearing House, 83(2), 39–43.

Sartori, R., et al. (2021). Environmental education and PBL: A synergic approach. Journal of Environmental Studies, 13(2), 122–135.

Çimer, A., et al. (2023). Implementing PBL in science to promote environmental awareness. Education and Science, 48(2), 67–85.

Setiawan, B., et al. (2021). Integrative science and natural science curriculum for sustainable learning. Journal of Science Education, 9(1), 34–42.

Putri, DA, et al. (2022). Contextual IPAS and local environmental projects. Indonesian Journal of Primary Education, 6(2), 75–84.

Ministry of Education, Culture,Research, and Technology. (2022). Independent Curriculum: Implementation Guide in Thematic Learning. Jakarta: Puskur.

Adams, R.M., et al. (2020). Eco-critical thinking in elementary science. International Journal of STEM Education, 7(13), 1–10.

Harahap, MI, & Manik, RP (2023). The influence of PjBL on environmental awareness of elementary school students. Journal of Elementary Education, 14(1), 45–55.

Hernández-Barco, R., et al. (2021). Eco-literacy through experiential learning. Journal of Environmental Education, 52(3), 215–230.

Lee, S.J., et al. (2021). Challenges in implementing project-based environmental education. Sustainability, 13(5), 2482.

Ramirez, C., et al. (2022). Community-supported environmental education projects. Journal of Community Engagement, 10(2), 123–134.

Wahyuni, E., et al. (2023). Teacher readiness in implementing PjBL in the Merdeka curriculum. Journal of Educational Innovation, 9(1), 67–76.

Yilmaz, H., et al. (2020). Improving environmental behavior through PBL. Eurasian Journal of Educational Research, 85, 189–206.

Fauziah, A., et al. (2023). Project-based science learning model to increase ecological awareness. Indonesian Science Education Journal, 12(1), 22–33.

attadib
Journal of Elementary Education
Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516
UIKA
Universitas Ibn Khaldun Bogor

Fink, A. (2019). Conducting Research Literature Reviews: From the Internet to Paper. SAGE Publications

Creswell, J. W., & Poth, C. N. (2018). Qualitative Inquiry and Research Design: Choosing Among Five Approaches (4th ed.). SAGE Publications.

Adams, P., Smith, L., & Brown, M. (2020). *Environmental education and sustainability in the classroom* . Routledge.

Bell, S. (2020). *Project-based learning for the 21st century* . Routledge.

Fauziah, R., Hasanah, N., & Prasetyo, A. (2023). The impact of project-based learning on students' environmental awareness. *Journal of Environmental Education* , 54(2), 145– 160.

Harahap, FR, & Manik, KES (2023). Implementation of project-based learning in environmental education. *Journal of Education and Learning* , 17(1), 23–32.

Hernández-Barco, M., Rodríguez, S., & Pérez, L. (2021). Project-based learning and environmental education: A systematic review. *Sustainability* , 13(4), 1856.

Holm, M. (2022). Project-based learning: A review of the literature. *Educational Research Review* , 17, 95–104.

Ministry of Education, Culture, Research, and Technology. (2022). *Independent Curriculum* . Ministry of Education, Culture, Research, and Technology.

Lee, J., Kim, H., & Park, S. (2021). Challenges and strategies for implementing project- based learning in environmental education. *Journal of Environmental Education* , 52(3), 210–225.

Putri, RE, Maulana, D., & Nugroho, A. (2022). The effectiveness of project-based learning in improving students' environmental awareness. *Journal of Environmental Education* , 53(1), 66–78.

Ramirez, P., Lin, Y., & Huang, C. (2022). Integrating technology in project-based learning for environmental education. *Journal of Educational Technology Development and Exchange* , 15(2), 50–68.

Setiawan, A., Kurniawan, D., & Wijaya, T. (2021). Integrating environmental education into science and social studies curriculum. *Journal of Environmental Education* , 52(4), 340–352.

Tilbury, D. (2021). Education for sustainable development: A review of the literature. *Sustainability* , 13(9), 4850.

Wahyuni, S., Hartati, E., & Surya, R. (2023). The role of technology in enhancing project- based learning for environmental education. *Journal of Educational Technology Development and Exchange* , 16(1), 35–48.

Attadib: Journal of Elementary Education
Web Jurnal: https://ejournal.uika-bogor.ac.id/index.php/at-tadib/index
p-ISSN: 2614-1760, e-ISSN: 2614-1752
Edisi : Vol. 9, No. 2, Juni/2025, hlm. 502-516

Wals, A.E.J., Brody, M., Dillon, J., & Stevenson, R.B. (2020). Environmental education and sustainability: A review of the literature. *Sustainability* , 12(1), 95.

Yilmaz, R., Aydin, M., & Cakir, H. (2020). The impact of project-based learning on students' environmental attitudes and behaviors. *Journal of Environmental Education*, 51(5), 375–390.