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Project-Based Learning for Fostering Students' Ecological Awareness: An Integration of Ecopedagogy and Islamic Ecotheology

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Abstract

This study aims to analyze the effect of Project-Based Learning (PjBL), the ecopedagogical approach, and Islamic ecotheological values on students' ecological awareness, with PjBL products as a mediating variable in Fiqh learning at state Islamic high school. This study employed a quantitative explanatory approach using the SEM-PLS method. The sample consisted of 120 students selected through purposive sampling. Data were collected using questionnaires and project product assessment rubrics. The results show that PjBL (P-value < 0.001), the ecopedagogical approach (P-value = 0.004), and Islamic ecotheological values (P-value = 0.032) have a positive and significant effect on PjBL products. PjBL products also have a significant effect on ecological awareness (P-value = 0.001). However, PjBL (P-value = 0.089) and the ecopedagogical approach (P-value = 0.234) do not have a significant direct effect on ecological awareness, while Islamic ecotheological values remain significant (P-value = 0.032). Furthermore, PjBL products act as a full mediator in the relationship between PjBL and the ecopedagogical approach on ecological awareness but do not mediate the effect of Islamic ecotheological values. These findings indicate that ecological awareness is more effectively developed through learning experiences embodied in project products, while spiritual values have a direct influence on students' behaviour.

Keywords: Project Based Learning, Ecopedagogy, Islamic Ecotheology, Learning Products, Ecological Awareness

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INTRODUCTION

The The current ecological crisis in Indonesia is increasingly worrying and has a far-reaching impact on environmental sustainability. Data from the Ministry of Environment and Forestry shows that national waste production reaches tens of millions of tons per year, while its management remains suboptimal, triggering environmental pollution (KLHK, 2024). In addition, the increase in the incidence of hydrometeorological disasters such as floods and landslides shows a close relationship between environmental degradation and environmentally unfriendly human activities (Lestari, 2025). This condition indicates that ecological problems are not only caused by natural factors, but also by low levels of ecological awareness and behavior in society (Nugroho, 2025). In the context of education, ecological awareness is understood as the integration of knowledge, attitudes and behavior towards the environment (UNESCO, 2020).

Various efforts have been made through the world of education to increase students' ecological awareness, one of which is through the application of innovative learning models such as Project Based Learning (PjBL). A number of studies show that PjBL contributes positively to improving student character and competence. PjBL is able to increase nationalism and social studies learning achievement (Made et al., 2024). In addition, other studies also show that PjBL can improve critical thinking skills, collaboration, and student engagement in learning (Satria et al., 2025). However, improvements in cognitive aspects and skills have not been fully followed by real changes in students' ecological behavior.

This shows that learning has not fully integrated the value dimension, especially religious and ecological values in the process of student-centered learning activities through the process of exploration, inquiry, and production of real work as a form of implementation of learning experiences, so that learning becomes more meaningful and applicable (Susilawati et al., 2025). The effectiveness of PjBL can be strengthened by an ecopedagogical perspective that emphasizes critical awareness of the environment and the integration of Islamic ecotheological values as a spiritual foundation (Amalia, 2024). Within this framework, project products serve not only as the final outcome of learning but also as concrete representations of students' internalization of values and learning experiences. The resulting products reflect the construction of knowledge, skills, and attitudes through active engagement in project-based learning (Zhan at al., 2022), so that it can be an authentic indicator of learning success.

This study aims to analyze the influence of Project-Based Learning based on ecopedagogy and Islamic ecotheological values on students' ecological awareness, and to examine the role of project products as mediating variables in Islamic jurisprudence learning. This study also examines the model of intervariable relationships as a basis for developing more contextual Islamic Religious Education (PAI) learning oriented toward building students' ecological awareness.

RESEARCH METHOD

This study uses a quantitative explanatory approach to test the causal relationships between variables in the research model. The object of the study is the Islamic jurisprudence (Fiqh) learning process based on Project-Based Learning (PjBL), integrated with an ecopedagogic approach and Islamic ecotheological values in shaping students' ecological awareness.

The study was conducted at MAN 4 Pekanbaru City. The study population was all students participating in Fiqh learning, while the sample was determined using a purposive sampling technique, with the criteria being students who were involved in project-based learning and produced learning products. The sample size was 120 respondents. Data collection techniques used a questionnaire and an assessment rubric. The questionnaire was used to measure Project-Based Learning, ecopedagogy, Islamic ecotheology, and students' ecological awareness using a Likert scale. Meanwhile, the learning product variable was measured using an assessment rubric as a formative construct.

Operationally, the Project-Based Learning variable was measured through indicators of project planning, implementation, collaboration, and evaluation (Li & Rohayati, 2024). Ecopedagogical variables are measured through indicators of critical awareness, environmental concern, and ecological responsibility (Wardani et al., 2025). The variables of Islamic ecotheology are measured through understanding the values of the caliphate, balance (mīzān), and prohibition of damage (fasād) (Nur et al., 2025). Learning product variables are measured based on the quality, creativity, and usefulness of the product (Fitri et al., 2024). Ecological awareness is measured through aspects of students' knowledge, attitudes and behavior towards the environment (Arshad et al., 2020). Data analysis was conducted using Partial Least Squares-based Structural Equation

Modeling (PLS-SEM) with the help of SmartPLS software. The analysis was conducted through evaluation of the measurement model (outer model) to test the validity and reliability of the constructs, as well as evaluation of the structural model (inner model) to test the relationship between variables and the research hypothesis. In addition, a mediation test was conducted to determine the role of learning products in mediating the relationship between independent variables and students' ecological awareness. The selection of PLS-SEM was based on the method's ability to analyze predictive models with reflective and formative constructs simultaneously.

FINDINGS AND DISCUSSION

Statistical Findings

This study involved 120 respondents from MAN 4 Pekanbaru City who participated in Project-Based Learning (PjBL)-based fiqh learning. The results of data analysis using PLS-SEM showed direct and indirect effects between variables in the research model.

Table 1. Direct Effect Test Results

Relationship	Coefficient	T-Statistic	P-value	Description
Product => Ecological Awareness	0.635	3.225	0.001	Significant
PjBL Model =>Product	0.531	4.481	< 0.001	Significant
PjBL Model => Ecological Awareness	0.278	1.701	0.089	Not significant
Ecopedagogy => Product	0.297	2.903	0.004	Significant
Ecopedagogy => Ecological Awareness	0.273	1.190	0. 234	Not significant
Ecotheology => Product	0.187	2.149	0.032	Significant
Ecotheology => Ecological Awareness	0.178	2.148	0.032	Significant

The results of the analysis of the direct influence between variables are presented in the table: Based on table 1, it is explained that the variables of the PjBL Model, Ecopedagogic Approach, and Islamic Ecotheological Values have been proven to have a positive and significant influence on PjBL Products. This is indicated by the P-value of each variable which is smaller than 0.05. Among the three, the PjBL Model is the strongest driver for the formation of PjBL Products with the largest path coefficient value, namely 0.531. This proves that project-based pedagogical synthesis is effective in producing authentic student work. The relationship between PjBL Products and Ecological Awareness shows a very significant positive influence with a T-statistic value of 3.225 > 1.96 with P-Values 0.001. This finding indicates that the better the quality of the project products produced by students, the stronger the internalization of ecological values formed within them.

Table 2. Indirect Effect Test Results

Relationship	Coefficient	T-Statistic	P-value	Description
PjBL Model =>Product => Ecological Awareness	0.337	2.724	0.006	Signifikan
Ecopedagogy => Product => Ecological Awareness	0.189	2.091	0.037	Signifikan
Ecotheology => Product => Ecological Awareness	0.118	1.405	0.032	Signifikan

The results of the study in Table 2 show that in the relationship between the Project-Based Learning (PjBL) model and ecological awareness, the mediation test produced a P-value of 0.006 (<0.05). This indicates that the PjBL product significantly mediates the influence of the PjBL model on ecological awareness. On the other hand, the direct influence of the PjBL model on ecological awareness was not significant (P-value = 0.089). Thus, the PjBL product acts as a full mediation, meaning that the influence of the PjBL model on ecological awareness is entirely channeled through

the products produced in the learning process. This finding indicates that the influence of the PjBL model and the ecopedagogical approach on ecological awareness does not occur directly, but rather through an intermediary variable in the form of learning products. This indicates that the learning process requires an internalization stage to produce changes in students. In this context, the PjBL product functions as a link between the learning process and the achieved outcomes, because through active involvement in the project and the resulting products, students gain meaningful learning experiences. Thus, learning cannot simply focus on delivering material; it must actively involve students so that the knowledge gained can develop into concrete attitudes and behaviors.

Discussion

The findings demonstrate that Project-Based Learning (PjBL) products play a significant mediating role in fostering students' ecological awareness. The significant indirect effects of the PjBL model and the ecopedagogical approach through project products indicate that ecological awareness is not formed merely through participation in learning activities, but through the process of producing tangible outputs that embody students' understanding and experiences. In project-based learning, products function as concrete representations of knowledge construction, enabling learners to connect environmental concepts with real-life situations. Through the process of planning, creating, evaluating, and presenting project outcomes, students engage in meaningful learning experiences that strengthen cognitive understanding and environmental responsibility. This finding supports the argument that learning artifacts generated in PjBL contribute significantly to environmental awareness because they transform abstract concepts into authentic experiences that are personally meaningful for learners (Agoub & El Haddouchi, 2025). Consequently, the quality and relevance of project products become important determinants in translating learning experiences into ecological consciousness.

Interestingly, the results reveal that neither the PjBL model nor the ecopedagogical approach exerts a significant direct influence on ecological awareness. These findings suggest that exposure to student-centered learning activities alone is insufficient to generate lasting environmental awareness. Rather, the impact of learning approaches emerges through an internalization process facilitated by project outcomes. From a constructivist perspective, knowledge and attitudes are developed through active engagement and reflection rather than direct transmission from teacher to learner. Students develop ecological awareness when they are required to transform ideas into concrete actions and observable products, allowing them to experience environmental issues firsthand. This interpretation is consistent with studies showing that output-oriented learning in PjBL strengthens sustainability consciousness because learners reflect on the significance and impact of their completed work (Xiao & Wang, 2022). Therefore, project products serve as a bridge connecting instructional experiences with behavioral and attitudinal outcomes, making the learning process more transformative and meaningful.

The significant mediation effect also reinforces the theoretical foundations of experiential learning and ecopedagogy. Experiential learning theory posits that meaningful learning occurs through a cycle of concrete experience, reflection, conceptualization, and active experimentation. In the context of this study, project products represent the culmination of this cycle because they embody students' reflections and applications of ecological knowledge. Similarly, ecopedagogy emphasizes critical awareness and transformative action toward environmental issues rather than passive acquisition of information. The findings suggest that ecological awareness emerges when learners actively participate in creating solutions, representations, or environmental projects that require critical engagement with ecological realities. This interpretation aligns with previous studies

indicating that Project-Based Learning promotes pro-environmental behavior by immersing students in authentic environmental projects and encouraging active participation in problem-solving processes (Azrai et al., 2024). Furthermore, PjBL has been shown to create meaningful learning environments where students develop environmental awareness through direct experiences rather than through theoretical instruction alone (Yolcu, 2023).

In contrast, Islamic ecotheology demonstrates a significant direct effect on ecological awareness while its indirect effect through project products is not significant. This finding indicates that the mechanism through which Islamic ecotheological values influence ecological awareness differs from that of pedagogical approaches. Islamic ecotheology is rooted in spiritual beliefs, religious obligations, and moral responsibility toward nature as part of divine creation. Such values possess intrinsic motivational power that can directly shape attitudes and behavioral intentions without requiring mediation through project-based experiences. Students may internalize ecological responsibility through religious teachings, ethical reflection, and spiritual commitment, allowing ecological awareness to emerge independently of tangible learning products. This finding suggests that spiritual values operate through an affective and moral pathway rather than through experiential or product-based mechanisms. Previous studies have similarly emphasized that religious values can directly influence environmental attitudes because they are internalized through belief systems and moral convictions that guide individual behavior (Muralidharan et al., 2024). Consequently, while project products effectively mediate cognitive and experiential learning processes, they appear less effective in translating deeply rooted spiritual values into ecological awareness.

The differential effects observed among the variables highlight the importance of adopting a holistic educational framework that integrates pedagogical innovation, experiential engagement, and spiritual value formation. The findings suggest that project products are particularly effective in mediating cognitive and affective dimensions of learning because they facilitate active participation, reflection, and contextual understanding. However, spiritual dimensions require complementary pedagogical strategies such as value reflection, ethical dialogue, and religious contemplation to strengthen the internalization of ecological responsibility. This observation is consistent with the argument that project outcomes alone have limitations in transforming spiritual consciousness unless they are accompanied by deeper reflective and value-oriented learning processes (Zulaika et al., 2025). Therefore, effective environmental education should combine project-based experiences with opportunities for critical and spiritual reflection, enabling students to develop ecological awareness that is not only knowledge-based but also morally and spiritually grounded.

This study contributes to the growing body of literature on ecological education by demonstrating that mediating variables are essential for explaining how educational interventions influence behavioral outcomes. Rather than focusing solely on direct relationships between instructional approaches and ecological awareness, the study uncovers the underlying mechanisms through which these effects occur. The findings show that project products function as a critical mechanism linking pedagogical approaches to ecological awareness, whereas Islamic ecotheology operates through a direct value-internalization pathway. This distinction enriches the understanding of ecological learning by illustrating that different educational dimensions follow different causal processes. As suggested by Yulianti et al. (2025), ecological awareness is most effectively developed when cognitive, affective, and spiritual dimensions are integrated within a comprehensive educational framework. Therefore, the novelty of this study lies not only in identifying significant relationships among variables but also in explaining the mechanisms that connect learning processes, value internalization, and ecological awareness, thereby offering a more comprehensive model for environmental education and behavioral transformation.

CONCLUSION

This study concludes that the development of students' ecological awareness occurs through two distinct mechanisms. First, the Project-Based Learning (PjBL) model and the ecopedagogical approach influence ecological awareness indirectly through PjBL products, indicating that meaningful learning experiences must be transformed into tangible outputs before they can shape students' environmental attitudes and behaviors. Second, Islamic ecotheological values exert a direct influence on ecological awareness, demonstrating that spiritual and religious values possess an intrinsic capacity to foster environmental responsibility without requiring mediation through learning products. These findings highlight the importance of integrating experiential learning, product-based activities, and spiritual value internalization within educational practices. Furthermore, the study contributes to the development of an integrative learning model by positioning PjBL products as a mediating mechanism that explains how pedagogical approaches translate into ecological awareness. Consequently, strengthening ecological awareness in Islamic Religious Education requires not only innovative learning strategies but also the incorporation of religious values that support the holistic development of students' cognitive, affective, behavioral, and spiritual dimensions.

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