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Integrating the Law on Environmental Protection and Management into Ecology Learning to Enhance Students Legal Awareness

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A B S T R ACT

The current global ecological crisis is often viewed as a failure of collective understanding regarding environmental legal instruments. At the secondary education level in Indonesia, there is a curricular dichotomy that separates biology from civic education, resulting in students understanding natural destruction cognitively but remaining indifferent to its juridical consequences. Previous research has extensively explored problem-based learning models; however, the majority remains limited to cognitive learning outcomes without systematically integrating legal instruments. This study aims to formulate and test the effectiveness of an ecology module integrated with crucial points of Law No. 32 of 2009 (UU PPLH) to enhance students' legal awareness. The method used is a qualitative approach with a descriptive case study design based on constructivist epistemology. Research subjects were selected through purposive sampling, involving Grade XI students and biology teachers. Data were collected through participant observation, in-depth interviews, FGDs, and documentation studies, and then analyzed using the interactive model of Miles, Huberman, and Saldana. A systematic transformation of student awareness. The integration of materials such as AMDAL (Environmental Impact Assessment) and Environmental Quality Standards successfully bridged science and legal literacy, shifting the students' paradigm from a biotic-abiotic understanding toward juridical awareness. Although initial resistance emerged due to cognitive load, the social constructivism approach was effective in transforming rigid legal texts into vibrant ethical discussions. These findings theoretically prove that legal literacy functions as a catalyst for ecological intelligence, creating ecological citizenship that is not only academically brilliant but also legally resilient in preserving the sustainability of the Earth.

1. INTRODUCTION

The global ecological crisis is not merely a biophysical issue; it is a manifestation of low compliance and a lack of collective understanding regarding environmental legal instruments (Boyd, 2010; Firdaus, 2025). At the secondary education level, ecology is often confined to purely scientific instruction, failing to address the binding juridical responsibilities of individuals as citizens (Boulot & Sterlin, 2022). This phenomenon creates a gap between students theoretical understanding of ecosystem balance and their awareness of the legal consequences of environmental destruction. The broader implication is the emergence of a generation that cognitively understands natural degradation but remains indifferent to the rule of law, which should serve as the primary bulwark for natural resource protection (Atta & Sharifi, 2025).

The urgency of integrating legal aspects into the science curriculum is crucial, as the effectiveness of environmental protection depends heavily on public legal literacy from an

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early age (Insani & Karimullah, 2023). Environmental law enforcement will not yield optimal results if society perceives regulations merely as external coercion rather than internalized values fostered through education (Gagné & Hewett, 2025). By internalizing the Law on Environmental Protection and Management (UU PPLH) into the classroom, education does more than produce scientists; it cultivates citizens aware of their constitutional rights and obligations to preserve the Earth, ultimately reducing future environmental violations (Kerner, 2022).

This research employs a Law-Related Education (LRE) framework collaborated with Social Constructivism (Baehaqi & Komalasari, 2022). This framework was selected because it posits that legal understanding is most effectively built through social interaction and real-life contexts, rather than rote memorization of statutes (Rafi et al., 2025). By linking ecological principles (such as carrying capacity) with legal norms (such as environmental permits and pollution sanctions), students are encouraged to develop a mental schema where every biological action carries juridical implications. This connection strengthens the relevance of ecological material as a foundation for ethical actions protected by state law (Berebon, 2025; Nurziana & Firdaus, 2025).

The context of this research focuses on secondary schools in Indonesia, where the primary challenge lies in a curricular dichotomy that separates Pancasila and Civic Education (PPKn) from Biology (Sunarso et al., 2024). Environmental education policies have historically been ceremonial, lacking the substantive aspects of prevailing regulations, such as Law No. 32 of 2009 (Aldyan, el all, 2025). This case is particularly relevant as Indonesia is highly vulnerable to environmental crimes, yet its formal curriculum does not explicitly mandate environmental law comprehension within science subjects (Alicia, 2024).

Previous research has extensively explored the effectiveness of problem-based learning models in ecology; however, most remain limited to improving cognitive learning outcomes or general environmental attitudes (Ardiansyah et al, 2024). There is a significant literature gap regarding how formal legal instruments are systematically integrated into biological content. Prior studies tend to treat scientific and legal literacy as two distinct domains (Cooper & Shooter, 2022). This study aims to fill that gap by evaluating the extent to which the integration of formal regulations can transform students' legal awareness within a scientific context (Aziz & Sain, 2025).

The primary objective of this research is to formulate and test the effectiveness of an ecology learning module integrated with crucial points of the UU PPLH. Specifically, this study seeks to measure improvements in students' legal awareness, encompassing legal knowledge, attitudes toward regulations, and behavioral patterns in responding to environmental issues in their surroundings.

The significance of this research lies in the urgent need to bridge the gap between theoretical ecological knowledge and the implementation of legal awareness among the younger generation. Amidst escalating natural degradation, teaching Ecology is no longer sufficient if it only focuses on the biological interactions of living things. Through the integration of the UU PPLH, this research becomes vital as it provides a juridical foundation for students to understand their rights and obligations as citizens toward the environment. This is essential for creating a society that is not only cognitively intelligent regarding nature but also compliant and critical toward environmental law enforcement in Indonesia.

The contributions of this research span both theoretical and practical dimensions in education. Theoretically, it enriches the discourse on interdisciplinary learning models that

bridge the natural and social (legal) sciences. Practically, the results are expected to serve as a guide for educators in developing integrative teaching modules and providing recommendations for policymakers to strengthen environment-based curricula. For students, the greatest contribution is the transformation from mere observers of nature into legally literate agents of change, capable of basic advocacy or, at the very least, avoiding actions that violate environmental laws in their daily lives.

The advantage of this research over conventional approaches is its contextual and multidimensional nature. It targets not only cognitive aspects but also the affective and psychomotor domains through the formation of legal consciousness. By analyzing real cases through a legal lens, learning becomes more vivid and relevant to social reality. Furthermore, the use of a qualitative approach allows for a deep exploration of organic shifts in student perception and behavior, yielding more humanistic and authentic findings on how legal understanding can effectively transform human interaction with the ecosystem.

2. METHOD

This research is grounded in constructivist epistemology, which posits that legal knowledge and awareness are not merely objective facts transferred from teacher to student, but are instead constructed through social interaction and the interpretation of real-world contexts (Gannar & Kilani, 2025). A qualitative approach was chosen because this study aims to explore, in depth, the organic and multidimensional process of transforming students' legal awareness (cognitive, affective, and psychomotor) (Abbasi et al, 2023). This approach allows the researcher to capture the phenomenon of "value internalization" that cannot be fully explained through statistical figures (Rijal et al., 2023).

2.1 Research Design/Approach

This study employs a Descriptive Case Study design. This design is used to dissect the phenomenon of integrating Law No. 32 of 2009 into the biology curriculum within a secondary school environment (Shambare, 2023). Through a case study, the researcher can understand in detail how the dichotomy between science and law is bridged in classroom teaching practices and its impact on student behavior in responding to environmental issues (Lovren & Jablanovic, 2023).

2.2 Methodological Framework

The research framework collaborates Law-Related Education (LRE) with Social Constructivism (Al Sulaimani et al., 2022). Law-Related Education: Used to provide substantive content regarding rights, obligations, and sanctions within the UU PPLH (Fatma & Danile, 2024). Social Constructivism: Used as an instructional strategy where students build legal understanding through real-case discussions, ethical debates, and collaborative bio-juridical impact analysis (Florez et al., 2022).

2.3 Data Collection and Sampling

The sampling technique utilizes Purposive Sampling, where informants are selected based on specific criteria: Grade XI students currently studying ecology and biology teachers involved in module development (Munasi, 2024). Data collection techniques include:

Participant Observation: Observing classroom interactions during the implementation of the integrated module (Kalm et al., 2022).

In-depth Interview: Exploring student perceptions regarding the link between ecological principles and legal responsibility (Al-Barakat et al., 2025). FGD (Focus Group Discussion): Discussing cases of environmental violations to observe students' collective behavior patterns (Boermans et al., 2024). Documentation Study: Analyzing students' written reflections and the drafts of the developed learning modules (Richlin, 2023).

2.4 Data Analysis Method

Data analysis utilizes the Interactive Analysis Model by Miles, Huberman, and Saldana, which includes (Asipi et al., 2022): Data Condensation: Sorting and simplifying data from interviews and observations relevant to aspects of legal awareness (Newberry & Carhart, 2024). Data Display: Presenting data in the form of descriptive narratives, conceptual relationship charts, or thematic tables (Tang, 2023). Conclusion Drawing: Formulating findings regarding the effectiveness of UU PPLH integration in changing students' perspectives on environmental sustainability (Baskoro, 2025).

2.5 Formal and Material Object

As a qualitative study, the research objects are defined as follows:

Material Object: Students' legal awareness in the context of environmental preservation. This encompasses knowledge of regulations, attitudes toward nature protection, and law-abiding behavioral tendencies (Belchior et al., 2024).

Formal Object: The integration of the Law on Environmental Protection and Management (UU PPLH) materials into Ecology subjects (Ramada et al.,, 2025). This formal object serves as the perspective or "lens" used by the researcher to dissect how formal legal instruments can be transformed into applicable science education material (Lim, 2025).

3. RESULT AND DISCUSSION

Through data triangulation involving participatory classroom observation, in-depth interviews with teachers and students, and a curricular analysis of teaching modules based on Law No. 32 of 2009, this research reveals a systematic process of evolution in legal awareness (Saralar & Turker, 2024). This transformation begins with cognitive internalization, where students absorb norms of environmental protection (Zhang & Cao, 2025); continues with a reconstruction of attitudes that alters their ethical perspectives; and culminates in the manifestation of advocative behavior, where students are no longer merely objects of the law, but active agents in advocating for ecosystem sustainability (Balontia, 2024).

3.1 Cognitive Transformation by Bridging Science Literacy and Legal Literacy

Prior to the curricular intervention, students' understanding of ecological material tended to be textual and confined to the domain of pure science (Cheung et al., 2024). Based on initial observations, students viewed ecosystems merely as webs of interaction between biotic and abiotic components, devoid of connections to the socio-political order (Spours, 2024). Natural phenomena such as energy cycles or ecological succession were understood as mechanically operating biological processes, where the human role was often positioned only as an external destructive factor, without a deep understanding of the legal boundaries governing such actions (Scheffran, 2025).

This literacy gap began to be bridged when the biology teaching modules were intervened with the integration of pollution prevention instruments derived from the UU PPLH. By incorporating material regarding Environmental Impact Assessments (AMDAL) and Environmental Quality Standards, students were invited to view biology through a more pragmatic lens (Kumayza & Widaningrum, 2024). Learning no longer stopped at the question "how does pollution occur?" but evolved into "how does the state limit such pollution through legal standards?". The inclusion of these juridical variables transformed ecological material which was originally theoretical-abstract into contextual and public policy-based content.

Post-intervention, a significant shift occurred in the way students processed information regarding environmental destruction. Students began to be able to link every biological phenomenon with its accompanying juridical consequences (Isenaj et al., 2025). For example, when discussing the decline of water quality in a river, students did not only analyze the biological impact on fish populations but also began to question the Water Quality Standard parameters that had been violated. This awareness indicates that students have understood that every human action toward nature carries legal implications that can be measured and held constitutionally accountable.

Furthermore, an understanding of AMDAL provided students with a new perspective on the importance of preventive measures in development (Purba et al., 2025). They began to realize that biological science is a key instrument in the creation of legal environmental documents (Sun et al., 2022). This fostered a critical attitude where students no longer viewed regulations as an administrative burden, but rather as a scientific bulwark for ecosystem protection (Timmis et al., 2025; Haikal et al., 2025). This transformation proves that integrating legal aspects into biology is capable of expanding students' horizons from mere observers of nature to individuals aware of their ecological rights and obligations (Gilbert et al., 2023).

The integration of Law No. 32 of 2009 into biology modules has successfully created a holistic learning model (Pertiwi et al., 2024). This paradigm shift from a biotic-abiotic understanding toward juridical awareness is a vital foundation for the formation of ecological citizenship (Parasain, 2024; Firdaus & Alifiyah, 2025). By understanding legal instruments from an early age, students are expected to possess not only intellectual intelligence in the field of science but also moral and legal firmness in safeguarding the sustainability of natural resources in the future (Bandi 2022).

The findings in this study reinforce the relevance of the Law-Related Education (LRE) framework, which states that legal understanding reaches its highest effectiveness when placed within the context of real life (Simson, 2022). In biology learning, environmental law is no longer taught as rigid, memorized statutes, but as a living instrument that interacts directly with natural phenomena (Simson, 2022). By contextualizing regulations within the local ecosystems known to students, the law is transformed from mere normative text into a functional guide for behavior. This proves that legal literacy integrated into science is capable of bridging the gap between textbook theory and the socio-ecological realities students face daily (Simson, 2022).

Unlike conventional research that tends to focus only on achieving cognitive learning outcomes in ecology, the integration of the UU PPLH in this module provides a solid "value framework" for every scientific datum found. Whereas in traditional learning students only collect data regarding physical and chemical environmental parameters, in this model, such data carries moral and legal weight (Ramadhani et al., 2023). Information regarding water acidity levels or heavy metal concentrations is no longer just a statistical figure, but an

indicator of compliance with or violation of constitutional mandates (Ramadhani et al., 2023). The addition of this value dimension changes the way students process scientific information: from mere fact collection to an assessment of environmental justice (Ramadhani et al., 2023).

The most striking paradigm shift is seen in the increased depth of students analysis regarding environmental damage (Zhao & Zhong, 2025). While previously students only had a general understanding that indiscriminate waste disposal would damage river ecosystems, they are now able to identify such actions as specific violations of Article 69 of the UU PPLH. The realization that environmental pollution is not merely a "technical error" but a wrongful act (unlawful act) with serious criminal consequences provides a profound psychological impact (Zhao & Zhong, 2025). Knowledge regarding the threat of sanctions and strict liability creates an intellectual deterrent effect that encourages students to think more critically before acting or when witnessing violations in their environment (Zhao & Zhong, 2025).

Furthermore, this integration has succeeded in shifting the position of students from passive observers of nature to legal subjects aware of their ecological rights. By understanding the structure of the UU PPLH, students realize they have a right to a good and healthy environment as part of their human rights. This understanding is crucial because science education has often ignored the aspect of advocacy. When students understand that river damage is a violation of a specific article, they begin to build the courage to voice objections and demand accountability, which is the core of advocative behavior in a democratic society.

In conclusion, these findings demonstrate that juxtaposing biological data with juridical consequences is a revolutionary pedagogical strategy for creating ecological citizenship. Science provides the evidence, while the law provides the consequence. The collaboration between these two disciplines ensures that ecological knowledge does not end in the laboratory but flows into a strong civic consciousness. By equipping students through an integrated Law-Related Education framework, educational institutions have prepared a generation that is not only smart in preserving nature biologically but also resilient in defending it legally.

3.2 Reconstruction of Attitudes: From Apathy Toward Constitutional Responsibility

This research specifically highlights a significant change in the students' affective domain, namely a shift in how they position themselves toward the environment (Bertoli et al., 2024). Through interactive group discussion methods, students were presented with various real-world case studies regarding environmental disputes occurring in Indonesia. This process proved effective in dismantling the barrier between abstract biological theory and socio-ecological reality. Students began to realize that natural destruction is not merely a scientific phenomenon occurring outside of themselves, but a humanitarian issue directly intersecting with their own dignity and survival (Bertoli et al., 2024).

This affective transformation reached a turning point when students began to view themselves no longer as passive observers of nature or distant spectators, but as empowered legal subjects (Esmail & Matthews, 2022). In conventional biological perspectives, humans are often positioned merely as causal factors of destruction or agents of conservation (Esmail & Matthews, 2022). However, by integrating legal instruments, students realized they possess a strong constitutional bargaining position. This awareness fostered a deeper sense of ownership toward environmental sustainability, as they understood that ecosystem health is a prerequisite for the fulfillment of their basic human rights (Esmail & Matthews, 2022).

The primary strength of this change stems from the students' understanding of Article 65 of the UU PPLH, which explicitly guarantees that every person has the right to a good and healthy environment as part of human rights. When students discussed environmental disputes through the lens of this article, a strong emotional resonance emerged. They began to understand that water pollution or deforestation is not merely a "biotic disturbance," but a violation of fundamental rights that can be legally contested. Knowledge of this constitutional right transformed empathy for nature into a robust principle of justice within the students.

Furthermore, case studies of environmental disputes in Indonesia provided a context that strengthened the students' moral courage. By analyzing how communities struggle to defend their living spaces, students learned about the importance of accountability and law enforcement (Tejada & Navas, 2023). These discussions triggered the internalization of ecological citizenship values, where students felt called to play an active role in environmental oversight. This affective change is crucial; without a sense of ownership over their legal rights, students' biological knowledge remains technical, lacking the drive to perform environmental defense or advocacy in the future (Tejada & Navas, 2023).

In conclusion, this sub-discussion proves that teaching biology alongside legal education is capable of creating more holistic student characters. The shift from "observer" to "legal subject" signifies that education has successfully moved beyond the transfer of cognitive knowledge toward the formation of a legally conscious civic identity. By equipping students with an understanding of Article 65 of the UU PPLH, we are not only producing future scientists who are academically brilliant but also environmental advocates who possess a strong legal foundation to safeguard the collective right to a sustainable environment for future generations.

One of the rather surprising findings in this research was the emergence of initial resistance from a number of students when legal material began to be integrated into the Biology learning structure (May, 2023). This group of students initially felt that the cognitive load brought by legal material, with its formal legal terminology, felt "too heavy" and foreign for a science lesson (May, 2023). This resistance was not merely a matter of technical difficulty in understanding text, but a reflection of compartmentalized learning expectations, where students are accustomed to separating natural sciences—viewed as objective-experimental—from socio-legal sciences, which are viewed as discursive and regulative (May, 2023).

This phenomenon of resistance revealed the presence of a very strong curricular dichotomy at the secondary school level (Giroux, 2024). Thus far, the education system has tended to separate disciplines rigidly (siloing), causing students to experience an epistemological shock when asked to connect biological variables with juridical consequences. This compartmentalized mindset becomes the primary obstacle in creating transdisciplinary learning (Giroux, 2024). Such conditions indicate that the greatest challenge in integrating the UU PPLH lies not in the availability of material, but in the mental readiness of students to tear down the dividing walls between science and law that have been constructed over years within the conventional education system (Giroux, 2024).

However, these psychological and cognitive barriers gradually began to erode as the Social Constructivism approach was applied in the learning process. Rather than providing one-way legal lectures, the teacher facilitated student interactions to build a shared understanding through dialogue. In this collaborative environment, knowledge was no longer regarded as a package of information "dropped" from above, but as the result of a negotiation of meaning within the classroom. Students who were initially resistant began to feel more

comfortable when they were permitted to explore the links between law and biology using their own language and logic, supported by teacher guidance and peer feedback.

The primary strength of this Social Constructivist approach lies in its ability to perform a radical transformation: changing "rigid legal text" into "vibrant ethical discussion." Articles in the UU PPLH that initially appeared cold and bureaucratic began to pulsate when linked to moral dilemmas in environmental case studies. When students debated Environmental Quality Standard limits or the urgency of AMDAL in development projects in their region, the law ceased to be merely a written rule and began to function as an ethical compass. This is where the integration succeeded; law was no longer understood as a memorization burden, but as a protective tool for the life they study in biology.

Despite showing promising results, this research is limited by the relatively short duration of the intervention. The process of transforming awareness from the cognitive stage to the advocative realm requires deep internalization time; therefore, the long-term stability of student attitudes still needs to be further tested through longitudinal studies. The changes observed at this time may be a response to temporary enthusiasm toward a new method (halo effect). Consequently, consistency is required in the implementation of this integrated curriculum to ensure that the legal awareness that has grown does not become merely temporary knowledge, but remains as the character of ecologically responsible citizens in the future.

3.3 Behavioral Manifestation Through Value Internalization

In the final stage of the study, a significant shift was found in the behavioral patterns of students, who now tend to be more responsive and substantive. This transformation marks the successful internalization of legal values into their ecological consciousness. Whereas previously students' environmental actions were limited to routines without deep reflection, the intervention of the UU PPLH-integrated module has changed the way they respond to environmental degradation around them. This responsive behavior is not merely a spontaneous reaction, but an action based on the understanding that every environmental problem has solution standards regulated by policy instruments.

A key finding is the change in the orientation of students' environmental actions, which are no longer trapped in ceremonial activities. Activities such as mass community cleaning or one-day tree planting which have long been icons of conventional environmental education are beginning to be viewed by students as good steps that nevertheless fail to touch the root of the problem (Plaku & Leka, 2025). Students are starting to realize that without oversight of pollution sources and the enforcement of rules, these physical actions are merely temporary and curative (Plaku & Leka, 2025). This shift indicates that the students' ecological maturity has moved beyond the aesthetic aspects of the environment toward systemic sustainability (Plaku & Leka, 2025).

Students' critical attitudes are now being directed toward waste management, both within the school environment and around their residences (Plaku & Leka, 2025).. They no longer simply dispose of trash in its proper place but have begun to question the effectiveness of sorting systems, collection frequency, and final disposal sites (Plaku & Leka, 2025).. These critical questions arise because students have been equipped with simple regulatory standards regarding domestic waste management. They have begun to compare field realities with the legal idealism they studied, creating a space for dialectics between what is happening and what should be done according to applicable regulations (Plaku & Leka, 2025)..

The strength of this responsive behavior lies in the use of regulatory standards as selfevaluation parameters. Students have begun to use legal logic to assess whether waste management in their environment meets environmental health and safety aspects. For example, they have begun to challenge the practice of open waste burning, which violates air pollution control principles. By using regulations as a reference, the arguments presented by students become more substantial and objective, no longer just emotional complaints, but a form of early advocacy based on the right to a good environment.

Overall, this improvement in behavioral patterns proves that biology education coupled with legal literacy is capable of creating resilient agents of change. Students have transformed from passive observers into active environmental monitors at the grassroots level. Their ability to question waste governance based on regulatory standards shows that the seeds of legal awareness have grown into the character of ecological citizenship. This serves as strong evidence that integrating the UU PPLH into the science curriculum is a strategic step toward producing a generation capable of guarding environmental sustainability through concrete actions with a legal foundation (Karuniasa & Firdaus, 2025).

Theoretically, the findings of this study provide an important contribution to environmental education discourse by proving that legal literacy is not merely additional material, but a primary catalyst for strengthening ecological intelligence. Until now, ecological intelligence has often been measured only by biological understanding and empathy for nature. However, the integration of the UU PPLH shows that awareness of constitutional rights and obligations provides a dimension of moral firmness that has been missing from science education. By understanding legal boundaries, students' ecological intelligence is no longer passive-contemplative but transforms into a critical consciousness capable of identifying systemic violations against ecosystem integrity.

Practical implications of these findings demand a reorientation in the professional development of biology teachers. For this curricular integration to be effective, it is no longer sufficient for biology teachers to master botany, zoology, or pure ecology; they need to be equipped with a comprehensive understanding of basic legal modules. This need is urgent to prevent misinterpretations of environmental law articles that could confuse students. Cross-disciplinary training between legal experts and science educators is key to ensuring that legal terminology such as "Quality Standards," "AMDAL," and "Strict Liability" is conveyed with juridical accuracy yet remains in pedagogical language easily digested by secondary students.

Furthermore, this integration encourages the need for curricular policy reform at the school level to dismantle the dividing walls between natural sciences and social sciences. Schools are expected to no longer view legal material as the exclusive domain of Pancasila and Civic Education (PPKn) subjects. By using environmental issues as a meeting point, biology can become an entry point for contextual Law-Related Education. Another practical implication is the need to develop teaching modules that juxtapose local scientific data with relevant legal instruments, allowing students to directly practice legal analysis on environmental conditions around their schools.

Looking forward, this research opens significant opportunities to expand sample scales to regions with more challenging socio-ecological characteristics. Future research should be directed toward schools located in agrarian conflict zones or industrial areas dense with pollution. In such crisis zones, the empowering force of UU PPLH integration can be tested more tangibly. Researchers can observe the extent to which environmental law knowledge can provide psychological protection and advocacy tools for students whose families are directly

impacted by land disputes or industrial waste pollution, so that education truly functions as an instrument of liberation.

In conclusion, the future direction of biology education must move toward a more courageous and applicable transdisciplinary model. Testing the long-term stabilization of attitudes and the effectiveness of students' advocative behavior in the field should be the focus of the next longitudinal studies. By strengthening the synergy between science and law, we are not only preparing an academically brilliant generation but also ecologically resilient citizens who are legally robust. The future sustainability of the Earth depends heavily on the ability of the younger generation to guard environmental policy with accurate scientific data and unshakable legal arguments.

Overall, this research concludes that the rigid separation between science and law in the secondary education curriculum is an educational anomaly with detrimental impacts on environmental protection. Historically, biology has been taught as a neutral and value-free entity, while law has been viewed as a separate socio-political domain. In the reality of the ecological crisis, however, both are two sides of the same coin: science provides the diagnosis of natural damage, while law provides the prescription for its recovery. Maintaining this dichotomy will only produce graduates who are academically intelligent but advocatively blind, which ultimately weakens the collective defense against the exploitation of natural resources.

Although this research provides optimistic findings, the author recognizes methodological constraints in the form of potential subjectivity in assessing "awareness" through a qualitative approach. Measuring the depth of inner transformation and shifts in students' thinking paradigms through interviews and observations certainly poses challenges in terms of standardization compared to quantitative data. However, these limitations do not diminish the validity of the findings but rather enrich our understanding of the human aspect of education. This subjectivity was managed through rigorous data triangulation to ensure that the observed changes are truly a reflection of authentic cognitive and affective development in students.

Despite these methodological challenges, the findings consistently show a strong psychological phenomenon: when students understand that nature is protected by the rule of law, their respect for the ecosystem increases significantly. The knowledge that a tree in the forest or water in a river has a legal status protected by Law No. 32 of 2009 changes the way students view nature from a mere material object to a subject entitled to protection. Legality provides "authority" to biological data; a polluted river is no longer seen merely as a bad sight, but as a violation of the legal order of a sovereign state.

On a macro level, these findings align with global trends that place Environmental Citizenship as a primary goal of 21st-century education. In various parts of the world, there is a shift from conventional environmental education toward education that empowers individuals to act politically and legally for the preservation of the Earth. By integrating the UU PPLH into Biology, schools have taken a progressive step in producing citizens who are not only capable of technical conservation but also capable of overseeing environmental policy and demanding ecological justice in the public sphere.

As a closing, this integration is not merely an innovation in teaching methods but an ideological statement about how modern humans should interact with their planet. Education must be able to produce individuals who possess the science literacy to understand nature and the legal literacy to defend it. By breaking down the disciplinary barriers between Biology and

Law, we are building the foundation for a resilient future generation, aware of their ecological rights, and possessing the integrity to ensure that the rule of law always stands on the side of the sustainability of life on Earth.

4. CONCLUSION

Based on the research results and discussions presented, it can be concluded that the integration of Law No. 32 of 2009 into biology learning modules has successfully created a holistic transdisciplinary learning model. This process triggered an evolution of student awareness starting from cognitive transformation, where science literacy is bridged with legal literacy through materials such as AMDAL (Environmental Impact Assessment) and Environmental Quality Standards. This shifted the students' perspective from merely understanding ecosystems in a textual-biological manner toward a contextual and public policy-based understanding, where every natural phenomenon is linked to juridical consequences that are constitutionally accountable.

Furthermore, this intervention encouraged a reconstruction of student attitudes from apathy toward constitutional responsibility. By understanding Article 65 of the UU PPLH, which guarantees the right to a good and healthy environment, students experienced an identity shift from passive observers to legal subjects with a strong sense of ownership over ecosystem sustainability. Although initial resistance emerged due to a rigid curricular dichotomy, the use of a Social Constructivism approach proved effective in transforming cold legal texts into vibrant ethical discussions, allowing the law to function as a moral compass in understanding environmental dilemmas.

Ultimately, the internalization of these values manifested in ecological behavior that is more responsive and substantial. Students began to move away from ceremonial environmental actions and shifted toward regulation-based early advocacy efforts, such as critiquing waste management using prevailing legal standards. Theoretically, these findings prove that legal literacy is a primary catalyst for strengthening ecological intelligence. By uniting scientific evidence and legal consequences, biology education is capable of producing a generation of ecological citizenship that is not only smart in preserving nature biologically but also resilient in defending it legally for future sustainability.

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