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Factors Affecting the Implementation of a Curriculum Based on Environmental Legal Literacy Education in Primary Education

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A B S T R A C T

Purpose: This study aimed to design and validate a curriculum model based on environmental legal literacy education for primary education to enhance students' environmental awareness, attitudes, and responsibility.

Methods and Materials: This study employed an exploratory mixed-methods design. In the qualitative phase, thematic analysis was used to identify the main dimensions of the proposed curriculum model. The participants included experts in curriculum planning, environmental education, and environmental law, who were selected through purposive sampling until theoretical saturation was reached. Overall, 19 experts participated in semi-structured interviews. The interview data were coded and organized into initial codes, basic codes, organizing themes, and overarching themes. In the quantitative phase, the content of primary school textbooks was analyzed purposefully, and Shannon entropy was applied to determine the relative importance of the identified components. In addition, partial least squares structural equation modeling was used to examine the relationships among the constructs of the proposed model. The statistical population included specialists in curriculum planning and environmental education, from whom 98 participants were selected using G*Power software and convenience sampling.

Findings: The inferential results of the structural equation modeling indicated that all identified constructs had significant effects on the curriculum model based on environmental legal literacy. Among the constructs, the principles governing curriculum content had the strongest effect on curriculum quality, indicating its central role in shaping an effective environmental legal literacy curriculum. The results also confirmed the meaningful contribution of the model's philosophical foundations, current situation analysis, objectives and competencies, teaching–learning strategies, implementation requirements, and evaluation mechanisms. These findings demonstrated that the proposed model has acceptable explanatory capacity for designing and implementing an interdisciplinary curriculum in primary education.

Conclusion: The findings suggest that environmental legal literacy should be systematically integrated into primary education through interdisciplinary content, active teaching–learning strategies, performance-based evaluation, and clear implementation requirements. Strengthening this area of the curriculum can support the development of environmentally responsible students who are familiar with their rights, duties, and legal responsibilities toward the environment.

Keywords: *Environmental Legal Literacy; Curriculum; Environmental Education; Primary Education; Educational System.*

1. Introduction

Environmental challenges have increasingly become among the most complex educational, social, legal, and managerial concerns of contemporary societies. Climate instability, biodiversity loss, pollution, unsustainable consumption, and the degradation of local ecosystems are no longer viewed merely as scientific or technical issues; rather, they are interwoven with questions of citizenship, responsibility, law, ethics, justice, and public governance. In this context, schools are expected to move beyond the passive transmission of environmental information and to prepare students for informed participation in environmental protection, responsible decision-making, and law-abiding social action. Since children's attitudes, habits, and civic orientations are shaped from the earliest stages of formal education, primary education provides a strategic platform for developing environmental awareness and environmental responsibility. Recent studies have emphasized that environmental risk factors influence children's development and educational achievement, making environmental learning a direct concern of educational quality and equity (Güneş, 2025). Similarly, the physical and ecological quality of educational environments has been considered an important dimension of educational planning and institutional responsibility (Csomós, 2026). Therefore, the incorporation of environmental themes into school curricula is not a marginal enrichment activity but a necessary response to the educational, developmental, and societal consequences of environmental change.

Environmental education has traditionally focused on knowledge about nature, ecological systems, pollution, resource conservation, and sustainability. However, contemporary environmental problems require learners not only to know about the environment but also to understand the rights, duties, legal norms, institutional mechanisms, and civic responsibilities associated with environmental protection. This expanded understanding gives rise to the concept of environmental legal literacy, which can be understood as the ability to recognize environmental rights and obligations, understand the legal and ethical foundations of environmental protection, identify environmentally harmful behaviors, and participate responsibly in individual and collective action for environmental preservation. Research on green curricula has shown that curriculum design can play a significant role in shaping pro-environmental behaviors and environmental value orientations, particularly when environmental concepts are integrated with values, participation, and action-oriented learning (Ni et al., 2024). From this perspective, environmental legal literacy is a multidimensional construct that connects environmental knowledge with citizenship education, ethics, legal awareness, and behavioral responsibility.

The need to integrate environmental legal literacy into primary education is further reinforced by the growing emphasis on environmental citizenship. Environmental citizenship implies that learners should be equipped to act as responsible members of society who recognize their relationship with nature, understand the consequences of human actions, and participate in collective efforts to protect environmental rights. Studies on environmental education planning for primary pupils have emphasized that curriculum development should be directed toward fostering environmental citizenship from early schooling (Obasi & Osah, 2022). In a similar line, curricula based on environmental care have been shown to support character education in elementary schools by linking environmental concern with moral development and responsible behavior (Oktarina & Nisa, 2021). Therefore, environmental legal literacy can be seen as a necessary extension of environmental citizenship, because it gives students a clearer understanding of the legal, ethical, and institutional dimensions of environmental responsibility.

Primary education is a particularly important level for implementing such a curriculum because children at this stage are developing foundational patterns of thinking, moral judgment, social participation, and behavioral self-regulation. Environmental learning during primary school can shape durable attitudes toward nature, law, public

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responsibility, and collective welfare. Studies on environmental education based on local values have shown that integrating environmental themes into elementary school curricula can enhance relevance and meaning by connecting learning with students' cultural and social contexts (Hernawan et al., 2021). In Iran, the position of environmental education in the elementary curriculum has also been examined, and findings have indicated the necessity of more systematic attention to environmental concepts in curriculum content (Kargozar et al., 2020). Moreover, practical elements derived from educational research and experiences suggest that environmental education becomes more effective when it is embedded within curriculum objectives, content, teaching methods, and evaluation processes rather than being treated as an isolated topic (Yasemi et al., 2022). These findings indicate that the implementation of environmental legal literacy requires a coherent curriculum model rather than scattered references to environmental issues.

A curriculum based on environmental legal literacy should be designed around several interrelated dimensions, including philosophical foundations, analysis of the current situation, educational objectives and competencies, curriculum content, teaching–learning strategies, implementation requirements, and evaluation mechanisms. The philosophical and ethical foundations of such a curriculum are important because environmental protection is closely associated with moral education, public responsibility, justice, and the common good. Studies on moral education curricula have shown that values, ethical reasoning, and behavioral orientation must be explicitly considered in curriculum design if education is expected to influence learners' conduct (Gholampour et al., 2021). In the field of environmental education, this means that learners should not only memorize ecological facts but also internalize values such as justice, moderation, care, responsibility, and respect for the rights of present and future generations. The integration of environmental themes into philosophy education also confirms the importance of reflective, ethical, and conceptual engagement with environmental questions (Tzvetkova, 2025). Accordingly, environmental legal literacy requires a value-based curriculum capable of connecting legal awareness with ethical understanding and responsible action.

Another important dimension is the analysis of the current curriculum situation. Many educational systems include environmental topics in textbooks, but these topics may be fragmented, descriptive, theoretical, or insufficiently connected to legal duties and civic action. Studies on the alignment of the intended, implemented, and achieved curriculum in environmental courses have shown that inconsistency among curriculum design, classroom implementation, and learning outcomes can limit the effectiveness of environmental education (Akbari et al., 2023). Similarly, research on principals' experiences of developing students' environmental participation indicates that school-level leadership, institutional culture, and practical opportunities for participation are crucial for translating environmental concepts into student engagement (Heidari et al., 2023). Therefore, identifying the strengths and weaknesses of the current curriculum is necessary for designing an implementable model of environmental legal literacy education. Without such analysis, curriculum reform may remain formal and declarative rather than transformative.

The objectives and competencies of an environmental legal literacy curriculum should also be clearly defined. These objectives should include cognitive, affective, behavioral, legal, and civic dimensions. Students need to learn basic environmental concepts, recognize environmental rights and responsibilities, develop sensitivity toward environmental harm, acquire problem-solving skills, and practice participation in school and community-based environmental activities. The development of ecological citizen curricula demonstrates that citizenship-oriented environmental education should include knowledge, attitudes, skills, and participatory competencies (Khandani et al., 2023). Similarly, environmental curriculum models based on self-management emphasize that learners must develop capacities for responsible self-regulation and sustainable behavior in relation to environmental issues (Mohkamkar et al., 2021). Accordingly, environmental legal literacy should not be reduced to legal information; it should cultivate students' capacity to connect knowledge with responsible conduct and civic participation.

The content of the curriculum is another determining factor in implementation. A curriculum based on environmental legal literacy should include national and international environmental laws, the right to a healthy environment, duties of citizens and institutions, environmental crimes and violations, rights of nature and animals, waste management, pollution, climate-related issues, sustainable consumption, and local environmental problems. At the same time, this content should be developmentally appropriate for primary school students

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and should be presented in simple, concrete, and meaningful ways. Place-based environmental curricula, such as curriculum units designed to foster energy literacy, show that connecting content to local environmental realities helps students understand abstract environmental issues through their immediate surroundings (Zangori, 2023). Outdoor and environmental education scholarship has also emphasized that curriculum content becomes more powerful when linked to direct experience, place, and embodied engagement with the environment (Lugg & Quay, 2022). Therefore, curriculum content must be both legally meaningful and pedagogically appropriate.

Teaching–learning strategies are central to the success of environmental legal literacy education. Traditional lecture-based methods are insufficient for developing the skills, attitudes, and participatory competencies required for environmental responsibility. Active learning, problem-based learning, role play, environmental court simulations, debates, case studies, project-based learning, storytelling, field visits, and community-based activities can help learners understand the practical meaning of environmental rights and duties. Research on eco-art and place-based curricula indicates that creative and experiential learning can encourage empathy for the environment and strengthen emotional connections with nature (Sunassee & Bokhoree, 2021). The use of a Theory of Change approach in environmental education has also shown that curriculum implementation benefits from explicit links among educational goals, learning activities, expected outcomes, and school-level practices (Jones, 2023). These findings suggest that effective implementation depends on active and coherent instructional strategies that move students from awareness to engagement.

In recent years, digital and hybrid learning environments have also become important contexts for curriculum implementation. Environmental legal literacy education can benefit from digital media, simulations, multimedia storytelling, virtual learning environments, and online collaborative activities, especially when these tools are used purposefully and coherently. Research on hybrid and eco-digital learning environments highlights the need to revisit curriculum design models in light of the interaction between ecological concerns and digital learning possibilities (Nielsen, 2023). Studies on instructional coherence in blended learning environments further show that the effectiveness of curriculum implementation depends on alignment among goals, content, pedagogy, and learning activities (Santagata et al., 2023). Experiences with virtual learning environments during the COVID-19 pandemic also suggest that digital tools can shape students' learning experiences, provided that they are integrated into the curriculum in a structured and meaningful way (Hwang et al., 2023). In the Iranian educational context, studies on e-learning opportunities and challenges during the Corona period have emphasized that digital learning development requires attention to infrastructure, teacher readiness, learner engagement, and post-crisis educational planning (Hajizadeh et al., 2021). Recent work on cyberspace opportunities in learning environments similarly shows that students' perspectives can provide useful insights for improving technology-supported education (Faridi Sfanjany et al., 2025). In addition, electronic learning environments compatible with brain-based learning have been found to affect students' executive functions, suggesting that digital curriculum environments can influence cognitive processes when they are designed according to learners' developmental characteristics (Rajabian Deh Zire et al., 2024). Therefore, digital tools can support environmental legal literacy education, but they must be aligned with pedagogical aims and developmental needs.

Implementation requirements are as important as curriculum design. Even a well-developed curriculum may fail if teachers are not prepared, educational managers do not support implementation, textbooks are not aligned, assessment systems remain traditional, or schools lack the necessary resources and institutional culture. Curriculum implementation requires coordination among policy-making, teacher education, school leadership, instructional materials, family participation, community institutions, and evaluation mechanisms. Research on workplace curriculum models with a futurology approach has emphasized that curriculum design should be forward-looking and responsive to future needs, institutional change, and emerging social demands (Aboutalebi et al., 2023). In another context, resilience-based curriculum development has shown that environmental scanning and literature-based planning can help curriculum designers identify gaps, needs, and implementation priorities (Wood & Chérif, 2022). These insights are relevant to environmental legal literacy because such a curriculum must prepare students not only for present environmental issues but also for future ecological, legal, and civic challenges.

Local, cultural, and indigenous dimensions should also be considered in designing and implementing environmental legal literacy curricula. Environmental problems are global, but they are experienced locally; therefore, curriculum

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content should be sensitive to local ecological conditions, cultural values, community practices, and students' lived experiences. Work on Indigenizing environmental sustainability curriculum and pedagogy emphasizes the need to confront ecological crises through knowledge traditions and sustainability perspectives that challenge purely technical or universalized approaches to environmental education (Jimenez & Kabachnik, 2023). Similarly, naturalistic intelligence and environmental sustainability literature highlights the importance of recognizing learners' relationship with nature and strengthening capacities that support environmental understanding and care (Rahim et al., 2025). These perspectives suggest that environmental legal literacy should be localized and culturally meaningful while remaining connected to broader national and international principles of environmental law and sustainability.

Evaluation is another essential element of curriculum implementation. If environmental legal literacy is assessed only through written tests of factual knowledge, the curriculum will likely fail to capture students' attitudes, skills, participation, and responsible behavior. Performance-based assessment, portfolios, project evaluation, self-assessment, peer assessment, formative evaluation, and school-community projects are more appropriate for measuring the multidimensional outcomes of environmental legal literacy. Environmental education and sustainability curricula in citizenship education have emphasized active citizenship as a central outcome, indicating that assessment should consider learners' participation, responsibility, and civic engagement, not merely their memorization of content (Moschopoulou & Karakatsani, 2020). Therefore, a curriculum model for environmental legal literacy should include an evaluation system that measures knowledge, values, skills, and action in an integrated way.

Despite the importance of environmental education, existing studies suggest that the legal dimension of environmental learning has received insufficient attention, especially in primary education. Many curricula address environmental awareness but do not systematically teach students about environmental rights, legal responsibilities, environmental justice, environmental violations, and mechanisms of civic participation. Moreover, the effective implementation of such education depends on multiple factors, including curriculum philosophy, content organization, teacher competence, school leadership, instructional methods, institutional support, digital capacities, localization, and evaluation procedures. The available literature provides valuable insights into environmental education, green curricula, ecological citizenship, active learning, digital curriculum environments, and curriculum implementation; however, there remains a need for an integrated model that specifically identifies the factors affecting the implementation of a curriculum based on environmental legal literacy education in primary education.

Accordingly, the present study aimed to identify and validate the factors affecting the implementation of a curriculum based on environmental legal literacy education in primary education.

2. Methods and Materials

In this study, a mixed-methods methodological approach was used to identify the factors affecting the implementation of a curriculum based on environmental legal literacy education in primary education. In terms of purpose, this research was applied, because its results could be used by educational organizations and departments. In terms of nature, the present study was categorized as developmental research, because it sought to identify the components of a curriculum based on environmental legal literacy education and, based on these components, to present and validate a model. In terms of research strategy, this study was descriptive and followed a sequential exploratory mixed-methods design; that is, in the first stage, the components and dimensions of the curriculum based on environmental legal literacy education were identified using qualitative methods, and in the next stage, the extracted model was tested and validated in the quantitative phase. Data were collected through both library and field methods; in the library phase, scientific sources, books, articles, and related documents were used, while in the field phase, data were collected through interviews and questionnaires. In the qualitative phase of the research, thematic analysis based on the approach of Braun and Clarke (2006) was used to identify the components and dimensions of the curriculum based on environmental legal literacy education. Thematic analysis is a systematic method for identifying, analyzing, and interpreting meaningful patterns in qualitative data, which leads to a deeper understanding of the phenomenon under study through data coding and the extraction of main and subthemes. In this study, the interview transcripts were first read several times so that the researcher could become fully familiar with the data. Then, the initial codes were extracted, the main and subthemes were identified through their classification and comparison, and finally, the

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conceptual framework and initial model of the curriculum based on environmental legal literacy education were developed.

The participants in the qualitative phase included experts and specialists in the fields of educational sciences, social sciences, public law, and environmental law in West Azerbaijan Province, who were selected using purposive and snowball sampling methods. The sampling process continued until theoretical saturation was reached; that is, sampling was stopped when new data no longer generated new codes or concepts and the information became repetitive. Ultimately, 19 participants took part as the final sample in the qualitative phase of the study. The data collection instrument in this phase was a semi-structured interview. In this type of interview, a set of pre-designed questions was asked, but participants were allowed to express their views and experiences freely, and the researcher also asked follow-up questions based on their responses. In the quantitative phase of the research, partial least squares structural equation modeling (PLS-SEM) was used to validate the model extracted from the qualitative phase. The statistical population of this phase included curriculum planning specialists, environmental law specialists, and primary school teachers with at least 10 years of teaching experience and master's or doctoral degrees in educational psychology, curriculum planning, public law, and environmental law in West Azerbaijan Province. The sample size was determined using G*Power software, and ultimately, 98 participants were selected as the final research sample. The data collection instrument in the quantitative phase was a researcher-made Environmental Legal Literacy Education Questionnaire, which was designed based on the findings of the qualitative phase and the components extracted from thematic analysis. The questionnaire items were developed based on the results of the Delphi process and expert opinions. Various methods were used to examine the validity of the instruments. In the qualitative phase, criteria such as the researcher's prolonged engagement with the data, continuous observation, peer review, recording and documentation of the research process, and participant validation of the results were used to enhance the credibility of the findings. The reliability of the qualitative data was also calculated using intercoder intra-subject agreement. In the quantitative phase, face validity, content validity, and construct validity were used to examine the validity of the questionnaire. Content validity was evaluated using the content validity ratio (CVR) and content validity index (CVI) based on expert judgment. In addition, construct validity was examined using the average variance extracted (AVE) index to assess convergent validity and by comparing the square root of AVE with the correlation coefficients among constructs to assess discriminant validity. The reliability of the questionnaire was also calculated using Cronbach's alpha coefficient. Finally, the qualitative data were analyzed using Braun and Clarke's thematic analysis method, and the quantitative data were analyzed using structural equation modeling based on the partial least squares approach to examine the fit and validity of the proposed curriculum model based on environmental legal literacy education.

3. Findings and Results

In the qualitative phase of the research, Braun and Clarke's thematic analysis method was used to identify the components and dimensions of the curriculum based on environmental legal literacy education. The participants in this phase included 19 experts in the fields of educational sciences, public law, environmental law, and social sciences, who were selected using purposive and snowball sampling methods. Examination of the demographic characteristics of these experts showed that they had considerable diversity in terms of gender, age, educational level, and work experience, and most of them held master's or doctoral degrees and had more than 10 years of work experience. This disciplinary and experiential diversity made it possible to obtain different perspectives on environmental legal literacy education and ensured that the qualitative data had sufficient richness.

In the first stage of thematic analysis, the researcher attempted to gain deep familiarity with the content of the data by repeatedly reading and reviewing the interview transcripts. As a result of this process, a total of 729 initial semantic codes were extracted from 19 interviews, reflecting the views and experiences of experts regarding environmental legal literacy education, curriculum elements, the current situation, and the characteristics of the desired curriculum model. The variation in the number of codes extracted from each interview indicated differences in the experiences, expertise, and level of participation of the experts in explaining the research topic. The data analysis also showed that fewer new concepts emerged in the final interviews and that the emphasis was mostly placed on previously identified concepts; therefore, it can be stated that the researcher reached an appropriate level of theoretical saturation.

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In the next stage, the initial codes were organized using manual coding. At this stage, important sentences and phrases in the interview transcripts were identified, and a semantic code was assigned to each. Then, similar or synonymous codes were compared and categorized. As a result of this process, among the 729 initial codes, after removing repeated items and integrating similar concepts, 110 basic codes were identified, which formed the basis for the development of the research themes.

Subsequently, the basic codes were categorized into organizing themes and overarching themes, and the conceptual map of thematic analysis was formed. The results of this stage showed that the experts' views on environmental legal literacy education could be classified into several main areas, including the foundations and necessities of environmental law education, challenges and shortcomings of the current situation, expected educational objectives and competencies, principles governing curriculum content and syllabi, teaching–learning strategies, and implementation requirements and the evaluation system. These themes indicated that environmental legal literacy education should adopt an interdisciplinary, problem-oriented, and socially participatory approach and, in addition to knowledge transmission, should focus on strengthening responsible attitudes and empowering citizens to protect the environment.

Table 1

Classification of Themes Extracted from Thematic Analysis in Designing a Curriculum Model Based on Environmental Legal Literacy Education

Overarching Theme	Organizing Theme	Basic Codes
1. Foundations, necessity, and philosophy of the model	1.1. Religious, jurisprudential, and ethical foundations	Right to a healthy environment, jurisprudential and Islamic legal foundations, optimal consumption and avoidance of wastefulness, Islamic worldview of protection, environmental justice
1. Foundations, necessity, and philosophy of the model	1.2. Strategic necessity and intergenerational justice	Strategic necessity and importance, intergenerational responsibility, sustainable development education, future orientation in law, compensatory orientation in violations, education for protecting planet Earth, use of international experiences
2. Analysis and critique of the current situation: challenges	2.1. Policy-making and macro-structural challenges	Structural critique of the existing educational system, components of environmental legal literacy, critique of the focus on graduate studies, absence of an independent course at the bachelor's level, shortcomings in macro-level policy-making, identification of environmental violations, independent course unit as a proposal
2. Analysis and critique of the current situation: challenges	2.2. Content-related and methodological inadequacies	Challenge of translated literature, critique of the dominance of theoretical education, dominance of knowledge-based objectives as a critique, inadequacy of traditional teaching methods, abstractness of concepts as a challenge, content coherence of textbooks
2. Analysis and critique of the current situation: challenges	2.3. Weakness of infrastructure and professional competence	Need to train specialized teachers, empowerment of school stakeholders, physical infrastructure of schools, professional competence of teachers
3. Expected objectives and competencies	3.1. Legal empowerment and demand-making	Strengthening informed demand-making, legal empowerment of citizens, granting agency to students, fostering responsible citizenship, protective and participatory attitude, linking awareness with social action, activism and civic participation, awareness of citizenship rights
3. Expected objectives and competencies	3.2. Green criminal literacy and identification of violations	Identification of environmental violations, legal thinking skills, green criminal policy and criminalization, rights of environmental victims, secondary environmental crimes, education in fundamental green concepts
3. Expected objectives and competencies	3.3. Development of responsible attitudes and activism	Prevention of environmental harm, internalization of values in childhood, environmental ethics and justice, culture of law-abidingness, challenges of urbanization and development, triangle of knowledge, motivation, and skill
4. Principles governing content and syllabi	4.1. Knowledge of national and international laws	Linking education with legislation, education on national laws, including the Constitution, international conventions, education in schools as the current situation, compulsory nature of the curriculum, commitment to law and enforcement guarantees
4. Principles governing content and syllabi	4.2. Biophysical knowledge and connection with nature	Education on the rights of nature and animals, biophysical knowledge of the environment, self-knowledge through nature, environmental and personal health, energy and fossil-fuel pollution, position of the environment in science, waste and garbage management
4. Principles governing content and syllabi	4.3. Localization and alignment with regional needs	Localization and regional needs, management of environmental crises, localization of content based on local issues, critical analysis of laws, linking education with policy-making

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4. Principles governing content and syllabi	4.4. Interdisciplinary integration and practical application	Applied and non-specialized education, interdisciplinary nature of the curriculum, integration into mathematics and other subjects, share of environmental content
5. Teaching–learning strategies: methods	5.1. Collaborative and interactive learning	Active and interactive learning, collaborative teaching methods, teacher's facilitative role, familiarity with responsible institutions, informal education and family, role of non-governmental organizations (NGOs), debate and legal dialogues, role play, school–community connection, festivals and competitions
5. Teaching–learning strategies: methods	5.2. Experiential learning and simulation	Modern educational approaches, including field-based and experiential approaches, problem-based learning, simulation of an environmental court, analysis of policy impacts, case studies, education from preschool, direct experience with nature, advance organizers in education, green curricula, modern ecocentric thinking system, longitudinal relationship in knowledge acquisition
5. Teaching–learning strategies: methods	5.3. Modern methods, storytelling, and media	Use of media and technology, multimedia and digital education, storytelling and scenario development
6. Implementation requirements and evaluation system	6.1. Process-oriented and performance-based evaluation	Performance-based and qualitative evaluation, project-based evaluation, formative and process evaluation, portfolio, self-assessment and peer assessment, inquiry and research skills
6. Implementation requirements and evaluation system	6.2. Dynamism, flexibility, and continuity of the model	Institutional and cultural dimensions, dynamism and flexibility of the curriculum, ethical decision-making, gradual age-based education

In the quantitative phase of the research, variance-based structural equation modeling (PLS-SEM) was used to evaluate the proposed model. After the questionnaire data were converted into quantitative data, they were first analyzed using descriptive statistics and then inferential statistics. In the first step, the demographic characteristics of the sample, including age, educational level, and gender, were described. The results showed that the highest frequency belonged to the age group of 41 to 45 years, and in terms of education, most respondents held master's degrees. Women also constituted the largest proportion of the sample. These findings provided a general picture of the composition of the statistical sample and prepared the ground for subsequent analyses.

Next, to examine the assumption of data normality, the Kolmogorov–Smirnov test was conducted for the research constructs. The results showed that the distribution of all variables was non-normal, with significance levels below 0.05. Given this condition, and to obtain valid estimates, the partial least squares method and SmartPLS software were used to test the model and research hypotheses. This method is robust against violation of the normality assumption and is suitable for relatively small samples and complex models.

To ensure the accuracy of the research results, model fit was first evaluated at two levels: the measurement model and the structural model. At the measurement model level, reliability indices, including Cronbach's alpha, rho_A coefficient, and composite reliability (CR), were examined. According to methodological standards, values above 0.70 for these indices indicate desirable internal consistency and acceptable reliability of the measurement instrument. In addition, to confirm convergent validity, the average variance extracted (AVE) should exceed the threshold of 0.50, indicating that the latent construct is capable of explaining more than half of the variance of its indicators. At the structural model level, model fit was assessed using the coefficient of determination (R^2), where values of 0.19, 0.33, and 0.67 are considered weak, moderate, and strong levels of explained variance in the dependent variable, respectively. Finally, the predictive power of the model was evaluated using the Stone–Geisser Q^2 index, for which values of 0.02, 0.15, and 0.35 indicate weak, moderate, and strong predictive power, respectively. The results of these evaluations are reported in the following table.

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Table 2

Fit Indices of the Measurement Model and Structural Model

Variable	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)	R Square	Adjusted R Square	Q^2 (=1-SSE/SSO)
Principles governing content and syllabi	0.866	0.894	0.909	0.716	—	—	—
Implementation requirements and evaluation system	0.771	0.778	0.897	0.813	—	—	—
Expected objectives and competencies	0.783	0.711	0.783	0.550	—	—	—
Curriculum based on environmental legal literacy education	0.937	0.948	0.946	0.515	1.000	1.000	0.480
Analysis and critique of the current situation: challenges	0.796	0.827	0.880	0.711	—	—	—
Teaching–learning strategies: methods	0.888	0.923	0.928	0.812	—	—	—
Foundations, necessity, and philosophy of the model	0.803	0.812	0.910	0.835	—	—	—

The results of the fit indices table show that the research model has desirable measurement and structural quality. At the measurement model level, the values of Cronbach's alpha, rho_A, and composite reliability (CR) for all constructs were reported to be above the threshold of 0.70, indicating appropriate internal consistency and acceptable reliability of the measurement instrument. Moreover, the values of average variance extracted (AVE) for all variables were greater than 0.50; this indicates that each latent construct was able to explain more than half of the variance of its indicators, and therefore, the convergent validity of the model was confirmed. At the structural model level, the R^2 value for the variable "curriculum based on environmental legal literacy education" was reported as 1.000, indicating the very strong explanatory power of the predictor constructs in explaining the variance of the dependent variable. In addition, the predictive relevance index value of $Q^2 = 0.480$ indicates strong predictive power of the model. Overall, the results indicate the desirable fit of the measurement model and the appropriate explanatory and predictive capacity of the structural model.

After confirming convergent validity, discriminant validity was assessed to ensure distinction among the research constructs and to examine whether each latent variable was statistically different from the other variables. In this section, two valid criteria were used. The first was the Fornell–Larcker criterion, in which the square root of the average variance extracted (AVE) of each construct is compared with its correlations with other constructs. According to this standard, the values on the main diagonal should be greater than all correlations below them in the same column. The results of this test are reported in the following table.

Table 3

Results of Discriminant Validity Using the Fornell–Larcker Criterion

	1	2	3	4	5	6	7
Principles governing content and syllabi	0.846						
Implementation requirements and evaluation system	0.622	0.902					
Expected objectives and competencies	0.804	0.612	0.742				
Curriculum based on environmental legal literacy education	0.858	0.855	0.866	0.718			
Analysis and critique of the current situation: challenges	0.679	0.757	0.727	0.900	0.843		
Teaching–learning strategies: methods	0.457	0.744	0.473	0.733	0.592	0.901	
Foundations, necessity, and philosophy of the model	0.683	0.691	0.794	0.880	0.838	0.525	0.914

The results presented in the discriminant validity table based on the Fornell–Larcker criterion show that the condition for distinction among the research constructs is acceptably established. According to this criterion, the square root of the average variance extracted (AVE) for each construct, which appears on the main diagonal of the matrix,

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should be greater than the correlation coefficients of that construct with the other constructs. As shown in the table, the diagonal values for all constructs, including foundations, necessity, and philosophy of the model (0.914), teaching–learning strategies (0.901), implementation requirements and evaluation system (0.902), principles governing content and syllabi (0.846), analysis and critique of the current situation (0.843), expected objectives and competencies (0.742), and curriculum based on environmental legal literacy education (0.718), are greater than their correlation coefficients with the other constructs. These findings indicate that each construct in the model has appropriate conceptual and empirical distinction from the other constructs and that the research measurement instrument has desirable discriminant validity. Therefore, it can be concluded that the indicators of each construct are more strongly associated with their respective construct than with the other constructs.

After ensuring the fit of the measurement models and confirming the validity and reliability of the constructs, the structural model of the research was examined at this stage to test the hypotheses. In path analysis using the partial least squares (PLS) method, two key indices, namely the path coefficient (β) and the significance statistic (t), are used as decision-making criteria. If the t-statistic is greater than 1.96, the relevant hypothesis is confirmed at the 95% confidence level. The results related to the model paths are presented in the following table.

Table 4

Path Coefficients and Significance Indices for Testing the Direct Hypotheses of the Model

Path	Effect Coefficient	Standard Deviation	T-Statistic	Significance	Test Result
Principles governing content and syllabi → Curriculum based on environmental legal literacy education	0.279	0.010	26.950	0.000	Confirmed
Implementation requirements and evaluation system → Curriculum based on environmental legal literacy education	0.159	0.005	29.590	0.000	Confirmed
Expected objectives and competencies → Curriculum based on environmental legal literacy education	0.162	0.008	20.907	0.000	Rejected
Analysis and critique of the current situation: challenges → Curriculum based on environmental legal literacy education	0.217	0.008	27.169	0.000	Confirmed
Teaching–learning strategies: methods → Curriculum based on environmental legal literacy education	0.195	0.011	16.969	0.000	Confirmed
Foundations, necessity, and philosophy of the model → Curriculum based on environmental legal literacy education	0.167	0.005	32.950	0.000	Confirmed

The results of path analysis in the structural model show that most predictor variables had a positive and significant effect on the "curriculum based on environmental legal literacy education." Based on the t-statistic values, which are much greater than the critical value of 1.96 for all confirmed paths, and the reported significance levels below 0.05, it can be concluded that the relationships among these constructs are statistically significant. Among them, the variable "principles governing content and syllabi," with a path coefficient of 0.279, had the greatest effect on the dependent variable, indicating that the design and organization of educational content and course syllabi play a decisive role in shaping a curriculum based on environmental legal literacy education. After that, the variable "analysis and critique of the current situation: challenges," with a coefficient of 0.217, and "teaching–learning strategies," with a coefficient of 0.195, were among the other influential factors, indicating the importance of addressing existing barriers and using appropriate educational methods in realizing this type of curriculum.

The results also show that "foundations, necessity, and philosophy of the model," with a path coefficient of 0.167, and "implementation requirements and evaluation system," with a coefficient of 0.159, also had positive and significant effects on the dependent variable, indicating the role of theoretical foundations as well as implementation and evaluation mechanisms in establishing this curriculum. In contrast, although the path coefficient of "expected objectives and competencies" was 0.162 and its t-statistic was reported to be greater than the threshold value, according to the results presented in the table, this hypothesis was not confirmed. Overall, the findings of the structural model show that the realization of a curriculum based on environmental legal literacy education is influenced by a set of content-related, educational, foundational, and implementation-related factors, and simultaneous attention

to these components can play an important role in the effective design and implementation of such a curriculum.

Figure 1

Measurement Model in the Coefficient Significance Estimation Mode

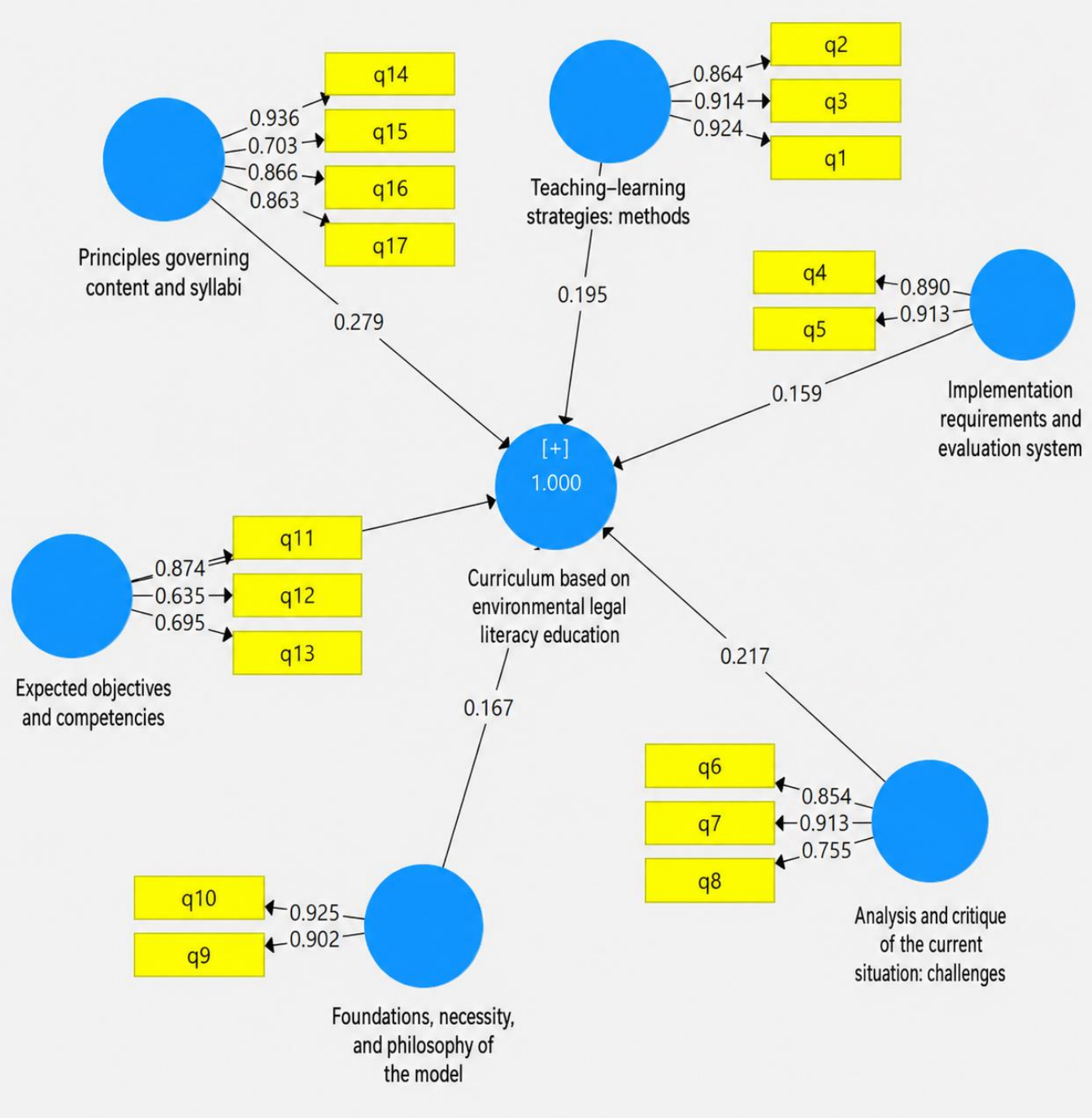

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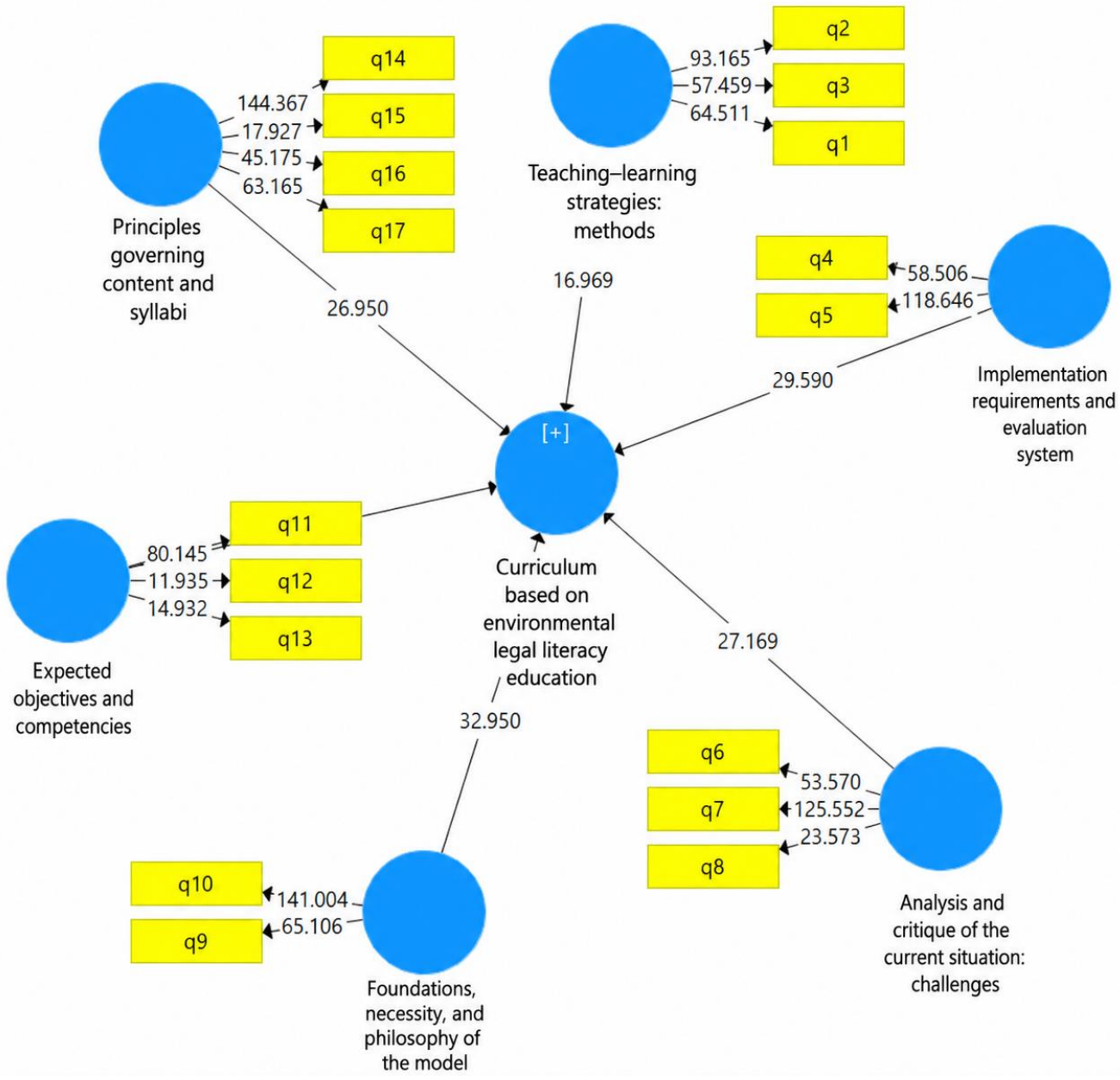
Figure 2

Structural Model in the Coefficient Significance Estimation Mode



4. Discussion and Conclusion

The present study aimed to identify the factors affecting the implementation of a curriculum based on environmental legal literacy education in primary education. The qualitative findings showed that the proposed curriculum model is organized around six overarching themes: foundations, necessity, and philosophy of the model; analysis and critique of the current situation; expected objectives and competencies; principles governing content and syllabi; teaching–learning strategies; and implementation requirements and the evaluation system. The extraction of 729 initial codes, 110 basic codes, 18 organizing themes, and six overarching themes indicates that environmental legal literacy education is not a single-content intervention, but a multidimensional curriculum and management issue that requires philosophical justification, structural planning, pedagogical redesign, and institutional support. This finding is consistent with studies emphasizing that environmental education should be embedded in the whole curriculum system rather than treated as an isolated topic or occasional activity (Kargozar et al., 2020; Obasi & Osah, 2022; Yasemi et al., 2022). It also aligns with curriculum studies that

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highlight the importance of coherence among curriculum goals, content, implementation mechanisms, and learning outcomes (Akbari et al., 2023; Santagata et al., 2023).

One of the most important qualitative findings was the identification of "foundations, necessity, and philosophy of the model" as a core dimension of the curriculum. This result suggests that environmental legal literacy education should be grounded in ethical, legal, cultural, and religious foundations and should clarify why environmental rights and responsibilities must be taught from childhood. This finding is aligned with studies that consider environmental education inseparable from moral education, citizenship, and value formation (Gholampour et al., 2021; Moschopoulou & Karakatsani, 2020). The emphasis on intergenerational responsibility, justice, and the right to a healthy environment is also consistent with approaches that integrate environmental themes into reflective and philosophical education (Tzvetkova, 2025). In addition, the inclusion of local, cultural, and value-based foundations is supported by research showing that environmental curricula become more meaningful when they are connected to learners' cultural contexts, indigenous knowledge, and local ecological realities (Hernawan et al., 2021; Jimenez & Kabachnik, 2023). Therefore, the philosophical dimension of the model provides the normative basis for transforming environmental education from simple awareness-raising into legal, ethical, and civic empowerment.

The second major qualitative finding concerned the analysis and critique of the current situation. The extracted codes indicated that the existing educational system faces several challenges, including insufficient policy support, lack of independent and coherent environmental legal content, dominance of theoretical teaching, weak teacher preparation, and inadequate infrastructure. This result confirms previous evidence showing that environmental education in school curricula is often fragmented, insufficiently implemented, and not fully aligned with intended outcomes (Akbari et al., 2023; Kargozar et al., 2020). It also supports findings indicating that school leadership, institutional culture, and opportunities for participation are necessary for developing students' environmental participation (Heidari et al., 2023). The present study extends these findings by showing that the problem is not only the limited presence of environmental content in textbooks, but also the absence of a legal-literacy orientation that can connect environmental knowledge with rights, duties, law-abiding behavior, and civic action.

The quantitative findings supported the overall validity of the proposed model. The measurement model showed acceptable reliability and validity, as Cronbach's alpha, rho_A, and composite reliability values were above the acceptable threshold, and the AVE values confirmed convergent validity. The Q^2 value of 0.480 also indicated strong predictive relevance of the model. These results suggest that the identified constructs were conceptually meaningful and empirically capable of explaining the proposed curriculum model. The high explanatory capacity of the structural model indicates that curriculum implementation in environmental legal literacy depends on simultaneous attention to multiple factors rather than on a single isolated component. This is consistent with curriculum implementation studies that emphasize systemic alignment, instructional coherence, and institutional readiness as prerequisites for effective curriculum change (Jones, 2023; Nielsen, 2023; Santagata et al., 2023). However, the reported R^2 value of 1.000 should be interpreted carefully, because such a perfect value may indicate a very high conceptual overlap between predictor constructs and the dependent construct or a model specification that strongly defines the dependent construct through its components.

Among the direct paths, "principles governing content and syllabi" had the strongest effect on the curriculum based on environmental legal literacy education ($\beta = 0.279$, $t = 26.950$, $p < 0.001$). This finding shows that content design is the most decisive factor in the implementation of such a curriculum. In other words, unless environmental legal literacy is translated into clear, age-appropriate, interdisciplinary, localized, and legally meaningful content, the curriculum cannot achieve its intended outcomes. This result is aligned with studies showing that green curricula can shape pro-environmental behaviors and environmental value orientations when content is systematically organized and linked to sustainability goals (Ni et al., 2024). It is also supported by research emphasizing the integration of environmental education into school curricula through practical, localized, and developmentally appropriate elements (Hernawan et al., 2021; Yasemi et al., 2022). The importance of content is further supported by studies on ecological citizenship curricula and self-management-based environmental curricula, which show that curriculum content must include knowledge, values, skills, and participatory capacities (Khandani et al., 2023; Mohkamkar et al., 2021). Therefore, the strongest path coefficient in the present model confirms that the quality of content and

syllabi is the central managerial lever for implementing environmental legal literacy education.

The effect of "analysis and critique of the current situation" on the curriculum model was also positive and significant (β = 0.217, t = 27.169, p < 0.001). This finding indicates that curriculum implementation must begin with a realistic assessment of existing challenges, including textbook limitations, policy gaps, teacher competencies, infrastructure, and school-level capacities. The result is consistent with studies that have identified gaps between intended, implemented, and achieved environmental curricula (Akbari et al., 2023). It is also in line with evidence showing that effective environmental participation among students requires school-level planning, leadership, and institutional facilitation (Heidari et al., 2023). From a curriculum management perspective, this means that implementing environmental legal literacy requires diagnostic planning before program design. Curriculum planners must identify where environmental rights, legal responsibilities, ecological citizenship, and action-oriented learning are absent or weak in the current system. Without such situational analysis, reforms may remain superficial and fail to change classroom practice.

The path from "teaching–learning strategies" to the curriculum based on environmental legal literacy education was also significant (β = 0.195, t = 16.969, p < 0.001). This finding confirms that the implementation of environmental legal literacy cannot rely on traditional teacher-centered methods. Instead, it requires active, participatory, experiential, and problem-based learning methods such as role play, environmental court simulation, case study analysis, community-based projects, debate, storytelling, and field experiences. This result is consistent with outdoor and environmental education research, which emphasizes direct experience, place-based learning, and active engagement with environmental issues (Lugg & Quay, 2022; Zangori, 2023). It also supports evidence that eco-art and place-based curricula can strengthen students' empathy toward the environment (Sunassee & Bokhoree, 2021). Moreover, the finding aligns with studies showing that environmental education becomes more effective when teaching activities are explicitly linked to expected outcomes through coherent implementation planning (Jones, 2023). Therefore, teaching–learning strategies are not merely delivery techniques; they are central mechanisms through which environmental legal literacy is transformed into students' understanding, attitudes, and action.

The results also showed that "foundations, necessity, and philosophy of the model" had a positive and significant effect on the curriculum model (β = 0.167, t = 32.950, p < 0.001). Although its path coefficient was lower than that of content and situational analysis, its very high t-value indicates a stable and meaningful contribution. This finding suggests that philosophical and normative clarity is necessary for legitimizing environmental legal literacy within primary education. Previous studies have similarly emphasized that environmental education should be connected with moral reasoning, citizenship, active responsibility, and sustainability values (Gholampour et al., 2021; Moschopoulou & Karakatsani, 2020; Oktarina & Nisa, 2021). The result also corresponds with research on naturalistic intelligence and environmental sustainability, which highlights the importance of cultivating learners' relationship with nature as a basis for environmental care (Rahim et al., 2025). In this sense, environmental legal literacy must be justified not only by ecological urgency but also by its contribution to character development, responsible citizenship, and social justice.

The significant effect of "implementation requirements and evaluation system" (β = 0.159, t = 29.590, p < 0.001) indicates that operational conditions and assessment mechanisms are essential for sustaining the proposed curriculum. This finding is compatible with studies emphasizing that curriculum reform requires institutional readiness, future-oriented planning, professional development, and continuous evaluation (Aboutalebi et al., 2023; Wood & Chérif, 2022). It also aligns with evidence that environmental learning should be assessed through performance-based, project-based, and participatory methods rather than only through conventional knowledge tests (Moschopoulou & Karakatsani, 2020). Since environmental legal literacy includes awareness, values, skills, legal reasoning, and civic participation, its evaluation must also be multidimensional. The finding therefore indicates that curriculum implementation will be incomplete unless schools are equipped with appropriate evaluation tools, teacher training programs, administrative support, and mechanisms for continuous revision.

The path related to "expected objectives and competencies" requires careful interpretation. The table reported a positive path coefficient (β = 0.162), a high t-statistic (t = 20.907), and a significance value of 0.000, which statistically indicate a significant relationship; however, the test result was reported as rejected. This inconsistency may reflect a reporting error, a decision rule

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not fully explained in the manuscript, or a possible issue in the conceptual distinction between objectives and the dependent curriculum construct. From a theoretical standpoint, objectives and competencies are expected to be central to curriculum design, as previous studies have shown that environmental education should develop knowledge, attitudes, values, self-management, ecological citizenship, and participatory skills (Khandani et al., 2023; Mohkamkar et al., 2021; Obasi & Osah, 2022). Therefore, if the rejection is retained, it should be justified more explicitly. One possible explanation is that objectives and competencies may influence the curriculum indirectly through content, teaching strategies, and evaluation requirements rather than exerting the strongest direct effect. This interpretation is compatible with curriculum alignment literature, which suggests that objectives become effective only when they are translated into coherent content, pedagogy, and assessment (Akbari et al., 2023; Santagata et al., 2023).

The findings also highlight the growing relevance of digital and hybrid learning environments for environmental legal literacy education. Although the central model emphasized content, pedagogy, and implementation, many of the extracted themes—such as multimedia education, digital learning, storytelling, and scenario-based instruction—can be strengthened through technology-supported curriculum design. Prior studies have shown that hybrid and eco-digital learning environments require new forms of curriculum design capable of integrating ecological and technological dimensions (Nielsen, 2023). Research on virtual learning environments also demonstrates that students' learning experiences can be shaped by digital platforms when they are pedagogically structured (Hwang et al., 2023). In the Iranian context, studies on e-learning during and after the Corona period have emphasized both opportunities and challenges related to infrastructure, teacher readiness, and learner engagement (Hajizadeh et al., 2021). In addition, research on cyberspace opportunities and brain-compatible electronic learning environments supports the use of digital tools for improving learning conditions and cognitive functioning (Faridi Sfanjany et al., 2025; Rajabian Deh Zire et al., 2024). These studies support the present finding that environmental legal literacy education should use modern instructional methods and media, provided that technology serves curriculum goals rather than replacing pedagogical coherence.

Finally, the results of this study should be understood in relation to the broader developmental and environmental importance of primary education. Environmental risks affect children's development, learning conditions, and educational achievement, which makes environmental education a matter of educational equity and child development, not merely environmental awareness (Güneş, 2025). Furthermore, the green and thermal quality of educational institutions shows that schools themselves are part of the environmental learning ecosystem and can model sustainable practices for students (Csomós, 2026). Accordingly, a curriculum based on environmental legal literacy can help primary schools become spaces where children learn about environmental rights, experience responsible environmental practices, and develop the competencies needed for sustainable citizenship. Overall, the findings indicate that effective implementation of such a curriculum depends on integrated curriculum governance, strong content principles, realistic analysis of current challenges, active teaching–learning strategies, philosophical legitimacy, and operational evaluation mechanisms.

This study had several limitations that should be considered when interpreting the findings. First, the qualitative phase was based on the views of experts from West Azerbaijan Province, and although theoretical saturation was achieved, the perspectives may not fully represent all regional, cultural, and institutional contexts. Second, the quantitative sample was selected through convenience sampling, which may limit the generalizability of the results. Third, the data in the quantitative phase were collected through a researcher-made questionnaire, and although validity and reliability indices were examined, self-report data may still be affected by response bias. Fourth, the study focused on specialists, experts, and experienced teachers, while the direct perspectives of students, parents, curriculum implementers at policy levels, and textbook authors were not extensively examined. Finally, the inconsistency between the statistical significance of the path related to expected objectives and competencies and its reported rejection should be addressed in future revisions of the model and manuscript.

Future studies should test the proposed curriculum model in different provinces and educational contexts to examine its stability, cultural adaptability, and generalizability. Longitudinal and experimental studies are also recommended to investigate whether implementing environmental legal literacy education can improve students' legal awareness, environmental responsibility, civic participation, and sustainable behaviors over time. Future research may also compare the effectiveness of

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different teaching strategies, such as role play, environmental court simulation, project-based learning, storytelling, field-based learning, and digital scenarios. In addition, future studies should include the perspectives of primary school students, parents, school principals, curriculum planners, environmental law experts, and policy-makers to provide a more comprehensive implementation model. Researchers are also advised to develop standardized measurement tools for assessing environmental legal literacy in children.

Educational policy-makers and curriculum planners should integrate environmental legal literacy into the primary education curriculum in a systematic, interdisciplinary, and age-appropriate manner. Textbook developers should include concepts such as the right to a healthy environment, environmental duties, responsible consumption, environmental violations, protection of animals and nature, and civic participation in simple and practical forms. Teacher training programs should prepare teachers to use active and participatory methods such as case studies, debates, simulations, field activities, and project-based learning. Schools should also strengthen cooperation with families, municipalities, environmental organizations, and non-governmental institutions to connect classroom learning with real environmental practices. Finally, assessment systems should move beyond written tests and include portfolios, performance tasks, student projects, peer assessment, and community-based environmental activities.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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