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Needs Analysis for Developing an Environmental Learning Model in an Environmental Knowledge Course

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Abstract

Environmental learning in Biology Education Study Programs plays an important role in developing the ecological competencies of prospective biology teachers. However, the Environmental Knowledge course continues to face challenges, including the dominance of theoretical instruction, limited integration of local environmental issues, and insufficient implementation of contextual and experiential learning activities, which may hinder students' ability to connect environmental concepts with real-life phenomena. This study aims to analyze the need for developing an environmental learning model for the Environmental Knowledge course in the Biology Education Study Program. A descriptive quantitative survey method with a needs assessment approach was employed. The participants consisted of 85 Biology Education students selected through purposive sampling. Data were collected using a needs analysis questionnaire covering learning difficulties, preferred instructional methods, digital technology needs, and students' expectations regarding environmental learning models. The data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations. The findings indicate that students had strong needs for contextual learning (92.8%), field-based activities (94.1%), strengthening environmental

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literacy (93.5%), collaborative learning (90.4%), and stronger connections between theory and practice (91.7%). Students also expressed a high need for the integration of digital technologies into environmental learning. The study concludes that the development of an environmental learning model should prioritize contextual, experiential, collaborative, digitally supported, and student-centered learning. This study contributes to environmental education and biology teacher education by providing empirical needs assessment evidence as a foundation for designing an environmental learning model aligned with the learning needs of prospective biology teachers.

Keywords: Needs Analysis; Environmental Learning Model; Biology Education; Environmental Literacy; Contextual Learning

INTRODUCTION

Environmental education has become an important component of higher education because it plays a crucial role in developing environmental literacy, ecological awareness, and individuals' capacity to address sustainability challenges. Increasing global environmental issues such as climate change, environmental pollution, biodiversity loss, and ecosystem degradation indicate that educational institutions have a major responsibility in preparing human resources who are capable of understanding and responding to environmental problems scientifically and sustainably (*Education for Sustainable Development: A Roadmap*, 2020). Within higher education, Biology Education Study Programs hold a strategic role in producing future educators who not only understand biological concepts but also possess environmental competencies and the ability to transfer such knowledge to students in schools.

The Environmental Knowledge course is one of the important subjects contributing to the development of ecological competencies among Biology Education students. This course is designed to equip students with an understanding of human environment relationships, ecosystem dynamics, global and local environmental issues, and sustainable environmental management efforts. Environmental education at the higher education level is expected not only to enhance knowledge but also to foster environmental concern and encourage concrete actions toward environmental issues (Ardoin et al., 2020). Furthermore, environmental learning in the twenty-first century should also encourage the transformation of knowledge, attitudes, and environmental responsibility (Eka Apriyanti,

2026). Population and Environmental Education also emphasizes the development of knowledge, attitudes, and responsible behavior regarding environmental issues to strengthen ecological awareness and sustainable environmental management competencies(Cornelda, 2024).

However, the implementation of environmental learning in higher education still faces several challenges. Learning processes often remain oriented toward theoretical concept mastery and provide insufficient contextual learning experiences that connect theory with real environmental conditions. Such conditions may cause students to experience difficulties in understanding the relationship between environmental concepts learned in class and environmental problems surrounding them. In addition, lecturer-centered learning practices may limit students' engagement in critical thinking, problem-solving, and decision-making related to environmental issues.

The researchers argue that environmental learning in higher education should be developed through approaches that are more contextual, practical, collaborative, and capable of providing opportunities for students to actively participate in the learning process. Effective environmental learning should not merely focus on cognitive achievement but should also foster ecological awareness and students' skills in addressing environmental challenges. Environmental learning should also be systematically designed through appropriate instructional strategies and learning approaches that promote active student participation and meaningful learning experiences *(*Nur, Suriani, 2017*)*. Active student involvement through direct learning experiences, problem-based learning, and the utilization of digital technologies may improve the quality of environmental learning in higher education (Ardoin et al., 2020).

Previous studies have demonstrated the importance of innovation in environmental learning within higher education. (Hamidah et al., 2024) found that digital citizen science approaches can increase student engagement and strengthen understanding of environmental issues through the use of digital technologies. Other studies indicate that environmental learning involving active student participation contributes to improvements in environmental literacy and pro-environmental behavior (Ardoin et al., 2020). Furthermore, the integration of digital learning technologies has also been reported to enhance student engagement in higher education learning processes (Bond et al., 2021).

Although numerous studies have developed technology-based environmental learning approaches, citizen science initiatives, and active learning strategies, previous research has largely focused on examining the effectiveness of specific media, strategies, or learning tools. Studies specifically conducting needs analysis prior to environmental learning model development remain limited, particularly within Environmental Knowledge courses in Biology Education Study Programs. Moreover, relatively few studies have mapped both students' and lecturers' needs as a foundation for developing environmental learning models aligned with higher education learning characteristics.

This research gap indicates the necessity of studies capable of identifying the actual needs of students and lecturers regarding environmental learning so that learning model development is grounded in strong empirical evidence. Needs analysis represents an essential stage in learning model development because it provides information regarding current learning conditions, user needs, and learning components requiring improvement.

The novelty of this study lies in analyzing the needs for developing an environmental learning model by considering both students' and lecturers' needs as the basis for designing an environmental learning model for the Environmental Knowledge course. This study also adopts a socio-ecological perspective as its conceptual foundation, positioning the relationship between humans and the environment as an interconnected system. This perspective is considered relevant to environmental learning because it enables students to understand environmental issues in a more holistic and contextual manner.

Based on these considerations, this study focuses on analyzing the need for an environmental learning model in the Environmental Knowledge course within the Biology Education Study Program. This study aims to analyze current learning conditions, identify students' and lecturers' needs regarding environmental learning, and formulate the learning components required as a foundation for developing an environmental learning model in subsequent research stages.

METHODS

This study employed a quantitative descriptive survey method. A quantitative descriptive survey method aims to describe the characteristics, conditions, or needs of a population without providing treatment or intervention to research participants (Sugiyono,

2019). In this study, a survey approach was utilized to obtain an overview of students' needs regarding the development of an environmental learning model in the Environmental Knowledge course within the Biology Education Study Program.

This study represents an initial stage (*need assessment*) in the development of a learning model; therefore, it focused on identifying current learning conditions, students' needs, and the requirements for developing environmental learning. The study was conducted in the Biology Education Study Program at a public university in South Sulawesi, Indonesia. Data collection was carried out during the second semester of the 2025/2026 academic year. The study population consisted of all Biology Education students who had completed the Environmental Knowledge course. The sampling technique employed was purposive sampling, with the criterion that respondents had successfully completed the Environmental Knowledge course and therefore possessed learning experiences relevant to the objectives of the study. A total of 85 students participated as research respondents.

Table 1. Research Population and Sample

Parameter	Description
Population	All students of the Biology Education Study Program who had completed the Environmental Knowledge course
Sampling technique	Purposive sampling
Sample criteria	Students who had successfully completed the Environmental Knowledge course
Number of respondents	85 students

The research instrument was a needs analysis questionnaire for the environmental learning model developed by the researchers based on the research objectives and a review of environmental education literature. The questionnaire consisted of 25 statement items covering four main aspects of learning needs.

Table 2. Blueprint of the Research Instrument

Aspect	Number of Items	Indicators
Difficulty level of learning materials	6	Ecosystems, environmental pollution, climate change, conservation, environmental policies, and local environmental issues
Learning method	7	Lectures, discussions, case studies, field practicum, projects,

preferences		field visits, and presentations
Digital technology needs	6	Interactive media, learning applications, collaborative platforms, instructional videos, digital simulations, and technology-based environmental applications
Expectations toward the learning model	6	Exploratory learning, collaboration, real-world action, integration of theory and practice, 21st-century skills, and environmental literacy (ecoliteracy)

The instrument employed a five-point Likert scale ranging from 1 (*strongly disagree/not needed*) to 5 (*strongly agree/highly needed*). Content validity of the instrument was established through expert judgment involving two environmental education experts and one expert in educational measurement and evaluation. Prior to its implementation in the main study, the instrument was piloted with students outside the research sample to ensure item clarity and instrument consistency. Reliability testing was conducted using Cronbach's Alpha coefficient, with the instrument considered reliable when the coefficient value was ≥ 0.70.

Data collection was carried out through several stages, as presented in Table 3.

Table 3. Data Collection Procedures

Stage	Activity
1	Development of the research instrument
2	Instrument validation
3	Instrument pilot testing
4	Instrument revision
5	Questionnaire distribution
6	Data collection and verification

Data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations. The percentage of needs was calculated using the following formula:

$$\text{Percentage} = \frac{obtained\ score}{maximum\ score}\ x\ 100\%$$

The analysis results were subsequently interpreted using need categories as presented in Table 4.

Table 4. Need Interpretation Categories

Percentage (%)	Category
81–100	Highly needed
61–80	Needed
41–60	Moderately needed
21–40	Less needed
0–20	Not needed

RESULTS

The research respondents consisted of 85 students from the Biology Education Study Program who had completed the Environmental Knowledge course. Respondent characteristics based on gender and academic cohort are presented in Table 5.

Table 5. Characteristics of Research Respondents

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	24	28.2
	Female	61	71.8
Academic Cohort	2022	42	49.4
	2023	43	50.6
Total		85	100

Based on Table 5, the respondents were predominantly female students, accounting for 61 participants (71.8%), while male students accounted for 24 participants (28.2%). Based on academic cohort, the respondent distribution was relatively balanced.

Difficulty Level of Learning Materials in the Environmental Knowledge Course

The needs analysis results indicated that several topics in the Environmental Knowledge course were still perceived as relatively difficult by students. The analysis results are presented in Table 6.

Table 6. Difficulty Level of Learning Materials in the Environmental Knowledge Course

Learning Material	Mean	SD	Category
Ecosystems and environmental interactions	3.28	0.74	Moderate
Environmental pollution	3.14	0.82	Moderate
Climate change	4.12	0.68	High
Biodiversity and conservation	3.37	0.71	Moderate
Environmental management	3.95	0.69	High
Local environmental issues	4.18	0.73	High

The findings indicate that local environmental issues received the highest need score (M = 4.18), followed by climate change (M = 4.12) and environmental management (M = 3.95).

Students' Preferences for Environmental Learning Methods

The survey results revealed variations in students' preferences regarding instructional methods expected in the Environmental Knowledge course.

Table 7. Preferences for Learning Methods

Learning Method	Mean	SD
Lecture	2.91	0.88
Group discussion	4.15	0.67
Environmental case studies	4.39	0.62
Field practicum	4.71	0.53
Environmental projects	4.48	0.61
Field visits	4.62	0.56
Group presentations	3.97	0.75

Field practicum obtained the highest mean score (M = 4.71), followed by field visits (M = 4.62) and environmental projects (M = 4.48).

Need for Digital Technology Integration in Environmental Learning

Students' needs regarding the integration of digital technology into environmental learning are presented in Table 8.

Table 8. Digital Technology Needs

Learning Technology	Mean	SD
Instructional videos	4.35	0.64
Digital collaboration platforms	4.28	0.69
Interactive media	4.46	0.58
Digital simulations	4.19	0.71
Technology-based environmental applications	4.52	0.57
Mobile learning	4.31	0.66

Technology-based environmental applications obtained the highest score (M = 4.52), followed by interactive media (M = 4.46).

Students' Expectations toward the Environmental Learning Model

The needs analysis results identified several learning components expected by students.

Table 9. Students' Expectations toward the Environmental Learning Model

Learning Component	Percentage (%)	Category
Contextual learning	92.8	Highly needed
Team collaboration	90.4	Highly needed
Field activities	94.1	Highly needed
Integration of theory and practice	91.7	Highly needed
Strengthening environmental literacy	93.5	Highly needed
Development of 21st-century skills	89.6	Highly needed

Field activities showed the highest percentage of need (94.1%), followed by strengthening environmental literacy (93.5%).

Synthesis of Environmental Learning Model Needs

Based on the overall analysis results, the needs for an environmental learning model in the Environmental Knowledge course can be synthesized into several key components:

1. Integration of local environmental issues
2. Field experience-based learning
3. Integration of digital technology
4. Collaborative learning activities
5. Strengthening environmental literacy
6. Integration of theory and practice in learning

These components provide the foundation for developing an environmental learning model aligned with the needs of students in the Biology Education Study Program.

DISCUSSION

The findings revealed that students in the Biology Education Study Program require an environmental learning model that is more contextual, practical, collaborative, and capable of connecting environmental concepts with real-world problems encountered in everyday life. These findings indicate that environmental learning in the Environmental Knowledge course should not merely focus on conceptual mastery but should also foster

environmental awareness, critical thinking skills, environmental literacy, and environmentally responsible behavior.

Students' need for more contextual learning is consistent with Cartono (n.d.), who explained that integrating environmental education into biology learning enhances conceptual understanding while fostering environmental awareness through direct experiences, field observations, and environment-based activities. Environmental education contributes not only to knowledge development but also to cultivating responsibility toward environmental sustainability.

The findings also demonstrated that students require learning approaches that provide authentic learning experiences and active engagement in environmental activities. These results align with (Sholihah et al., 2025), who reported that experiential learning improves students' environmental literacy through direct experiences and meaningful learning activities. Environmental literacy represents an important component in strengthening students' ability to understand environmental issues more comprehensively.

Students' need for participatory learning activities is further supported by (Ballard et al., 2024) and Cotey et al. (2025), who found that citizen science approaches provide opportunities for students to participate directly in scientific activities, thereby improving scientific skills, scientific literacy, critical thinking abilities, and students' connectedness to real environmental issues. Citizen science approaches also enhance student engagement, collaboration, and authentic learning experiences in higher education.

The findings also indicated that students require learning approaches capable of strengthening environmental literacy. These findings are consistent with (Ardoin et al., 2020), who argued that environmental education contributes positively to environmental literacy, ecological awareness, and students' pro-environmental behavior. Furthermore, the meta-analysis conducted by (van de Wetering et al., 2022) demonstrated that environmental education positively influences environmental knowledge, environmental attitudes, environmental behavioral intentions, and pro-environmental behavior.

Strengthening environmental literacy is also closely related to shaping students' environmental behavior. Sulphey et al. suggested that the New Environmental Paradigm (NEP), environmental attitudes, and pro-environmental behavior contribute significantly to environmental sustainability. Strong environmental paradigms may foster more responsible

environmental behavior; therefore, environmental learning should not focus solely on cognitive dimensions but should also address affective and behavioral aspects.

The findings further demonstrated that students require the integration of educational technology into environmental learning. This result aligns with (Bond et al., 2021), who explained that educational technology enhances student engagement, learning interactions, and meaningful learning experiences. Technology integration in environmental education is increasingly important to support learning flexibility, collaboration, and broader access to learning resources.

Students' need for contextual learning is also associated with the ability to understand environmental issues more holistically. Byrne et al. (2025) emphasized the importance of interdisciplinary ecological learning to enable students to understand relationships among social, cultural, and ecological dimensions within complex systems. Interdisciplinary approaches help students develop systems thinking skills, making learning more relevant to twenty-first-century environmental challenges. Students' need for participatory learning activities further supports the findings of (Hamidah et al., 2024), who showed that citizen science project approaches strengthen students' sustainability literacy through active engagement in environmental investigation activities. Similar findings were reported by (Ballard et al., 2024), who argued that citizen science-based learning provides opportunities for students to participate directly in scientific processes, thereby strengthening the connection between learning and real environmental issues.

The findings also reinforce the Socio-Ecological System perspective developed by Ostrom, which suggests that environmental issues cannot be understood in isolation because they involve complex interactions between humans and environmental systems. Therefore, environmental learning in Biology Education Study Programs should be designed to help students understand reciprocal relationships between social and ecological systems, thereby strengthening comprehensive environmental competencies.

Furthermore, students' need for more transformative learning approaches is consistent with (Apriyanti et al., 2025), who emphasized that twenty-first-century environmental education should focus on transforming knowledge, attitudes, and behavior in response to global environmental crises. Environmental education functions not merely as a process of knowledge transmission but also as a mechanism for fostering critical

thinking, collaboration, creativity, and contextual environmental problem-solving competencies.

The findings are also relevant to (Fatria et al., 2024) (comparative and predictive studies), who demonstrated that students' environmental behavior is influenced by multiple factors, including environmental paradigms, environmental attitudes, and learning experiences acquired during educational processes. Therefore, environmental learning model development should consider learning experiences, environmental attitude formation, and environmental literacy strengthening as essential components in promoting students' pro-environmental behavior.

(Abbass et al., 2022), (Fawzy et al., 2020), (Kundariati & Putra, 2025), (Pratama et al., 2024), and (Rofi'ah & Chusna, 2022) also highlighted that effective environmental learning should consider sustainability, climate change, environmental behavior, and strengthening environmental competencies as essential aspects in preparing younger generations to address future environmental challenges.

From a theoretical perspective, the findings strengthen the Socio-Ecological System approach developed by (Ostrom, 2009), emphasizing that environmental issues cannot be understood in isolation because they involve complex interactions between humans and environmental systems. Therefore, the development of an environmental learning model for the Environmental Knowledge course should be designed to help students understand reciprocal relationships between social systems and ecological systems, thereby fostering more comprehensive environmental competencies.

Overall, the findings indicate that environmental learning models for the Environmental Knowledge course should integrate contextual learning, environmental literacy, direct learning experiences, educational technology, citizen science approaches, pro-environmental behavior, socio-ecological perspectives, and environmental sustainability principles. These components may serve as a foundation for developing environmental learning models in future research stages.

CONCLUSION

The findings revealed that students in the Biology Education Study Program require an environmental learning model that is more contextual, collaborative, and capable

of connecting environmental concepts with real-world issues encountered in daily life. Students also demonstrated a strong need for learning approaches that integrate field activities, digital technology, environmental literacy enhancement, and stronger connections between theory and practice.

The findings indicate that learning in the Environmental Knowledge course should not merely focus on theoretical concept mastery but should be designed to provide more meaningful, practical, and relevant learning experiences aligned with twenty-first-century educational needs. Furthermore, the integration of local environmental issues and the strengthening of critical thinking skills emerged as essential components that should be considered in environmental learning development.

This study provides an empirical foundation for developing an environmental learning model that aligns with the characteristics and needs of Biology Education students. The identified needs analysis findings may serve as a basis for designing environmental learning models in subsequent research stages to support the enhancement of students' environmental literacy and ecological competencies.

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