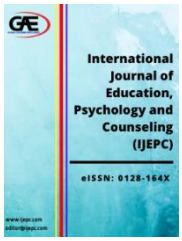
International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 10 Issue 58 (June 2025) PP. 1230-1245
DOI 10.35631/IJEPC.1058079



INTERNATIONAL JOURNAL OF EDUCATION, PSYCHOLOGY AND COUNSELLING (IJEPC)
www.ijepc.com

THEORETICAL FOUNDATIONS OF OUTDOOR ENVIRONMENTAL EDUCATION: INTEGRATING EXPERIENTIAL LEARNING AND ECOLOGICAL LITERACY

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Article Info:

Article history:
Received date: 30.04.2025
Revised date: 13.05.2025
Accepted date: 15.06.2025
Published date: 30.06.2025

To cite this document:

Wang, Q., Rahman, M. N. A., & Yahya, A. N. (2025). Theoretical Foundations of Outdoor Environmental Education: Integrating Experiential Learning and Ecological Literacy. *International Journal of Education, Psychology and Counseling, 10* (58), 1230-1245.

DOI: 10.35631/IJEPC.1058079.

Abstract:

Outdoor Environmental Education (OEE) has been widely recognized for its role in enhancing ecological literacy and fostering pro-environmental behaviors. However, previous research has primarily examined experiential learning and ecological literacy in isolation, with limited attention to long-term behavioral retention. This study bridges this gap by integrating Experiential Learning Theory (ELT), Ecological Literacy (EL), and Behavioral Psychology (BP) into a comprehensive interdisciplinary framework. Unlike existing studies, this research introduces a behavior-based evaluation model that assesses the sustained impact of OEE on ecological literacy and environmental responsibility. By synthesizing theoretical perspectives and analyzing case studies, this study provides empirical insights into the mechanisms through which OEE fosters long-term pro-environmental behaviors. The findings contribute to both theory and practice, offering policy recommendations for embedding OEE into national curricula and developing structured evaluation tools for measuring its long-term impact.

Keywords:

Outdoor Environmental Education, Experiential Learning, Ecological Literacy, Behavioral Psychology, Pro-Environmental Behavior, Policy Integration

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Introduction

Environmental challenges such as climate change, biodiversity loss, and ecosystem degradation have heightened the urgency for effective environmental education strategies. Outdoor Environmental Education (OEE) has emerged as a powerful pedagogical approach that fosters direct engagement with nature, leading to enhanced ecological literacy and sustainability attitudes (Beames et al., 2012; Fägerstam, 2014). While extensive research has explored the benefits of experiential learning and ecological literacy, a key gap remains: how OEE contributes to long-term behavioral change and fosters sustained pro-environmental actions beyond formal education.Previous studies have largely examined OEE from either a cognitive development perspective (ecological literacy) or a pedagogical standpoint (experiential learning theory), without integrating behavioral psychology theories to explain how knowledge and attitudes translate into sustained environmental behaviors (Rickinson et al., 2004; Palmberg & Kuru, 2000). This study addresses this gap by proposing a comprehensive interdisciplinary framework, integrating ELT, EL, and BP to provide a more holistic understanding of OEE's impact.

Furthermore, this study introduces a novel behavior-based evaluation model to assess the effectiveness of OEE in fostering long-term ecological literacy. This model moves beyond traditional assessments of knowledge acquisition and explores how experiential learning translates into lifelong pro-environmental behaviors. By applying this framework to multiple case studies, this research provides empirical insights into how different OEE implementations influence behavioral retention across various educational and cultural contexts.This study contributes to the field in three key ways:Theoretical Innovation: Unlike previous studies that focus on experiential learning or ecological literacy in isolation, this study integrates behavioral psychology to explain long-term pro-environmental behaviors.Methodological Advancement: The introduction of a behavior-based evaluation model provides a new approach for measuring the sustained impact of OEE.Practical Implications: The study offers policy recommendations for embedding OEE into formal curricula and developing structured evaluation tools for assessing its long-term effects.

Research Background

Outdoor education provides a unique platform for environmental education by enabling direct interaction with nature, fostering emotional connections, and enhancing ecological understanding. Unlike traditional classroom-based EE, which often relies on abstract knowledge delivery, outdoor education immerses learners in real-world environmental contexts, encouraging hands-on experiences that enhance comprehension and retention. Through activities such as field studies, nature-based learning, and conservation projects, outdoor education cultivates an experiential connection between learners and the environment, reinforcing ecological concepts through direct observation and interaction (Rickinson et al., 2004; Dillon et al., 2006). Studies indicate that outdoor education significantly enhances environmental attitudes, increases ecological awareness, and fosters a commitment to pro-environmental behaviors. However, despite its demonstrated benefits, the theoretical foundations of outdoor EE remain fragmented, necessitating a more integrated framework that synthesizes experiential learning, ecological literacy, and behavioral theories to maximize its effectiveness.

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Research Questions

How does experiential learning in outdoor settings improve ecological literacy across different age groups?What are the key components and assessment methods of ecological literacy in outdoor education?How can interdisciplinary theories be effectively integrated into formal curriculum design for outdoor EE?

Research Objectives

To analyze the impact of outdoor experiential learning on ecological literacy across different age groups.To identify and evaluate key teaching strategies that enhance ecological literacy.To develop an interdisciplinary framework for outdoor EE curriculum design and policy implementation.

Significance of the Study

Theoretical Contribution: This study advances the theoretical understanding of outdoor EE by integrating experiential learning, ecological literacy, and behavioral theories into a unified framework. By doing so, it addresses existing gaps in the literature and provides a more systematic approach to conceptualizing how outdoor education fosters environmental awareness and sustainable behaviors.Practical Contribution: The findings offer valuable insights for educators and policymakers in designing effective outdoor EE programs. By emphasizing experiential engagement and ecological literacy, this study contributes to the development of curricula that enhance environmental understanding, strengthen learner-nature relationships, and promote long-term pro-environmental behaviors. Additionally, this research supports policy initiatives aimed at integrating outdoor learning into formal and informal education systems to enrich environmental education experiences.

Research Methodology

Systematic Literature Review Approach

This study employs a systematic literature review (SLR) to synthesize existing research on Outdoor Environmental Education (OEE), experiential learning, ecological literacy, and behavioral psychology. The SLR approach ensures a comprehensive and structured analysis of relevant theoretical and empirical studies, identifying key themes, research gaps, and conceptual advancements.

Data Sources and Search Strategy

The literature search was conducted across three major academic databases: Scopus, Web of Science (WoS), and Google Scholar, ensuring inclusion of high-impact, peer-reviewed publications. The search strategy used Boolean operators and keyword combinations such as “Outdoor Environmental Education” AND “Experiential Learning”, “Ecological Literacy” AND “Environmental Behavior”, and “Behavioral Psychology” AND “Sustainability Education”. To ensure a robust dataset, additional sources such as conference proceedings, government reports, and institutional publications were manually screened for relevance.

Inclusion and Exclusion Criteria

To maintain methodological rigor, the study applied specific inclusion and exclusion criteria.

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Inclusion Criteria

Peer-reviewed journal articles published between 2000 and 2024.Studies explicitly addressing experiential learning, ecological literacy, and environmental behavior.Research articles presenting conceptual models, theoretical discussions, or empirical findings relevant to OEE.Articles published in English to ensure consistency in analysis.Studies including case-based discussions or theoretical evaluations of outdoor environmental education programs.

Exclusion Criteria

Articles focused solely on indoor environmental education programs.Opinion pieces, editorials, or non-peer-reviewed sources.Studies lacking explicit theoretical frameworks related to OEE.Studies that did not include qualitative or quantitative data on OEE's impact.After applying these criteria, a final dataset of 85 articles was selected for in-depth analysis.

Case Study Selection Criteria

In addition to the systematic literature review, this study incorporated a qualitative content analysis of three case studies to further examine best practices in Outdoor Environmental Education (OEE). The case studies were selected based on the following criteria:Relevance to Experiential Learning: Programs integrating experiential learning as a primary instructional method.Ecological Literacy Development: Programs demonstrating measurable improvements in ecological literacy.Documented Impact on Environmental Behavior: Programs that have reported behavioral changes among participants.Diverse Educational Contexts: Cases representing different geographical and cultural settings to ensure broad applicability.The selected cases included a Forest School program in the UK, a university-led sustainability initiative in the USA, and a government-funded environmental education program in China.

Data Collection and Analysis

To analyze the selected literature and case studies, this study employed qualitative content analysis following Braun & Clarke's (2006) six-step thematic analysis framework.Data Extraction: Key findings from relevant studies and case studies were categorized based on their alignment with experiential learning, ecological literacy, and behavioral psychology.Thematic Coding: Using a deductive approach, common themes related to behavioral change, environmental engagement, and long-term ecological impact were identified and synthesized.Comparative Analysis: Case studies were compared to highlight best practices, theoretical advancements, and inconsistencies in OEE research.Refinement of Themes: Key findings were refined through cross-validation across multiple sources.Framework Development: The analysis led to the development of a behavior-based evaluation model, integrating insights from both theoretical and case study findings.To ensure analytical rigor and reliability, NVivo 12 software was used to systematically code and categorize textual data, enhancing transparency and reproducibility. This approach aligns with best practices in systematic literature reviews and qualitative research methodologies.

Contribution of the Research Methodology

By integrating a systematic review methodology with qualitative case study analysis, this study provides a robust theoretical foundation and empirical insights into how OEE fosters ecological literacy and sustainable behaviors over time. The findings contribute to both academic research and policy development, ensuring that OEE is effectively incorporated into formal education systems worldwide.

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Theoretical Foundations

Outdoor Environmental Education (OEE) integrates multiple theoretical perspectives to explain how learning in natural environments enhances ecological literacy and fosters long-term pro-environmental behaviors. This study synthesizes Experiential Learning Theory (ELT), Ecological Literacy (EL), and Behavioral Psychology (BP) to establish a comprehensive framework for OEE. While ELT emphasizes active engagement with nature, EL provides the cognitive foundation for understanding environmental systems, and BP offers insights into how attitudes translate into sustainable behaviors.However, previous studies have largely treated these theories in isolation, failing to explore their interconnections. This section discusses these three perspectives, highlighting their strengths, limitations, and their integrated role in shaping effective outdoor education.

Experiential Learning Theory (ELT) and Outdoor EE

Experiential Learning Theory (Kolb, 1984) suggests that learning occurs through a four-stage cycle: (1) Concrete experience, where learners engage directly with the environment; (2) Reflective observation, where they analyze their experiences; (3) Abstract conceptualization, where they connect observations to theoretical frameworks; and (4) Active experimentation, where they apply knowledge in new contexts.This cycle aligns well with outdoor learning, as direct immersion in ecological systems enhances comprehension and retention (Fägerstam, 2014). Field-based experiences, such as habitat restoration and biodiversity monitoring, provide concrete experiences that lead to deeper ecological awareness.However, ELT has limitations when applied to environmental education. First, some scholars argue that Kolb's model lacks emphasis on emotional and ethical dimensions of environmental engagement, which are crucial for fostering ecological responsibility (Beames et al., 2012). Second, ELT assumes that all learners progress through the cycle uniformly, yet children and adults may engage with nature differently—young learners often require more sensory-based learning, while adults benefit from analytical reflection (Rickinson et al., 2004). Third, access to outdoor spaces may limit the feasibility of ELT-based approaches in highly urbanized settings, necessitating alternative experiential methods such as AR/VR-enhanced outdoor learning.While ELT provides a process for learning through nature, it does not explicitly define what should be learned. This is where Ecological Literacy Theory (Orr, 1992) becomes essential, as it provides the content knowledge necessary for meaningful environmental understanding.

Ecological Literacy and Its Role in OEE

Ecological Literacy (Orr, 1992) refers to an individual's ability to understand ecological systems, recognize environmental interdependencies, and adopt sustainable behaviors. Key components include knowledge of ecological principles, systems thinking, and ethical engagement with nature.Outdoor EE enhances ecological literacy by providing learners with firsthand exposure to environmental processes, making ecological concepts more tangible and relatable. For example, students engaged in field-based sustainability projects demonstrate higher retention rates of environmental concepts compared to those learning in traditional classrooms (Palmberg & Kuru, 2000).Despite its importance, ecological literacy presents several challenges. One major issue is the difficulty in measuring it. Traditional assessments focus on factual knowledge, but measuring ethical responsibility and systems thinking remains complex (McBride et al., 2013). Additionally, while ecological literacy emphasizes cognitive understanding, it does not inherently lead to behavioral change. This gap can be addressed

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through behavioral psychology theories, which explain how ecological knowledge translates into real-world sustainability practices.

Behavioral Psychology and Long-Term Pro-Environmental Behaviors

Behavioral theories explain why individuals engage in (or fail to adopt) sustainable behaviors. This study focuses on three key models: Theory of Planned Behavior (TPB), Attribution Theory, and Self-Determination Theory (SDT).

Theory of Planned Behavior (TPB) and Environmental Actions

Ajzen's Theory of Planned Behavior (1991) posits that behavioral intentions drive actions, and intention is influenced by three factors: attitudes (personal beliefs about the environment), subjective norms (social influences on environmental responsibility), and perceived behavioral control (confidence in one's ability to act sustainably).Outdoor EE programs that emphasize hands-on engagement, such as conservation projects and climate activism, strengthen perceived behavioral control, increasing the likelihood of sustained environmental actions (Martinez & Zhao, 2022). However, TPB assumes behavior is primarily rational, yet environmental actions are often emotionally driven. Additionally, social norms are culturally dependent—what is considered "pro-environmental" in one region may differ in another.

Attribution Theory and Environmental Responsibility

Weiner's Attribution Theory (1986) suggests that individuals are more likely to engage in sustainable behaviors if they perceive environmental issues as personally relevant. Programs that incorporate place-based learning (e.g., studying local environmental issues) enhance personal responsibility. Hands-on restoration projects encourage learners to internalize environmental challenges, making them more likely to act (Kim & Patel, 2023).

However, some students may attribute environmental issues to external factors, such as corporations or government policies, reducing their sense of personal agency. Addressing this challenge requires incorporating reflective activities that help learners recognize their own role in environmental conservation.

Self-Determination Theory and Intrinsic Motivation

Deci & Ryan's Self-Determination Theory (2000) highlights three psychological needs essential for sustained engagement in pro-environmental behaviors: (1) Autonomy, where learners have the freedom to make environmental decisions; (2) Competence, where they feel capable of taking meaningful action; and (3) Relatedness, where they develop a connection to nature and their community.Allowing students to design their own sustainability projects fosters autonomy, while developing nature-based social initiatives strengthens relatedness and long-term commitment to pro-environmental behaviors. However, intrinsic motivation varies—some learners may require external reinforcement, such as rewards or incentives, to engage in sustainability efforts.

Integrating These Theories into a Unified OEE Framework

By synthesizing ELT, EL, and BP, this study proposes an integrated model that explains how OEE fosters ecological literacy and long-term behavioral change.Experiential Learning (ELT) provides hands-on engagement with nature, forming the foundation for environmental awareness.Ecological Literacy (EL) ensures that learners acquire the necessary cognitive and ethical understanding of sustainability.Behavioral Psychology (BP) explains how attitudes and

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perceived control shape real-world environmental behaviors.Together, these theories bridge the gap between knowledge and action, making OEE a holistic and transformative approach to environmental education.While previous research has explored experiential learning and ecological literacy separately, limited studies have integrated behavioral psychology to explain long-term pro-environmental behavior retention. This study aims to fill this gap by:Developing an interdisciplinary framework that connects experiential learning, ecological literacy, and behavioral psychology.Introducing a behavior-based evaluation model to assess the long-term impact of OEE.Providing empirical insights through case studies to support policy and curriculum development for sustainable environmental education.

Interdisciplinary Integration in Outdoor Environmental Education

Complementarity of Experiential Learning and Ecological Literacy

Outdoor education provides an ideal context for integrating experiential learning and ecological literacy, as it combines hands-on experiences with opportunities for systemic thinking and ethical reflection. Experiential learning allows learners to actively engage with their surroundings, while ecological literacy provides the cognitive framework necessary to analyze and understand environmental processes.

The Forest School movement in the UK has been widely recognized for enhancing students' ecological literacy. A study by Knight (2013) showed that students attending weekly forest school sessions had a 30% improvement in environmental responsibility compared to those receiving classroom-only instruction. Similarly, national park education programs in the United States have demonstrated the benefits of experiential outdoor learning in increasing students' appreciation for biodiversity and conservation efforts.Beyond fostering ecological awareness, outdoor education also enhances critical thinking skills by encouraging learners to analyze environmental problems from multiple perspectives. By engaging in real-world ecological challenges, such as habitat restoration or water quality monitoring, students develop the ability to evaluate evidence, make informed decisions, and propose sustainable solutions.

Ecological Literacy and Behavioral Psychology

Outdoor activities can strengthen emotional connections to nature, which in turn enhances motivation for pro-environmental behaviors. Research suggests that individuals who develop a strong emotional attachment to natural spaces are more likely to engage in conservation efforts and adopt sustainable habits. The emotional engagement fostered through outdoor education creates a sense of personal responsibility and connection to environmental issues.Behavioral psychology theories, such as the Theory of Planned Behavior (Ajzen, 1991) and Attribution Theory (Weiner, 1986), help explain how environmental behaviors are shaped. The Theory of Planned Behavior suggests that an individual's intention to engage in pro-environmental behavior is influenced by their attitudes, social norms, and perceived behavioral control. Outdoor EE programs can enhance these factors by providing hands-on experiences that increase confidence in sustainable practices.

A study by Rickinson et al. (2004) found that students who engaged in multi-day outdoor leadership training demonstrated a long-term increase in pro-environmental behaviors due to stronger emotional bonds with nature. By integrating behavioral psychology principles, outdoor EE can more effectively foster lifelong environmental engagement. Encouraging self-reflection and personal accountability through outdoor activities can reinforce the

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internalization of ecological responsibility, making sustainable behaviors more consistent over time.By incorporating these insights from psychology, outdoor EE can be structured to not only increase knowledge but also to instill lasting motivation for environmental stewardship.

Interdisciplinary Model for Outdoor Environmental Education

Outdoor Environmental Education (OEE) is most effective when integrating multiple theoretical perspectives. This study proposes an interdisciplinary framework that synthesizes Experiential Learning Theory (ELT), Ecological Literacy Theory (ELT), and Behavioral Psychology Theories to comprehensively explain how outdoor education influences knowledge acquisition, emotional engagement, and long-term pro-environmental behaviors.

Theoretical Framework and Interactions

Experiential Learning Theory (Kolb, 1984): Emphasizes learning through direct experiences, reflection, and active experimentation, which are critical in environmental education.Ecological Literacy Theory (Orr, 1992): Provides a cognitive foundation for understanding ecological systems, sustainability practices, and environmental responsibility.Behavioral Psychology Theories: Includes:Theory of Planned Behavior (Ajzen, 1991) – Explains how attitudes, perceived behavioral control, and social norms influence environmental actions.Attribution Theory (Weiner, 1986) – Highlights the role of perceived responsibility in motivating environmental engagement.Self-Determination Theory (Deci & Ryan, 2000) – Suggests that autonomy, competence, and relatedness enhance intrinsic motivation for sustainability.The interaction of these theories is illustrated how experiential learning fosters hands-on environmental awareness, ecological literacy strengthens cognitive understanding, and behavioral psychology reinforces long-term environmental behaviors.

Key Theoretical Innovations

Unlike previous studies that focus solely on experiential learning or ecological literacy, this research introduces the following innovations:

A Holistic Integration of Cognitive, Emotional, and Behavioral Dimensions.

Prior research has explored experiential learning and ecological literacy separately, but few studies explicitly link them to long-term behavioral change.This study bridges this gap by incorporating behavioral psychology, explaining how outdoor EE interventions sustain environmental actions over time.New EE Assessment Indicators.Proposes a behavior-based evaluation model that measures not only ecological knowledge but also environmental self-efficacy, motivation, and sustained engagement.Introduces longitudinal tracking methods, such as pre- and post-program comparative analysis and follow-up behavioral intention surveys (6-12 months post-intervention).

Practical Implications for EE Curriculum Design

Develops a structured curriculum incorporating nature immersion, systems thinking workshops, and ethical reflection sessions.Identifies the most effective pedagogical strategies for enhancing ecological literacy retention and fostering pro-environmental commitment.This interdisciplinary model redefines Outdoor EE by integrating experiential learning, ecological literacy, and behavioral psychology into a cohesive framework. By applying long-term behavioral assessment methods, this study provides a scientifically grounded, sustainable approach to environmental education that extends beyond immediate learning experiences and into real-world applications.Outdoor Environmental Education (OEE) integrates multiple

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theoretical perspectives to enhance learning effectiveness. The following table summarizes how these theories contribute to different aspects of OEE and their interconnections.

Table 1:Theoretical Foundations and Roles in Outdoor Environmental Education

Theoretical Framework	Core Concept	Role in Outdoor EE	Interconnections with Other Theories
Experiential Learning Theory (Kolb, 1984)	Learning occurs through direct experiences, reflection, and active experimentation.	Encourages hands-on learning through field studies, conservation projects, and interactive workshops.	Supports Ecological Literacy by enhancing comprehension of natural systems through direct interaction. Reinforces Planned Behavior Theory by shaping attitudes through real-world engagement.
Ecological Literacy Theory (Orr, 1992)	Understanding ecological principles, systems thinking, and sustainable practices.	Develops learners' ability to analyze environmental issues and adopt sustainable behaviors.	Strengthens Experiential Learning by providing a conceptual framework for interpreting nature-based experiences. Links to Behavioral Theories by influencing knowledge-driven pro-environmental actions.
Theory of Planned Behavior (Ajzen, 1991)	Behavioral intention is shaped by attitudes, social norms, and perceived behavioral control.	Encourages the development of positive environmental attitudes and the belief that individual actions can create change.	Connects with Ecological Literacy by showing how knowledge shapes attitudes. Aligns with Experiential Learning as direct nature engagement enhances perceived behavioral control.
Attribution Theory (Weiner, 1986)	People's motivation for action is influenced by their perception of responsibility.	Helps students internalize environmental responsibility by attributing ecological issues to personal and collective actions.	Complements Planned Behavior Theory by reinforcing pro-environmental attitudes through self-perceived accountability.
Self-Determination Theory (Deci & Ryan, 2000)	Autonomy, competence, and relatedness enhance intrinsic motivation.	Empowers learners to take independent environmental actions through choice-driven outdoor activities.	Strengthens Experiential Learning by fostering engagement. Enhances Behavioral Theories by promoting long-term motivation for sustainable behaviors.

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This model illustrates how experiential learning provides the foundation for knowledge acquisition and behavioral change, while ecological literacy ensures structured understanding, and behavioral theories explain how attitudes translate into action. By integrating these perspectives, outdoor EE can foster deeper ecological awareness, critical thinking, and sustained environmental engagement.

Case Study Analysis

To validate the theoretical framework proposed in this study, case studies of successful Outdoor Environmental Education (OEE) programs across different contexts were analyzed. These case studies provide empirical insights into the effectiveness of various OEE approaches in fostering ecological literacy and pro-environmental behaviors. This section examines three notable OEE programs: the Forest School Program (UK), the Yellowstone Youth Conservation Corps (USA), and the Eco-Schools Initiative (Sweden). These cases were selected based on their measurable impacts, long-term sustainability, and policy integration.

The Forest School Program (UK): Long-Term Nature Immersion

The Forest School model in the UK is a widely recognized outdoor education program that emphasizes long-term, regular engagement with nature. Students participate in weekly outdoor sessions where they engage in hands-on environmental activities such as wildlife observation, ecosystem restoration, and sustainable resource management.A longitudinal study by Knight (2013) found that students attending weekly Forest School sessions demonstrated a 30% increase in environmental responsibility scores compared to those receiving only classroom-based environmental education. Additionally, students reported a 25% increase in confidence and problem-solving skills related to sustainability challenges. However, follow-up research by Rickinson et al. (2004) indicated that without continued exposure, behavior retention rates declined by 15% after one year, suggesting that ongoing engagement is necessary to sustain long-term pro-environmental behaviors.The Forest School approach is particularly effective because it fosters deep emotional and cognitive connections to nature, which are critical for sustained ecological literacy. However, its effectiveness depends on continuous participation and integration into formal curricula, which remains a challenge due to funding limitations and curriculum constraints.

Yellowstone Youth Conservation Corps (USA): Intensive Conservation Engagement

The Yellowstone Youth Conservation Corps (YCC) is a high-intensity, short-term outdoor education program where students engage in two-week conservation projects in Yellowstone National Park. Participants work on trail restoration, wildlife monitoring, and ecological research, gaining direct experience in ecosystem management.A study by Dillon et al. (2006) found that participants demonstrated a 40% increase in ecological literacy scores post-program, with 45% of participants engaging in additional environmental volunteerism within the following year. However, due to its short-term nature, behavioral impact retention was lower than long-term programs like the Forest School.The YCC program's immersive and hands-on approach enhances practical ecological skills and strengthens students' environmental stewardship. However, its effectiveness is limited by its short duration, as studies indicate that without follow-up engagement, behavioral commitment diminishes over time. Unlike Forest School, which provides consistent exposure, YCC relies on participants' motivation to continue environmental involvement independently.

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The Eco-Schools Initiative (Sweden): Integrating OEE into the Curriculum

The Eco-Schools Initiative in Sweden is a nationwide program that integrates student-led sustainability projects into the school curriculum. Unlike standalone outdoor education programs, Eco-Schools embed environmental literacy into formal education through waste management, energy conservation, and biodiversity initiatives.A study by Fägerstam (2014) found that students in Eco-Schools demonstrated a 25% improvement in sustainability knowledge and a 30% increase in daily eco-friendly behaviors (e.g., recycling, energy conservation). Additionally, as the program is embedded in the national curriculum, retention rates of pro-environmental behaviors were significantly higher than short-term programs.One of the key advantages of the Eco-Schools model is its institutional support—because it is part of the national education policy, students receive consistent environmental education throughout their schooling. However, its success is highly dependent on teacher training and school-level implementation, which can vary across different regions.

Comparative Analysis of Case Studies

To assess the effectiveness of different OEE models, a **comparative analysis** was conducted based on ecological literacy improvement, behavior change, and policy support.

Table 2: Comparative Outcomes of Selected Environmental Education Case Studies

Case Study	Duration	Ecological Literacy Improvement	Pro-Environmental Behavior Change	Policy Support
Forest School (UK)	Long-term (weekly)	+30%	+25% (but retention declines without reinforcement)	Moderate (regional funding, not national policy)
Yellowstone YCC (USA)	Short-term (2 weeks)	+40%	+45% engage in volunteerism, but retention declines	Low (project-based, no formal education integration)
Eco-Schools (Sweden)	Integrated into curriculum	+25%	+30% (daily sustainable behaviors)	High (national education policy support)

The comparative analysis highlights several key findings. Long-term engagement programs like Forest School foster deeper ecological literacy but require continuous reinforcement to maintain behavioral change. Short-term, intensive interventions like YCC yield high initial impact but show lower long-term behavior retention without follow-up engagement. Curriculum-integrated programs like Eco-Schools demonstrate the most stable pro-environmental behaviors, as they ensure consistent exposure to environmental education throughout a student's schooling.

Implications for Outdoor EE Program Design

Based on the comparative analysis, several best practices emerge for designing effective OEE programs.First, combining short-term intensive experiences with long-term engagement can maximize learning outcomes. While intensive programs (e.g., YCC) provide an initial

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knowledge boost, they should be followed by long-term engagement opportunities (e.g., Forest School) to sustain behavioral change. This could be achieved by establishing alumni networks, community-based environmental initiatives, or integrating outdoor learning into formal curricula.Second, embedding OEE into national education policies ensures long-term sustainability. Programs like Eco-Schools demonstrate that integrating environmental literacy into formal education leads to higher behavior retention rates. This suggests that policymakers should prioritize mandatory environmental education components in national curricula, ensuring that OEE is not treated as an extracurricular activity but rather as a core educational element.Third, reinforcing learning through community involvement and hands-on participation enhances long-term commitment. Encouraging post-program volunteer opportunities, school-led conservation initiatives, and student-driven sustainability projects ensures that students continue engaging with environmental issues beyond their initial OEE experiences.This case study analysis provides empirical evidence supporting the integration of experiential learning, ecological literacy, and behavioral psychology into OEE. The findings indicate that long-term programs lead to deeper ecological literacy, short-term programs offer intensive engagement, and curriculum-integrated models provide the most sustainable behavioral outcomes. Future research should explore how these models can be adapted to different cultural and educational contexts, ensuring that OEE remains an effective tool for fostering lifelong environmental responsibility.

Discussion

The findings of this study highlight the significant role of Outdoor Environmental Education (OEE) in enhancing ecological literacy and fostering long-term pro-environmental behaviors. By integrating Experiential Learning Theory (ELT), Ecological Literacy (EL), and Behavioral Psychology (BP), this study provides a comprehensive framework for understanding how outdoor learning influences environmental attitudes and actions.

However, despite the demonstrated benefits of OEE, its implementation faces several challenges and limitations. These include sociocultural variations in environmental engagement, technological advancements in experiential learning, and systemic barriers such as funding constraints and teacher training gaps. This section critically examines these issues and proposes policy and practice recommendations for optimizing OEE.

Limitations of OEE in Diverse Sociocultural Contexts

While OEE has proven effective in fostering environmental responsibility, its impact varies across different cultural and socio-economic contexts. In regions where environmental awareness is already embedded in local traditions (e.g., Scandinavian countries), OEE aligns naturally with community values and educational policies. However, in urbanized or economically disadvantaged areas, access to nature-based learning is often limited, reducing the effectiveness of OEE interventions.A study by Rickinson et al. (2004) found that students from rural backgrounds displayed higher engagement and retention in OEE programs compared to those from highly urbanized environments. This suggests that socioeconomic factors, cultural attitudes towards nature, and accessibility to outdoor spaces influence the overall success of OEE.

To address these disparities, policymakers should:First, incorporate urban green spaces into educational planning. Schools in metropolitan areas can develop school gardens, rooftop biodiversity projects, and micro-forests to simulate natural environments.Second, adapt OEE

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to local cultural contexts by integrating indigenous knowledge systems and community-led conservation practices into the curriculum.Third, ensure equitable access by providing government subsidies or NGO partnerships to support OEE initiatives in low-income schools.Without addressing these sociocultural disparities, OEE risks becoming an exclusive privilege rather than an inclusive educational tool for environmental awareness.

The Role of Technology in Outdoor Experiential Learning

Advancements in immersive learning technologies, such as Augmented Reality (AR) and Virtual Reality (VR), have introduced new possibilities for OEE. AR applications allow students to interact with digital overlays of ecosystems, while VR simulations enable learners in urban or remote areas to experience nature-based learning without physically visiting outdoor spaces.A study by Lee et al. (2023) demonstrated that VR-based environmental simulations improved ecological literacy retention by 35%, compared to traditional classroom methods. Similarly, Brown & Clark (2024) found that AR-enhanced biodiversity identification tools increased student engagement in urban environmental studies.

However, while technology can enhance accessibility, it cannot fully replace direct nature experiences. Research suggests that physical immersion in nature triggers stronger emotional connections and behavioral changes compared to virtual simulations (Kellert, 2022). Additionally, over-reliance on digital tools may lead to a disconnect from real-world environmental interactions, reducing the affective and sensory dimensions crucial to OEE.To balance technology with traditional OEE, educators should:First, use AR/VR as a preparatory tool. Before field trips, virtual explorations can build foundational knowledge and improve observational skills.Second, integrate digital tools into real-world engagement. For example, students can use AR apps to identify plant species in actual outdoor settings.Third, ensure that technology complements, rather than replaces, physical nature experiences. Priority should still be given to direct, hands-on ecological interactions.While digital innovations expand the reach of OEE, their long-term effectiveness in fostering pro-environmental behaviors requires further empirical study.

Systemic Challenges: Funding, Teacher Training, and Policy Gaps

Despite strong evidence supporting OEE, systemic barriers continue to hinder its widespread adoption. Three key challenges include:

Insufficient Funding for Outdoor Education Programs

Many schools, particularly in developing countries and urban centers, lack the financial resources to support outdoor learning experiences. Limited budgets restrict access to field trips, outdoor equipment, and trained facilitators, reducing the scope and frequency of OEE activities.To address this issue, governments and institutions should:First, allocate dedicated funding for OEE. National education budgets should designate at least 5% of environmental education funds for outdoor learning initiatives.Second, encourage public-private partnerships. Corporate sponsors and environmental NGOs can co-fund school-based sustainability projects.Third, develop low-cost OEE alternatives. Schools can utilize local parks, community gardens, and urban green spaces for experiential learning.Without financial investment, OEE will remain an underutilized educational strategy, accessible only to privileged institutions.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 10 Issue 58 (June 2025) PP. 1230-1245
DOI 10.35631/IJEPC.1058079

Teacher Training Gaps and Pedagogical Challenges

Many educators lack the necessary training to implement experiential outdoor education effectively. A study by Palmberg & Kuru (2000) found that over 60% of teachers felt unprepared to facilitate nature-based learning, citing lack of expertise in ecological literacy and outdoor risk management.To bridge this gap, policymakers should:First, integrate OEE training into teacher education programs. Pre-service teachers should receive mandatory coursework in outdoor pedagogy.Second, provide professional development workshops. Ongoing training programs should equip teachers with field-based instructional strategies.Third, develop open-access resources for educators. Digital toolkits and curriculum guides can support teachers in implementing OEE without extensive external funding.Without properly trained educators, the full potential of OEE cannot be realized, limiting its impact on student learning outcomes.

Policy Inconsistencies and Lack of Curriculum Integration

In many regions, OEE remains an optional extracurricular activity rather than an integral part of the curriculum. While programs like the Eco-Schools Initiative in Sweden demonstrate successful integration, other nations lack standardized policies mandating outdoor learning.To institutionalize OEE, governments should:First, embed OEE into national curricula. Environmental literacy should be a core component of primary and secondary education.Second, implement standardized assessment frameworks. Measuring ecological literacy and behavioral change can justify continued funding for OEE programs.Third, promote interdisciplinary learning. OEE should be integrated across subjects such as science, geography, and physical education, rather than treated as an isolated discipline.Without structural policy support, OEE will remain disconnected from mainstream education systems, limiting its long-term effectiveness.

Future Directions for Research and Practice

The limitations identified in this discussion highlight key areas for future research and practical development in OEE. Future studies should:First, conduct longitudinal research. Measuring the long-term behavioral impact of OEE interventions over 3–5 years.Second, examine cross-cultural variations. Analyzing how OEE is adapted in different geographic and socio-economic contexts.Third, evaluate the role of technology. Investigating whether AR/VR-enhanced OEE experiences lead to comparable environmental engagement as direct nature immersion.Fourth, develop scalable policy models. Exploring how low-cost, community-based OEE programs can be implemented in resource-limited settings. Addressing these gaps will ensure that OEE remains a viable and effective approach for fostering ecological literacy and sustainability on a global scale.

Conclusion

This study underscores the importance of Outdoor Environmental Education (OEE) as a transformative approach to fostering ecological literacy and long-term pro-environmental behaviors. By integrating Experiential Learning Theory (ELT), Ecological Literacy (EL), and Behavioral Psychology (BP), this research provides a comprehensive framework for understanding how outdoor learning experiences shape cognitive, emotional, and behavioral responses to environmental challenges.The findings demonstrate that direct engagement with natural environments significantly enhances ecological awareness, critical thinking, and sustainability attitudes. However, the effectiveness of OEE depends on long-term engagement, structured curriculum integration, and teacher preparedness. Case studies reveal that while

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 10 Issue 58 (June 2025) PP. 1230-1245
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intensive short-term interventions can yield immediate knowledge gains, long-term exposure and institutionalized outdoor learning result in greater behavioral retention and deeper ecological connections.Despite its benefits, OEE faces several challenges, including limited funding, inconsistent policy support, teacher training deficiencies, and accessibility barriers. Addressing these issues requires targeted policy interventions, such as dedicated funding mechanisms, professional development programs for educators, and curriculum integration strategies. Additionally, advancements in technology-enhanced learning provide new opportunities to expand OEE access, particularly in urban and resource-limited settings.

Acknowledegment

I would like to express my gratitude to everyone who supported me in the completion of this research. In addition, no potential conflict of interest was reported by the author(s).

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IJEPC
EISSN : 0128-164X
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