INPLASY

Pedagogical Strategies for Teaching Environmental Literacy in Secondary School Education: A Systematic Review

INPLASY202590089
doi: 10.37766/inplasy2025.9.0089
Received: 22 September 2025
Published: 23 September 2025

Xiong, Z; Song, Y; Zhu, R.

Corresponding author:
Ziyin Xiong

ziyin.xiong@sjtu.edu.cn

Author Affiliation:
Shanghai Jiao Tong University.

ADMINISTRATIVE INFORMATION

Support - This research was supported by the National Education Science Planning Project of China (Project No. [EIA230501]).

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202590089

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 23 September 2025 and was last updated on 23 September 2025.

INTRODUCTION

Review question / Objective Research question 1: What pedagogical approaches are employed to deliver EE in secondary school education?
Research question 2: What are the impacts of different pedagogical approaches on students' environmental literacy?

Condition being studied Environmental literacy is essential for preparing students with the knowledge, skills, and dispositions to address pressing environmental challenges. This systematic literature review examines how pedagogical approaches used in secondary education foster students' environmental literacy. The review enriches the current literature by shifting attention away from the predominant focus on higher education and providing new empirically grounded insights into the effectiveness of classroom practices in enhancing students' environmental literacy at the secondary education level. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 22 peer-reviewed studies published between 2010 and 2024 were identified through Web of Science, Scopus and ERIC. The analysis is guided by Joyce and Calhoun's taxonomy of teaching models and the conceptualization of environmental literacy developed by the North American Association for Environmental Education (NAAEE). Findings show that strategies grounded in the social family and information-processing models of teaching were most frequently used, reflecting a pedagogical shift toward collaboration, critical thinking, and active engagement, yet a significant gap remains in cultivating environmentally responsible behavior (ERB).

METHODS

Participant or population This review focuses exclusively on participants in formal secondary

education settings, including both lower secondary (typically ages 12–15) and upper secondary (typically ages 15–18) students. Studies that involved mixed groups spanning both lower and upper secondary levels were also included, provided that data relevant to these age groups were reported. Teachers and educators were considered as participants only insofar as their pedagogical practices were studied in relation to student learning outcomes. Studies conducted in non-school settings (e.g., community workshops, corporate training, informal education programs, or higher education) were excluded, as the review is delimited to formal school-based secondary education contexts.

Intervention This review evaluates pedagogical strategies and teaching models implemented in formal secondary education settings with the explicit aim of fostering students' environmental literacy (EL). Interventions were broadly defined to include structured instructional practices, teaching models, and pedagogical approaches applied within classroom or school-based contexts.

The interventions examined were categorized using Joyce and Calhoun's (2024) taxonomy of teaching models, which delineates four families of pedagogical models:

Social Family – e.g., community and public engagement, fieldwork, deliberative pedagogies, whole-school approaches.

Information-Processing Family – e.g., inquiry-based learning, technology-integrated learning, context-based learning, model-based learning, visual-material integrated strategies.

Personal Family – e.g., reflective practices, counter-stories, eco-art and other self-expressive pedagogies.

Behavioral Family – although no interventions from this family were identified in the included studies, their absence itself forms part of the findings.

Interventions were included if they:

explicitly addressed environmental education (EE) or education for sustainable development (ESD) themes,

were designed for secondary school students, and

reported measurable outcomes related to at least one dimension of environmental literacy (knowledge, competencies, dispositions, or environmentally responsible behavior [ERB]).

Comparator Not applicable.

Study designs to be included To address the objective of this review, we included peer-reviewed empirical studies that investigated pedagogical strategies for fostering environmental literacy in secondary school education. Eligible study designs comprised:Quantitative studies, including experimental and quasi-experimental designs (e.g., randomized controlled trials, pre-test/post-test designs, and comparative group studies).Qualitative studies, including case studies, ethnographic analyses, and action research, provided they reported student learning outcomes relevant to environmental literacy.Mixed-methods studies.

Eligibility criteria The review did not restrict studies to a single comparison group but instead included any study that examined the effectiveness of a pedagogical strategy for teaching environmental literacy in secondary education against a comparative condition. Acceptable comparisons included:

Traditional or conventional instruction, such as lecture-based teaching or textbook-driven approaches.

Alternative pedagogical strategies, where two or more innovative teaching models (e.g., social family vs. information-processing models) were compared within the same study.

Pre–post comparisons, in which changes in students' environmental literacy dimensions (knowledge, competencies, dispositions, or environmentally responsible behavior) were assessed before and after the implementation of a pedagogical intervention.

Information sources The review drew on multiple peer-reviewed and scholarly databases to ensure a comprehensive coverage of relevant literature. Specifically, three major electronic databases were searched:

Web of Science (WOS)

Scopus

Education Resources Information Center (ERIC).

Main outcome(s) The majority of studies reported positive outcomes in dispositions (n = 20), followed

by competencies (n = 11) and knowledge (n = 10). However, ERB was rarely assessed (n = 5), reflecting a methodological and structural gap in the literature. Importantly, most outcomes were short-term, with limited evidence of sustained longitudinal impacts.

Quality assessment / Risk of bias analysis The methodological quality of the included studies was assessed using a structured appraisal framework adapted for educational research. The assessment focused on four key domains:

Clarity of Research Design – whether the study clearly specified its design (e.g., qualitative case study, quasi-experimental, mixed methods), the rationale for its selection, and alignment with research objectives.

Sampling and Participant Description – the extent to which the study described the participant population (e.g., age, grade level, sample size), recruitment procedures, and contextual factors (e.g., school setting, socio-cultural environment).

Rigor of Data Collection – evaluation of the appropriateness and reliability of instruments (e.g., validated questionnaires, observation protocols, interviews, performance tasks). Studies relying exclusively on self-reports without triangulation were considered lower in rigor.

Transparency of Data Analysis – whether the study provided sufficient detail about coding, statistical analysis, or qualitative interpretation, and whether procedures were replicable.

Validity of Findings – consideration of internal and external validity, including attention to potential biases, use of control or comparison groups (where applicable), and acknowledgment of limitations.

Each study was independently assessed by two reviewers. Cohen's κ was calculated to measure inter-rater reliability, with agreement rates exceeding 0.80, indicating strong reliability. Discrepancies were resolved through discussion until consensus was reached.

Strategy of data synthesis The analysis are conducted using a combined deductive–inductive coding approach, allowing both structured categorization and openness to emergent themes.

Deductive Analysis

Two established analytical frameworks guided the initial coding:

Joyce & Calhoun's taxonomy of teaching models (social, information-processing, personal, and behavioral families), used to classify pedagogical approaches.

NAAEE's environmental literacy framework, applied to code learning outcomes across the four dimensions: knowledge, competencies, dispositions, and environmentally responsible behavior (ERB).

Each study are coded into one or more categories according to the teaching models and environmental literacy dimensions explicitly reported. For instance, if a study combines fieldwork (social family) and inquiry-based learning (information-processing), it will be coded under both categories.

Inductive Analysis

Following the deductive coding, an inductive phase identify cross-cutting patterns, hybrid approaches, and contextual factors not captured by the predefined frameworks. This will ensure that novel pedagogical strategies (e.g., interdisciplinary or culturally specific adaptations) are captured.

Emerging codes are compared iteratively across studies until thematic saturation is reached.

Quantitative Synthesis

Descriptive statistics (frequencies, percentages) are used to summarize the distribution of teaching models, pedagogical approaches, and reported learning outcomes across the 22 included studies.

Tables and figures present the relationships between models, approaches, and environmental literacy dimensions.

Qualitative Synthesis

Narrative synthesis are employed to interpret the findings in depth, highlighting how different teaching models were implemented, the contextual conditions that shaped their success, and the types of learning outcomes achieved.

Special attention are given to identifying gaps, tensions (e.g., between dispositions and behavior), and opportunities for pedagogical innovation.

Integration of Findings

Finally, the results from the deductive and inductive analyses are integrated to provide a holistic picture of how pedagogical approaches contribute to environmental literacy in secondary education.

Subgroup analysis Geographical Distribution

Studies are grouped by region (e.g., Global North vs. Global South; United States, Europe, Asia, Africa, Oceania, Latin America) to examine potential cultural and contextual differences in pedagogical approaches and learning outcomes.

Educational Level

Studies focusing on lower secondary versus upper secondary students are compared, to assess whether pedagogical strategies differ in complexity, implementation, or outcomes across grade levels.

Research Design and Methodology

Outcomes are examined by study design (qualitative, quantitative, mixed-methods) to assess whether particular methodologies are more likely to capture certain dimensions of environmental literacy (e.g., questionnaires capturing dispositions vs. experiential methods capturing competencies and ERB).

Teaching Model Families

Analyses are structured around Joyce & Calhoun's four model families (social, information-processing, personal, behavioral) to explore whether different models are associated with particular dimensions of environmental literacy (knowledge, competencies, dispositions, or ERB).

Learning Outcome Dimensions

Studies reporting on knowledge, competencies, dispositions, and ERB are compared to determine if particular approaches are consistently associated with stronger results in specific dimensions.

Sensitivity analysis Sensitivity analyses were conducted to test the robustness of the findings. Specifically, we repeated the analysis after excluding lower-quality studies, small-sample studies, and those relying solely on self-reported outcomes. We also compared results across different study designs and geographical contexts.

Language restriction English.

Country(ies) involved China.

Keywords Environmental education; environmental literacy; teaching strategies; secondary education; systematic review.

Contributions of each author
Author 1 - Ziyin Xiong.
Author 2 - Yuye Song.
Author 3 - Ruizhi Zhu.