

# Curriculum Renewal via Interdisciplinary Project-Based Learning in Primary and Secondary Education

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**Abstract:** As competency-oriented reform continues to reshape basic education, curriculum innovation in primary and secondary schools is gradually shifting from optimising disciplinary content to restructuring learning processes and curriculum organisation. Interdisciplinary project-based learning (iPBL) embeds authentic problems into classroom contexts and emphasises sustained inquiry, collaborative learning, and evidence-based expression, making it a promising approach for bridging disciplinary knowledge and real-world problem solving. However, current practices in primary and secondary schools often reveal limited depth of curricular integration, misalignment between project goals and disciplinary objectives, activity-oriented implementation, and assessment practices dominated by final products. Drawing on relevant theoretical perspectives and authentic school-based cases, this study examines the design logic, enactment processes, and learning outcomes of iPBL and proposes a curriculum renewal framework aligned around goals, tasks, evidence, and scaffolds. The findings suggest that clarifying disciplinary roles, strengthening formative assessment based on learning evidence, and establishing sustainable teacher collaboration are essential for high-quality iPBL implementation, with strong potential for broader application in integrated practice, science education, and school-based curriculum development.

**Keywords:** Interdisciplinary project-based learning; Primary and secondary education; Curriculum renewal; Formative assessment; Authentic learning contexts

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## 1. Introduction

As social problems become increasingly complex and uncertain, the competency requirements placed on students in basic education are undergoing profound changes. Primary and secondary education is no longer limited to the acquisition of disciplinary knowledge but is progressively emphasising students' ability to integrate knowledge from multiple disciplines to solve problems in authentic contexts. However, in long-standing educational

practice, curriculum structures in primary and secondary schools have been predominantly organised around disciplinary boundaries. Teaching content is divided into relatively independent knowledge units, and learning activities are largely oriented toward discipline-specific objectives. While such discipline-based structures help ensure the internal coherence of knowledge systems, they also weaken students' holistic understanding of real-world problems and constrain knowledge transfer and integrated application abilities <sup>[1]</sup>.

Against this background, interdisciplinary project-based learning has gradually entered the instructional landscape of primary and secondary schools. Project-based learning emphasises authentic problems as starting points and guides students to actively construct knowledge through sustained inquiry, collaborative learning, and reflective activities. The interdisciplinary orientation further requires students to integrate concepts, methods, and perspectives from multiple disciplines during project implementation, thereby fostering a systematic understanding of complex problems <sup>[2]</sup>. Previous studies have shown that when project-based learning is organised around core disciplinary concepts and practices, it not only enhances students' learning motivation but also significantly promotes higher-order thinking and problem-solving abilities <sup>[3-5]</sup>.

Nevertheless, in actual teaching practice, the effectiveness of interdisciplinary project-based learning in primary and secondary schools remains uneven. Some projects remain at the level of thematic activities or product exhibitions, with limited alignment between learning tasks and disciplinary objectives. Other projects prioritize artifact completion while neglecting the accumulation of learning evidence and cognitive development processes. In addition, teachers often face substantial time and professional costs in interdisciplinary collaboration during design and implementation <sup>[6,7]</sup>. These issues weaken the pedagogical value of interdisciplinary project-based learning. Therefore, this study takes interdisciplinary project-based learning in primary and secondary education as its research focus and systematically examines its implementation logic and practical pathways from the perspective of curriculum reconstruction, aiming to provide actionable theoretical and practical references for high-quality classroom implementation.

## **2. Theoretical foundations and analytical framework**

The theoretical foundations of interdisciplinary project-based learning primarily derive from constructivist learning theory and situated learning theory. Constructivism posits that learning is not a passive reception of external knowledge but an active process in which learners construct meaning through interaction with others in specific sociocultural contexts <sup>[5]</sup>. In interdisciplinary project-based learning, students engage in sustained inquiry around complex problems and continuously integrate knowledge resources from multiple disciplines, which contributes to the formation of more stable and transferable cognitive structures.

Situated learning theory further emphasises that the meaning of knowledge is inseparable from the contexts in which it is generated and applied, and learning detached from context is unlikely to support authentic problem solving. By introducing real or highly simulated problem situations, project-based learning enables students to understand the functions and limitations of knowledge through problem-solving processes, thereby enhancing learning depth and durability <sup>[6]</sup>. In recent years, STEAM education research has also highlighted that the essence of interdisciplinary integration does not lie in the number of disciplines involved but in whether disciplinary contributions are organised around core problems and whether students engage in discipline-specific practices <sup>[8,9]</sup>.

Building on these theoretical perspectives, this study constructs an analytical framework characterised by the coherence of goals, tasks, evidence, and scaffolds. According to this framework, high-quality interdisciplinary project-based learning requires coordination at the curricular level in four aspects: curriculum goals should

explicitly target disciplinary understanding, disciplinary practices, and value judgment to avoid goal diffusion; learning tasks should be structured around progressive core questions to ensure internal logic; learning outcomes should be demonstrated through traceable evidence chains rather than solely final products; and instructional scaffolds together with teacher collaboration mechanisms should provide essential support to reduce implementation risks and enhance sustainability <sup>[10,11]</sup>.

### **3. Curriculum practice of interdisciplinary project-based learning in primary and secondary schools**

At the practical level, this study examines interdisciplinary projects implemented across different grade levels in primary and secondary schools. These projects are grounded in real-world issues perceptible to students and integrate elements of scientific inquiry, data analysis, textual expression, and social value discussion. Curriculum design begins by delineating project boundaries through core questions and subsequently decomposes learning processes into a sequence of progressive tasks, enabling different disciplines to play clearly defined roles at specific stages <sup>[8,12]</sup>.

During implementation, students typically work in groups to conduct inquiry activities such as observation, measurement, interviews, and information analysis. Under teacher guidance, students organise, interpret, and argue with the collected data. Unlike project approaches centred on final presentations, these curricula emphasise the continuous accumulation of “evidence packages,” incorporating data records, reasoning texts, iterative revisions, and reflective outputs into assessment processes. Practical evidence indicates that such evidence-centred project structures facilitate students’ transition from experience-based judgments to evidence-based argumentation, significantly enhancing their analytical and explanatory capacities <sup>[10,13]</sup>.

From the perspective of developmental differences, interdisciplinary projects at the primary level focus more on learning experiences and value awareness, with task designs emphasising contextual relevance and operational feasibility. At the secondary level, project complexity is gradually increased, guiding students toward more systematic data analysis, model construction, and argumentative expression. This differentiated design within a unified framework supports the construction of a coherent developmental trajectory for interdisciplinary project-based learning across primary and secondary education <sup>[12,14]</sup>.

### **4. Problem analysis and optimisation pathways**

Comprehensive analysis of practice reveals that challenges in interdisciplinary project-based learning in primary and secondary schools primarily cluster around curriculum integration, assessment practices, and teacher collaboration. In some cases, insufficient clarification of disciplinary contributions during the design phase leads to ambiguous learning objectives. Assessment practices often prioritise final products while overlooking cognitive changes during learning processes. Teacher collaboration frequently relies on individual experience rather than stable institutional mechanisms <sup>[6,7,13]</sup>.

To address these challenges, this study proposes several optimisation pathways. First, clarifying disciplinary contributions and core questions can enhance the depth of curriculum integration and ensure that project learning genuinely serves disciplinary understanding. Second, reconstructing assessment systems around evidence chains enables the integration of formative and summative assessment. Third, establishing stable teacher collaboration mechanisms, such as joint task and assessment design, can reduce the time and professional costs associated

with interdisciplinary project implementation. These pathways aim to improve the instructional quality of interdisciplinary project-based learning at the curriculum structure level in primary and secondary education <sup>[11,15,16]</sup>.

## 5. Conclusion

Grounded in authentic teaching contexts in primary and secondary schools, this study systematically explores curriculum reconstruction and practical pathways for interdisciplinary project-based learning. The findings suggest that achieving higher-order learning and sustainability in interdisciplinary project-based learning hinges on the coherence among curriculum goals, learning tasks, learning evidence, and instructional scaffolds. Through systematic curriculum design and implementation support, interdisciplinary project-based learning not only promotes students' integrated competency development but also offers a transferable and scalable model for curriculum reform in primary and secondary education.

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