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How Project-Based Learning Is Developing 21st-Century Skills Among Secondary School Students In India: A Secondary Data Review

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Abstract:

Project-Based Learning (PBL) has gained renewed relevance in India as schools shift toward competency-based education and experiential pedagogies encouraged by national and board-level policy directions. Yet, despite widespread advocacy, Indian evidence on *how* and *which* 21st-century skills are developed through PBL at the secondary level remains scattered across subject areas, school systems, and implementation contexts. This secondary-data review synthesizes policy documents, curriculum guidance, and peer-reviewed empirical and meta-analytic research to examine the link between PBL and 21st-century skills among secondary students in India. Using a structured review approach (identification, screening, eligibility, synthesis), the study maps PBL design features to skill outcomes—critical thinking, collaboration, communication, creativity, self-management, and digital literacy. Findings indicate that PBL is most strongly associated with gains in higher-order thinking, collaborative problem solving, and learner agency when projects are anchored in driving questions, authentic contexts, feedback cycles, and student voice. However, uneven infrastructure, assessment misalignment, teacher preparedness, and superficial "project display" practices often dilute impact. The review proposes a context-sensitive framework—PBL-to-Skills Pathway Model—for secondary schools in India, along with implementation and evaluation recommendations aligned to policy expectations and board standards.

Keywords: project-based learning, 21st-century skills, secondary education, India, experiential learning, competency-based education, review

1.Introduction

Secondary education in India is increasingly expected to produce learners who can apply knowledge, think critically, collaborate, communicate effectively, and solve real-world problems. These "21st-century skills" have moved from being an aspirational add-on to a central requirement, as reflected in national policy and board curricula emphasizing competency-based learning and experiential pedagogy. The National Education Policy 2020 (NEP 2020) calls for education that is holistic, experiential, and oriented toward higher-order capabilities rather than rote reproduction of content [1]. In parallel, the Central Board of Secondary Education (CBSE) curriculum guidance explicitly foregrounds experiential and active learning as preferred pedagogies for competency-based learning and links them with critical thinking and creativity [2].

Project-Based Learning (PBL) is frequently positioned as a practical route to such outcomes. In classical scholarship, PBL is described as learning organized around complex tasks, driven by challenging questions or problems, sustained over time, involving student decision-making, and producing a public product or performance [3]. In Indian school discourse, "projects" have often been part of assessment practice, but the shift now is toward instructionally central projects—where the project is not merely an assignment after teaching, but the vehicle through which learning occurs. NCERT materials also discuss project-based learning as giving students practical exposure, helping them organize work, and supporting teamwork [4].

Despite the policy push and increasing adoption in schools, the Indian evidence base is dispersed. Studies are often subject-specific (science, social science, language), limited to single-school settings, or report outcomes inconsistently. Moreover, some implementations labelled "PBL" are closer to craft-based displays than inquiry-led learning, making it difficult to interpret results.

This review therefore asks: How is PBL developing 21st-century skills among secondary school students in India, and under what conditions does it work best? Rather than presenting new primary data, the paper synthesizes secondary data—policy documents, curriculum guidance, and research literature—to produce a coherent picture that is useful for schools, teacher educators, and policymakers.

2.Conceptual Background

2.1 What counts as Project-Based Learning?

A persistent challenge in PBL research is definition. Thomas's influential review identifies defining features: projects are central to the curriculum, organized around driving questions, involve constructive investigation, are student-driven to a meaningful degree, and are realistic rather than purely school-like [3]. In contemporary PBL design guidance, "Gold Standard PBL" emphasizes elements such as a challenging problem or question, sustained inquiry, authenticity, student voice and choice, reflection, critique and revision, and a public product [5].

These design elements matter because they are the mechanisms through which skills develop. If a "project" becomes a poster-making activity with minimal inquiry, it may build presentation effort but not necessarily deeper critical thinking or collaboration. Thus, this review treats PBL as a **pedagogical model** rather than a single activity type.

2.2 21st-century skills as outcomes

Although frameworks vary, many converge on a cluster of skills including critical thinking/problem solving, creativity, collaboration, communication, self-direction, and often digital literacy. Research literature regularly connects PBL to these outcomes, arguing that projects require students to plan, negotiate roles, synthesize information, and communicate to authentic audiences [6]. Meta-analytic and large-scale syntheses also link PBL with achievement and thinking outcomes under certain conditions [7].

In the Indian context, policy and board documents emphasize competency-based learning outcomes and the need for higher-order capacities [1], [2]. The review therefore organizes skills into six outcome domains:

Critical thinking & problem solving

Collaboration & teamwork

Communication (oral/written/multimodal)

Creativity & innovation

Self-management & learner agency

Digital literacy (as relevant to project work)

3. Methodology: Secondary Data Review Design

3.1 Review approach

This study uses a structured secondary-data review method with transparent screening and synthesis steps. It is not a full PRISMA-certified systematic review, but it follows a PRISMA-inspired logic to improve traceability. The corpus includes:

National and board policy/curriculum documents relevant to experiential learning and competency-based education in secondary schooling [1], [2]

NCERT materials discussing learning outcomes and/or PBL approaches [4], [8]

Peer-reviewed international syntheses/meta-analyses that provide generalizable mechanisms of PBL impact [3], [6], [7]

Research reporting PBL effects in Indian secondary or CBSE-affiliated settings where available [9]

3.2 Search and identification (secondary sources)

Search terms were constructed around: project-based learning, secondary school, India, CBSE, 21st-century skills, critical thinking, collaboration, and experiential learning. Priority was given to:

Peer-reviewed journal articles and open-access repositories

Government/board documents (Ministry/CBSE/NCERT)

High-citation foundational PBL reviews and frameworks

3.3 Inclusion and exclusion criteria

Included sources:

Discuss PBL (or closely aligned models) with explicit or measurable links to skills/competencies

Concern secondary schooling or high-school levels (or provide mechanisms generalizable to secondary contexts)

Provide empirical evidence, meta-analysis, or authoritative policy/curriculum guidance

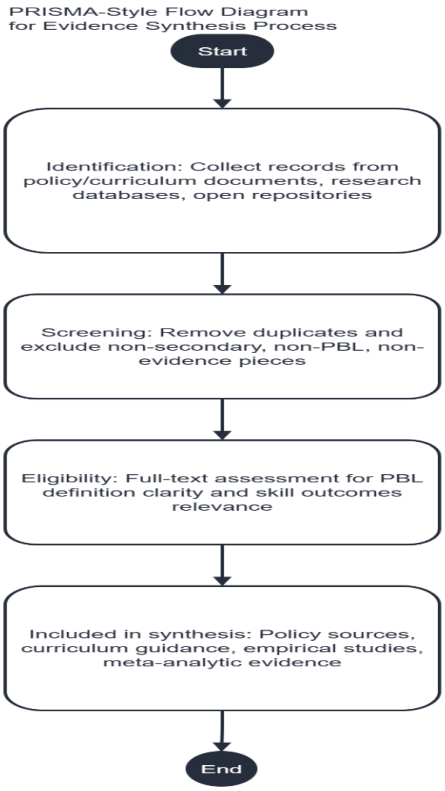
Excluded sources:

Pure opinion pieces without evidence

Low-credibility promotional content

Studies unrelated to school-level learning

3.4 PRISMA-style flow diagram (text form)



4. Policy and Curriculum Context in India

NEP 2020 places strong emphasis on shifting from rote learning to education that supports critical thinking, experiential learning, and holistic development [1]. While the policy does not prescribe PBL as a single mandatory method, it strongly legitimizes project-oriented and inquiry-based pedagogies as part of broader reform goals.

CBSE's secondary curriculum documents explicitly position experiential and active learning as preferred pedagogies for competency-based education and link them to critical thinking and creativity [2]. This matters because board alignment influences assessment practice, teacher training priorities, and school monitoring.

NCERT's learning outcomes guidance provides a national anchor for expected competencies at the secondary stage, supporting a shift away from content domination and toward outcome-oriented learning [8]. Meanwhile, NCERT materials that describe project-based learning emphasize practical exposure, organization, teamwork, and effective time use—elements closely related to self-management and collaboration [4].

Interpretive point: Policy documents create enabling conditions, but skill development depends on classroom enactment—teacher capability, assessment alignment, time allocation, and resource access.

5. Findings: What the Secondary Evidence Suggests

5.1 PBL and critical thinking/problem solving

Across the broader evidence base, PBL is frequently associated with improved thinking skills when projects require sustained inquiry and reasoning. A large meta-analytic paper notes that PBL effects are often assessed on achievement, thinking skills, and affective outcomes, emphasizing the value of meta-analytic synthesis for reliable conclusions [7]. A widely cited review argues that PBL organizes learning around complex tasks and challenging questions, making cognitive demand central rather than peripheral [3].

In Indian secondary contexts, available studies suggest similar patterns when projects are inquiry-led rather than decorative. For example, a CBSE-affiliated school study (Grade 9) reported measurable differences associated with project-based learning exposure, although generalization is constrained by sample size and single-setting design [9].

Synthesis: PBL is most consistently linked to critical thinking when (a) the question is genuinely challenging, (b) inquiry is sustained, and (c) students must justify decisions using evidence.

5.2 PBL and collaboration/teamwork

Collaboration is a built-in requirement of many projects. NCERT PBL descriptions emphasize that projects are generally developed in groups, enabling students to learn teamwork processes [4]. "Gold Standard PBL" design also places student voice, critique, and revision at the centre—mechanisms that naturally require interaction and negotiation [5].

Synthesis: Collaboration outcomes are strongest when teachers intentionally teach teamwork norms (role allocation, communication routines, peer feedback protocols) rather than assuming group work automatically leads to collaboration.

5.3 PBL and communication (multimodal and audience-facing)

PBL commonly culminates in a product or public presentation. This aligns with PBL design frameworks that emphasize public product and authentic audiences [5]. Communication outcomes include structured speaking, argumentation, report writing, and multimodal presentation.

Synthesis: Communication skill gains are most visible when rubrics explicitly assess communication quality (clarity, evidence use, audience awareness) and when students engage in critique and revision cycles.

5.4 PBL and creativity/innovation

Creativity is not guaranteed by a project label; it emerges when students have meaningful choices, open-ended design space, and opportunities to iterate. Board and policy discourse often links experiential learning to creativity [2].

Synthesis: Creativity outcomes are strongest when projects require design thinking (prototype, test, revise), and when assessment rewards originality and reasoning rather than surface aesthetics alone.

5.5 PBL and self-management/learner agency

Time management, goal setting, and responsibility are frequently cited as project benefits. NCERT PBL material explicitly notes organizing projects and using time effectively [4].

Synthesis: Self-management improves most when teachers scaffold project planning (milestones, check-ins, reflection prompts) instead of leaving students unsupported.

5.6 PBL and digital literacy

Digital literacy becomes more central when projects involve online research, data representation, or digital product creation. However, digital gains depend on access and guidance. Policy encourages technology integration, but schools vary widely in infrastructure and teacher readiness [1], [2].

Synthesis: Digital skill development is strongest when digital tools are used purposefully (data analysis, simulation, collaborative writing) rather than simply for browsing or slide-making.

6.Tables: Secondary Data Synthesis

Table 1. Policy and Curriculum Anchors Supporting PBL and 21st-Century Skills in India

Source	What it emphasizes	Relevance to PBL	Link to 21st-century skills
NEP 2020 [1]	Experiential, holistic, competency-based education	Enables project/inquiry pedagogies	Critical thinking, real-world application, holistic skills
CBSE Secondary Curriculum (2021–22) [2]	Experiential and active learning for competency-based learning	Supports classroom adoption of PBL approaches	Critical thinking, creativity, study skills
NCERT PBL text/chapter [4]	Practical exposure, teamwork, organization, time management	Describes PBL structure and student processes	Collaboration, self-management, problem solving
NCERT Learning Outcomes (Secondary) [8]	Outcomes-based learning, reducing content domination	Encourages skill-linked assessment	Higher-order outcomes and competencies

Table 2. Evidence Map: How PBL is linked to Skill Outcomes (secondary synthesis)

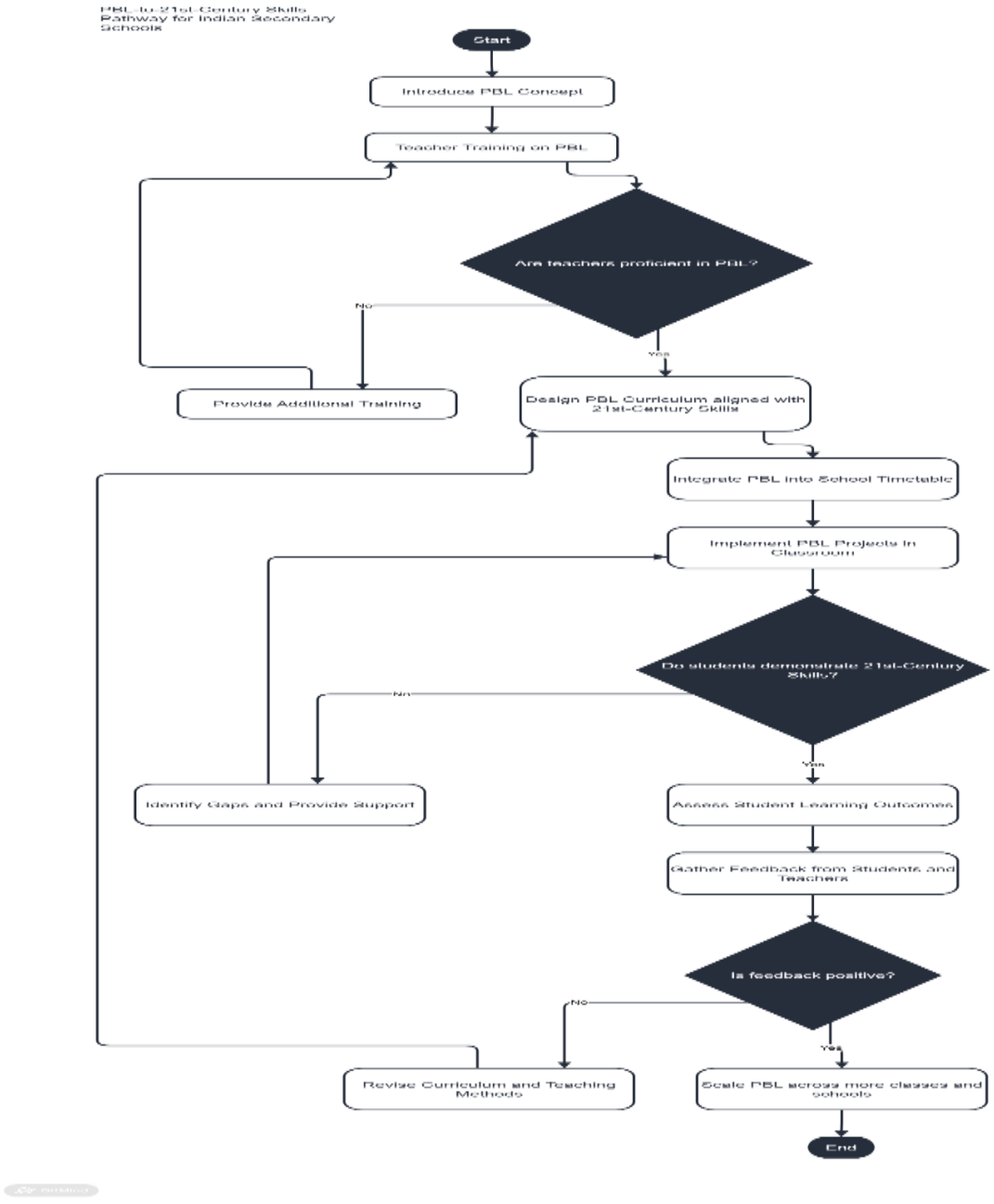
Evidence source	Context/type	Skills reported as strengthened	Key conditions noted
Thomas (2000) [3]	Foundational research review	Problem solving, inquiry, student-driven learning	Driving questions, student autonomy, constructive investigation
Bell (2010) [6]	Peer-reviewed conceptual/empirical discussion	Collaboration, communication, problem solving	Student inquiry + teacher facilitation + authentic products
PBL meta-analytic synthesis (learning outcomes) [7]	Meta-analytic review	Achievement + thinking skills + affect	Quality of implementation and outcome measures
Gold Standard PBL design elements [5]	Design framework/white paper	Success skills (“21st-century skills”)	Authenticity, reflection, critique/revision, public product
Indian CBSE-affiliated Grade 9 study [9]	India, secondary school	Reports learning differences with PBL exposure	Context-limited; suggests need for rigorous multi-site studies

Table 3. Implementation-to-Outcome Pathways in Indian Secondary Schools

Evidence source	Context/type	Skills reported as strengthened	Key conditions noted
Thomas (2000) [3]	Foundational research review	Problem solving, inquiry, student-driven learning	Driving questions, student autonomy, constructive investigation
Bell (2010) [6]	Peer-reviewed conceptual/empirical discussion	Collaboration, communication, problem solving	Student inquiry + teacher facilitation + authentic products
PBL meta-analytic synthesis (learning outcomes) [7]	Meta-analytic review	Achievement + thinking skills + affect	Quality of implementation and outcome measures
Gold Standard PBL design elements [5]	Design framework/white paper	Success skills ("21st-century skills")	Authenticity, reflection, critique/revision, public product
Indian CBSE-affiliated Grade 9 study [9]	India, secondary school	Reports learning differences with PBL exposure	Context-limited; suggests need for rigorous multi-site studies

7.Proposed Graphic Model: PBL-to-21st-Century Skills Pathway for Indian Secondary Schools

Figure 1. Input–Process–Output with Quality Gates (text diagram)



8.Discussion:

8.1 What the evidence supports most strongly

The secondary evidence converges on a clear message: PBL can develop 21st-century skills when it is implemented as sustained, inquiry-driven learning rather than as a decorative assignment. Foundational PBL scholarship emphasizes driving questions, constructive investigation, and student-driven processes as defining characteristics [3]. Contemporary design frameworks reinforce the need for reflection and critique/revision—features closely tied to communication quality, teamwork maturity, and metacognitive growth [5].

Meta-analytic work points to measurable impacts on learning outcomes and thinking skills, while also noting variation driven by implementation quality and measurement choices [7]. In India, where curriculum systems and school realities vary widely, this insight is especially important: the label "PBL" is not sufficient; design integrity is central.

8.2 Why Indian secondary schools face distinctive implementation challenges

Even with policy encouragement [1] and curriculum emphasis on experiential learning [2], several constraints shape enactment:

Assessment misalignment: If board-oriented assessment remains predominantly memory-based, teachers may treat projects as peripheral.

Time pressure and syllabus completion: Teachers may compress projects into short timeframes, undermining sustained inquiry.

Teacher readiness: PBL facilitation requires skills in guiding inquiry, supporting teamwork, and assessing process—not only content delivery.

Infrastructure inequality: Digital access, labs, and libraries vary, affecting what kinds of projects are possible.

Superficial "project culture": Some projects become display artifacts rather than learning processes—reducing skill development to aesthetics.

8.3 Interpreting "skills" carefully

Another challenge is the measurement of 21st-century skills. Studies often rely on self-report, teacher ratings, or proxy measures. Stronger evidence requires performance tasks, rubrics, and observable indicators (e.g., quality of reasoning, collaboration behaviours, iteration quality). Board and NCERT learning outcomes provide a direction for outcome-based evaluation [8], but operationalizing these outcomes into classroom rubrics remains uneven.

9.Implications for Practice and Policy

9.1 Recommendations for secondary schools

Adopt a common PBL design rubric aligned to Gold Standard elements (driving question, inquiry, authenticity, student voice, critique/revision, public product) [5].

Teach collaboration explicitly (roles, norms, peer feedback) rather than assuming it will emerge automatically.

Use dual rubrics: one for content understanding and one for skills (communication, teamwork, reasoning, self-management).

Build reflection cycles (journals, exit tickets, reflection prompts) to turn experience into learning.

Focus on fewer, better projects rather than many short projects that sacrifice inquiry depth.

9.2 Recommendations for teacher education and professional development

Teacher preparation programs should train teachers not only to "assign projects" but to **facilitate inquiry, manage group dynamics, and assess process**. Modules should include: project design studios, micro-teaching with PBL, skill rubric design, and classroom-based action research.

9.3 Recommendations for boards and system actors

Boards can strengthen implementation by:

Encouraging competency-linked project rubrics

Integrating project evidence into internal assessment structures

Providing exemplars of high-quality PBL aligned to learning outcomes [2], [8]

Supporting resource-light PBL models for low-infrastructure schools

10. Limitations and Future Research Directions

Limitations of this review:

Indian secondary PBL studies are fewer than expected and often small-scale, limiting generalization.

Definitions of PBL vary across studies, creating comparability issues.

Skill outcomes are measured inconsistently across sources.

Future research priorities:

Multi-state, multi-board studies comparing PBL implementation models.

Rigorous designs (quasi-experimental/longitudinal) capturing skill growth over time.

Rubric-based performance assessments for collaboration, critical thinking, and communication aligned with national learning outcomes [8].

Equity-focused research on how PBL benefits students in resource-constrained settings.

11. Conclusion:

This secondary-data review concludes that PBL holds strong potential to develop 21st-century skills among secondary students in India—particularly critical thinking, collaboration, communication, and learner agency—when projects are designed and facilitated with integrity. Policy and curriculum environments provide enabling signals [1], [2], and NCERT resources support the broader shift toward experiential, outcomes-based learning [4], [8]. Yet the translation of intent into outcomes depends on teacher capacity, assessment alignment, resource realities, and adherence to core PBL design principles [3], [5].

A practical takeaway is clear: India does not merely need "more projects" in secondary schooling; it needs better projects—designed for inquiry, assessed for skills, and supported by teacher development. Such an approach can move PBL from being a compliance activity to becoming a genuine pathway toward future-ready competencies.

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