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Project-Based Curriculum Development to Enhance Students' Skills

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ABSTRACT

This study develops, implements, and evaluates a Project-Based Curriculum (PjBC) model to enhance core 21st-century skills: critical thinking, collaboration, communication, and time management. Using a Research and Development (R&D) mixed-methods approach following the ADDIE Model, the curriculum was tested with approximately 35 tenth-grade students at an urban high school. Quantitative skill assessments showed overall effectiveness, with Critical Thinking scoring 82.5%, Collaboration 80.7%, and Communication 78.3%. Time Management presented the primary challenge at 68.4%. The study's innovation integrates continuous teacher coaching and a structured Micro-Milestone strategy within the PjBC framework to address common implementation barriers. Findings emphasize robust teacher support and explicit project guidance for comprehensive 21st-century skill development, offering policymakers a validated model aligned with global competency standards.

Keywords: *Communication, Collaboration, Critical Thinking, Project-Based Learning, 21st-Century Skills*

INTRODUCTION

The demands of education in the age of globalization and the Fourth Industrial Revolution extend beyond mere academic content mastery. Education must now prioritize the development of essential 21st-century skills, including creativity, critical thinking, teamwork, communication, and problem-solving. To effectively equip students to deal with complex dynamics, educational systems must provide relevant and contextual learning experiences (Darling-Hammond, Flook, Cook-Harvey, Barron, & & Osher, 2020). Consequently, curriculum design must incorporate creative strategies focused on cultivating these essential competencies.

A highly pertinent strategy for meeting this demand is the adoption of a Project-Based Curriculum (PjBC). Within the Project-Based Learning (PjBL) approach, students are placed at the center of the learning process, engaging in active, firsthand experiences through the completion of genuine, real-world projects (Rocha et al., 2025). This methodology places equal emphasis on developing practical skills and critical thinking alongside theoretical mastery, all of which are

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necessary for success in social and professional contexts. PjBC allows for the integrated development of cognitive, affective, and psychomotor skills, providing a well-rounded educational experience. This approach is consistent with constructivism, which posits that firsthand learning experiences lead to a deeper and more meaningful acquisition of information(Torang, 2025).

Research strongly supports the efficacy of PjBL. A meta-analysis, for instance, confirms that the use of PjBL across various educational environments significantly improves learning motivation, critical thinking abilities, and conceptual mastery. By emphasizing active and practical learning, PjBL also aids in building positive character traits and attitudes, such as tenacity and a strong sense of responsibility. Furthermore, studies highlight that the quality of PjBL implementation is greatly influenced by teacher professional development. Sri Lestari's (2024) research indicates that effective teacher coaching and training are essential for enhancing student abilities, particularly in creativity and teamwork(Lestari, 2024).

Similarly, Attadrib's (2024) study on Islamic law instruction demonstrated that PjBL significantly enhanced students' psychomotor abilities, confirming its effectiveness in fostering kinesthetic skills crucial for hands-on learning(Attadrib, 2024). At the national level, the PjBL method is integrated into the Merdeka Belajar Curriculum ("Freedom of Learning"), initiated by the Indonesian Ministry of Education, Culture, Research, and Technology. This curriculum uses PjBL to give students the freedom to select and create projects aligned with their interests, abilities, and local context, resulting in learning experiences that are authentic, meaningful, and applicable to their daily lives.

However, the successful implementation of PjBL is challenged by significant systemic hurdles. Several studies point out difficulties such as teachers' insufficient expertise, lack of time, and scarcity of adequate resources (Arwiyah, Machfiroh, & & Hidayatullah, 2023) Additionally, assessment in PjBL demands a thorough and holistic evaluation approach to accurately capture both the learning process and the final outcome. While much existing literature focuses on the benefits of PjBL and the challenges of its general implementation, there remains a critical lack of research focused specifically on the systematic, practical steps required for developing and evaluating a PjBC designed explicitly to enhance a defined set of student skills within a specific educational context.

Previous studies often describe the *need* for training but do not detail a structured curriculum development model that integrates teacher coaching and an adaptable evaluation system as core components of the PjBC process.

Therefore, this study aims to develop and validate a structured Project-Based Curriculum model specifically tailored to enhance students' 21st-century skills. The novelty of this research lies in its focus on integrating three critical elements into the curriculum development process: (1) Systematic Curriculum Design based on clear skill outcomes, (2) Continuous Teacher Training and Coaching, and (3) Holistic and Adaptable Assessment Frameworks designed to support the viability and efficacy of PjBL implementation in classrooms. The findings are expected to provide an empirical model and practical guidelines for sustainable PjBC development in the Indonesian national education context (Rosinda, 2025).

METHODS

1. Research Approach and Objectives

This study employs a Research and Development (R&D) methodology aimed at developing and validating a structured Project-Based Curriculum (PjBC) model designed to enhance students' 21st-century skills: creativity, critical thinking, teamwork, and communication. The R&D method was chosen to systematically create a tangible product and evaluate its validity, effectiveness, and feasibility (Mardianto, Kuat, & Muchlas, 2023). This research addresses the critical gap of lacking a structured PjBC model and limited teacher expertise by systematically developing a model integrating three key components: (1) systematic curriculum design, (2) ongoing teacher training and coaching, and (3) a holistic assessment framework.

2. Phases of Research and Development Model

The study follows the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation), a systematic iterative framework widely used in instructional design.

a. **Analysis (Initial Research)**

This phase involved a literature review and preliminary data collection to assess the potential, issues, and needs related to the current project-based curriculum. Data included evaluation of learning facilities, teacher readiness, and student needs (Universitas Tanjungpura, 2024). This stage provided the foundation for developing a curriculum aligned with learning objectives and context.

b. Development of Curriculum (Curriculum Creation)

Based on the initial analysis, a project-based curriculum emphasizing 21st-century skills was developed. The learning syntax comprised six structured steps: (1) identifying project problems, (2) planning solutions, (3) organizing implementation schedule, (4) executing and monitoring projects, (5) preparing reports and presentations, and (6) evaluation and reflection.

c. Implementation and Evaluation (Trial and Evaluation)

The PjBC model was tested with about thirty-five tenth-grade students from an urban high school, who represented the study's target group. Data on validity, effectiveness, and feasibility were collected through observations, interviews, questionnaires, and learning outcome evaluations.

3. Specifics of Implementation

a. Location and Research Subjects

The research was conducted at an urban high school involving roughly 35 tenth-grade students, selected based on student characteristics and school readiness to adopt PjBL. The sampling technique used was Purposive Sampling, based on student characteristics and school readiness to adopt PjBL.

b. Time and Duration of the Research

The curriculum development and testing span six months, including planning, implementation during the learning cycle, and model assessment and revision.

c. Research Tools

Instruments for evaluating challenges during the learning process included observation sheets for student skills, project outcome evaluations, motivation and satisfaction surveys, and

teacher interview guides (Iswantari, 2021). Specifically, student skills were evaluated using analytical rubrics, while motivation and satisfaction were measured using a Likert scale.

4. Analysis of Data

Both quantitative and qualitative analyses were applied to comprehensively assess effectiveness, feasibility, and validity.

a. Quantitative Data Analysis (Effectiveness and Validity)

Table 1. Quantitative Data Analysis (Effectiveness and Validity)

Analysis Type	Purpose	Key Metric/Test
Descriptive Statistics	To describe student skills pre- and post-intervention, and report survey/questionnaire results.	Mean, Standard Deviation, Frequency, Percentage.
Expert Validity Test	To quantify the consensus and relevance of the curriculum components as judged by experts/validators.	Content Validity Ratio (CVR) or Aiken's V (for judgment).
Inferential Statistics	To compare student skill development before and after the curriculum implementation (to establish effectiveness).	Paired Samples *t*-test (or Wilcoxon Signed-Rank Test if assumptions are violated).

b. Qualitative Data Analysis (Feasibility and Acceptability)

Table 2. Qualitative Data Analysis (Feasibility and Acceptability)

Data Source	Analysis Technique	Purpose
Inerviews & Observation Notes	Content Analysis and Thematic Analysis	To examine recurring themes, critical incidents, and emergent categories related to factors facilitating and hindering learning (e.g., teacher roles, resource availability, student engagement patterns).

RESULTS

A number of student skill areas, including critical thinking, communication, teamwork, and time management, showed notable gains when the project-based curriculum was implemented. The following average efficacy across the examined skills was found using quantitative data gathered via observations, questionnaires, and formative assessments:

The effectiveness of the project-based curriculum in developing student skills was evaluated across four key aspects, namely Critical Thinking, Communication, Collaboration, and Time Management. The findings, derived from observation, project assessment, and self-assessment instruments, are summarized in Table 3, which shows the average effectiveness percentage for each skill.

Table 3. Average Effectiveness of Skills Aspects in the Implementation of Project-Based Curriculum

No	Skills Aspect	Average Effectiveness (%)	Description
1	Critical Thinking	82.5	Effective
2	Communication	78.3	Fairly Effective
3	Collaboration	80.7	Effective
4	Time Management	68.4	Needs Improvement

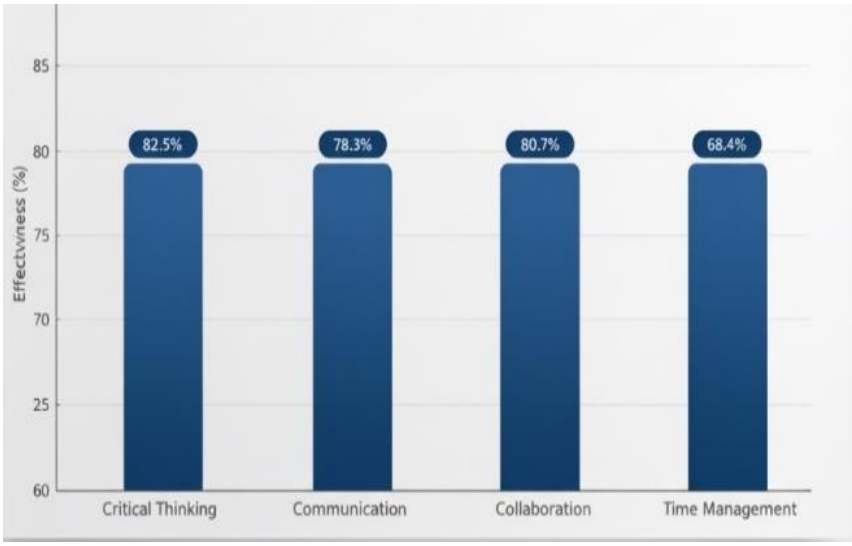
Interpretation and Context

Effectiveness Criteria: Classification follows these validation-established thresholds: (1) Effective (81%–100%); (2) Fairly Effective (71%–80%); (3) Needs Improvement (<70%). Table 1 indicates the project-based curriculum effectively develops cognitive and collaborative skills, achieving "Effective" ratings for Critical Thinking (82.5%) and Collaboration (80.7%), and "Fairly Effective" for Communication (78.3%).

Context of Project Assignment: Skills assessment occurred during the "Sustainable Urban Solutions: Designing a Waste Management Prototype for the Local School Environment" project, requiring Critical Thinking (waste data analysis), Collaboration (team design work), and Communication (prototype presentations to administrators). Time Management showed the lowest effectiveness at 68.4% ("Needs Improvement"), indicating students succeed in cognitive/collaborative tasks but struggle with project structuring and timeline adherence.

To address this challenge, specific strategies were implemented and should be emphasized in future curriculum cycles:

a. Concrete Strategy: Micro-Milestone Implementation. Instructors provided structured templates requiring students to define and report on weekly "micro-milestones" (small, measurable steps) rather than focusing solely on the final deadline.
b. Implementation Example: During the project, instructors scheduled mandatory 15-minute Check-in Sessions every Monday morning. Teams were required to submit a Time Allocation Log for the week ahead and justify how their planned activities supported the micro-milestones. This enforced external accountability on time planning.



Graph 1. Effectiveness of Student Skills Development (in percentage)

The results showed that critical thinking, collaboration, and communication aspects were above 78% effective, while time management was below 70%, indicating a need for special attention.

Field observations and learning documentation confirmed the students' improved ability to complete projects collaboratively using a problem-solving approach and structured presentation of results.

DISCUSSION

The findings indicate that the project-based curriculum (PjBC) is generally effective in cultivating 21st-Century Skills, achieving an "Effective" status in three out of four measured aspects. This efficacy (above 78% for Critical Thinking, Collaboration, and Communication) aligns strongly with the social constructivism theory (Santrock, 2020), which posits that learning through social interaction and authentic project contexts significantly promotes cognitive and skill growth. The success observed validates the project-based approach as an active learning paradigm well-suited for developing skills essential for global competitiveness (Alhayat, Mukhidin, Utami, & & Yustikarini, 2023)

The high effectiveness scores for Critical Thinking (82.5%) and Collaboration (80.7%) are central to this study's success. The contextual learning offered by the project-based format successfully trains students in Higher-Order Thinking Skills (HOTS) analysis, assessment, and solution formulation by requiring them to tackle real-world problems (Tafakur et al., 2023). This high success rate is consistent with findings from numerous PjBL studies globally, but contrasts with early-stage PjBL adoption reports where teacher inexperience often initially limits deep critical thinking development. This study's success, therefore, suggests that the integrated teacher coaching component in the developed PjBC model was effective. Furthermore, the strong Collaboration score corroborates Vygotsky's theory; peer learning through extensive social interaction in groups enhances not only learning outcomes but also crucial social and character skills

(Cooper & & Robinson, 2022). This strong showing underscores the teacher's vital role as a facilitator who helps structure task distribution, provides guidance, and mediates conflicts, ensuring that group work translates into genuine skill development.

The Communication skills aspect, with an effectiveness score of 78.3% "Fairly Effective", confirms that the curriculum provides valuable practice opportunities through presentations and

group discussions (Sofiriyah, Romadon, Fatmala, & & Ahmad, 2024). Analysis: This "Fairly Effective" score reveals minor obstacles. Field data documented recurring challenges such as fear of performing (public speaking anxiety) and difficulties managing group dynamics, which are strongly influenced by students' emotional and psychological factors (Oktifa, 2025). This suggests that while the curriculum facilitates technical communication practice, future implementation must integrate structured training on soft skills, such as anxiety control, group bargaining, and digital media communication, to support students' full communication potential.

The most significant finding demanding discussion is the low effectiveness of Time Management (68.4%) ("Needs Improvement"). Mechanistic Explanation: This deficiency is primarily rooted in students' undeveloped self-regulation skills and their difficulty in conceptualizing the longitudinal dependency of project tasks. Unlike daily assignments, PjBL requires the student to manage internal motivation and project flow over weeks or months, a skill often not explicitly taught. This low score aligns with numerous international studies on PjBL implementation, where long-term planning and adherence to project timelines consistently emerge as a fundamental challenge. Novel Contribution: The unique contribution of this study is the integration and testing of specific, concrete solutions in the field. The implementation of the "Micro-Milestone" strategy requiring weekly check-in sessions, submission of a Time Allocation Log, and enforcing external accountability demonstrates a practical, effective method to mitigate this common weakness. These findings argue that explicit instruction in self-regulation and time management tools must be an integrated component of the soft skills curriculum, rather than solely relying on inherent student discipline.

The findings are highly consistent with the constructivist framework and the goals of 21st-century learning. The PjBL approach serves as a powerful vehicle for character development and skill acquisition, aligning with policies like the Independent Curriculum (Kurikulum Merdeka). This study, therefore, highlights the critical necessity for policymakers and academic institutions to take specific actions:

1. Allocate sufficient time for worthwhile project assignments.
2. Continuously train educators in soft skill development and project facilitation.
3. Provide comprehensive evaluation resources that assess both process and final results.
4. Encourage the use of technology to aid in project management and monitoring.

Integrated policies such as these will allow the PjBL curriculum to be scaled up more readily, maximizing the development of 21st-century abilities across various educational contexts.

The study is limited by its narrow focus and small sample size (N=35), which makes it difficult to generalize the results across variations in student characteristics and instructor skill. Consequently, the validity and reliability of these findings should be tested by additional research employing more extensive quantitative techniques.

Future studies should specifically address the following:

1. Quantitative Validation: Conduct a larger-scale quasi-experimental study utilizing a control group to statistically confirm the superior effectiveness of the Micro-Milestone strategy on Time Management skills across different schools.
2. Psychosocial Analysis: Incorporate psychosocial analysis, examining the connection between student emotional intelligence, academic motivation, and the effective execution of the Project-Based Curriculum.

3. Teacher Competency Correlation: Conduct a study correlating teacher training frequency and quality with student skill outcomes to quantify the return on investment of the continuous teacher coaching component.

CONCLUSIONS

The research on developing a project-based curriculum successfully validates its efficacy as a strategic model for enhancing critical 21st-Century Skills in students. The implementation successfully achieved high effectiveness scores in Critical Thinking (82.5%) and Collaboration (80.7%), and a "Fairly Effective" status in Communication (78.3%). This outcome demonstrates that the project-based structure provides the necessary context for authentic, real-world learning, strongly reinforcing the principles of social constructivism by cultivating self-reliant, cooperative, and adaptive learners. The curriculum thus serves as a powerful instrument for achieving both the national education goals and the specific skill-focused results required by contemporary educational paradigms.

While the curriculum proves highly effective overall, the finding regarding Time Management (68.4%) highlights a critical area for improvement and a significant contribution of this study. This challenge, which is common in project-based learning contexts, was directly addressed through the integration of the Micro-Milestone strategy, demonstrating that success requires explicit pedagogical support not just project execution. Therefore, the development and successful implementation of this curriculum represent an essential step toward raising educational standards by providing a model that is both theoretically sound and practically adaptable to foster future-ready graduates.

Based on the findings and identified limitations, it is recommended that stakeholders: (1) Continuously enhance teacher competence in soft skill development and advanced project-based learning facilitation, ensuring they can actively guide students through complex challenges. (2) Ensure adequate provision of teaching tools and resources, particularly technology, to aid in project monitoring and time management. (3) Establish a comprehensive assessment system that rigorously evaluates students' skill development across both the process and the final outcome. Furthermore, future research should broaden the scope of investigation, potentially using larger samples, and explore the psycho-sociological aspects, such as the influence of motivation and emotional intelligence, on the efficacy of project-based curricula.

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