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Improving Critical Thinking and Problem-Solving Skills Through PBL: Evidence from Secondary Education

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Abstract

Critical thinking and problem-solving abilities are vital competencies of the 21st century; nevertheless, they have not yet been fully cultivated by traditional education methods. This study seeks to evaluate the impact of the Problem-Based Learning (PBL) model on the critical thinking skills and problem-solving abilities of junior high school students, while also comparing the outcomes with traditional instructional methods. The methodology employed was a quasi-experimental design featuring a non-equivalent control group, comprising 64 eighth-grade pupils allocated into experimental and control groups. The assessment tool was created utilizing Ennis indicators and Polya stages. The study results indicated that the experimental group exhibited substantial enhancements in both skills, evidenced by a modest N-Gain value (≈ 0.39) and a large effect size (Cohen's $d > 1.0$). Conversely, the control group exhibited merely a little increase. These findings reinforce the efficacy of PBL as a constructivist learning methodology that promotes active, collaborative, and reflective participation. The implication is that the systematic implementation of PBL can serve as an effective educational technique to enhance learning quality and prepare students with 21st-century competencies.

Keywords: Problem-Based Learning, critical thinking, problem solving, junior high school education, constructivism, 21st century competencies

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INTRODUCTION

In today's rapidly evolving world, critical thinking and problem-solving have become core competencies essential for students to succeed across disciplines. These skills support learners in analyzing complex issues, making informed decisions, and adapting to dynamic challenges. However, in Indonesia, the shift toward fostering such higher-order thinking is often hindered by entrenched traditional teaching methods that emphasize memorization and teacher-centered instruction (Azriyanti & Syafriani, 2023; Saqr & López-Pernas, 2023; Uminingtyas et al., 2019). Despite the government's recent efforts through the Merdeka Curriculum to promote student autonomy and contextual learning,



implementation remains inconsistent—particularly due to limited teacher training and the persistence of exam-oriented classroom cultures (Ariesta & Purwanti, 2019; Shofiyatul Masruro et al., 2021).

Problem-Based Learning (PBL) has emerged as a promising strategy to bridge this gap. Rooted in constructivist theory, PBL places students at the center of the learning process by engaging them in real-world problems that require critical inquiry, collaboration, and reflective thinking. (Shofiyatul Masruro et al., 2021) emphasize that these methods reduce students' opportunities to gain hands-on experience and practice problem-solving, which are crucial for nurturing evaluative and critical reflection. Furthermore, the dominance of lecture-based instruction tends to limit student interaction and collaboration, thereby weakening opportunities for collective inquiry and deeper cognitive engagement (Xu et al., 2023). These limitations signal an urgent need for a pedagogical shift toward active learning models that are capable of developing students' intellectual autonomy and reasoning skills. Furthermore, its alignment with the collaborative ethos of the Merdeka Curriculum makes it a relevant approach for Indonesian classrooms (Saqr & López-Pernas, 2023).

By promoting social learning, shared inquiry, and student agency, PBL also addresses the socio-cultural dimensions of learning often overlooked in conventional models (Munawaroh, 2020; Tanjung et al., 2023). Empirical studies consistently highlight the benefits of PBL across various contexts, showing improvements in students' motivation, academic performance, and self-efficacy (Trullàs et al., 2022). For instance, (Napitupulu et al., 2019) found that the implementation of PBL significantly enhances students' problem-solving abilities and overall learning outcomes, underscoring its practical relevance in contemporary curricula.

Additionally, PBL reinforces the social dimensions of learning emphasized in constructivist pedagogy by encouraging collaboration and meaningful discourse among students. Hidayati et al. (2019) and Muvid et al. (2022) affirm that PBL creates opportunities for learners to engage in shared inquiry and negotiation of meaning, essential elements of social learning (T. Hidayati & Purwaningsih, 2023; Muvid et al., 2022). (N. Hidayati et al., 2019) further assert that this model is aligned not only with cognitive but also social constructivist principles, as students work in groups to resolve complex, context-rich tasks. Through such collaborative engagements, learners develop deeper conceptual understanding and higher-order thinking through sustained inquiry and reflection (Elkhamisy et al., 2021). Therefore, as education systems increasingly shift toward developing 21st-century competencies, PBL offers a pedagogically sound and empirically supported model that not only embodies constructivist principles but also delivers tangible benefits in enhancing student engagement, autonomy, and critical skill development (Hallinger, 2023).

This study is innovative in its context and emphasis on cultivating 21st-century abilities, particularly critical thinking and problem-solving, via the implementation of the Problem-Based Learning (PBL) paradigm in junior high schools. This study highlights the systematic implementation of Problem-Based Learning (PBL) in eighth grade of junior high school, utilizing a quasi-experimental design to assess its direct effect on two critical cognitive skills, despite prior research validating PBL's



efficacy in higher education or specific subjects. The utilization of structured instruments grounded in Ennis indicators for critical thinking and Polya stages for problem-solving enhances methodological rigor and bolsters the validity of the measurement. This study offers a significant contextual contribution to the advancement of novel learning methodologies within the Indonesian educational landscape, which remains predominantly influenced by traditional methods (T. Hidayati & Purwaningsih, 2023; Munawaroh, 2020).

This study aims to enhance the understanding of the efficacy of problem-based learning methods, particularly in fostering advanced cognitive skills in secondary education. This study further reinforces the empirical foundation of constructivism theory, which highlights the significance of active and contextual learning in the development of student cognition (Hallinger, 2023). The findings of this study serve as a reference for educators and institutions in developing innovative project-based learning strategies that promote active student engagement, enhance learning motivation, and cultivate reflective thinking and systematic problem-solving skills (Napitupulu et al., 2019; Trullàs et al., 2022). Consequently, this study is anticipated to serve as a reference for enhancing the quality of education in schools through an approach aligned with the requirements of the 21st century. This study seeks to examine the impact of the Problem Based Learning (PBL) paradigm on the critical thinking skills and problem-solving capabilities of junior high school students. The study aims to compare learning results between students engaged in problem-based learning and those participating in conventional learning. This study employs an experimental quantitative methodology to ascertain the degree to which the implementation of Project-Based Learning (PBL) enhances the two primary competences of the 21st century and to evaluate the efficacy of this educational model within junior high school settings.

METHODS

This research employed a quasi-experimental design featuring a non-equivalent control group (Sitorus & Pardede, 2024). This method was employed as it enables researchers to evaluate outcomes between groups that were not randomly picked but have substantially similar features. This model is pertinent to the setting of already established classroom instruction. The independent variable in this study is the Problem-Based Learning (PBL) paradigm, whereas the dependent variables encompass students' critical thinking skills and problem-solving capabilities. The subjects of this study comprised eighth grade pupils at a public junior high school in Jombang. The research sample was obtained by a purposive sampling method, which considered specific criteria such as the similarity in students' academic performance based on their previous semester grades, the homogeneity of classroom learning environments, and the availability of experienced teachers who had not previously implemented PBL in their teaching. Only classes with mid-to-high academic profiles were selected to ensure baseline comparability and minimize confounding variables related to learning readiness. In addition, both teachers involved had a minimum of five years of teaching experience and similar instructional loads, which ensured a controlled variation in instructional delivery (Djafar et al., 2021). The sample comprised two classes, each containing 32 pupils, allocated into an experimental group and a control

group. The sample is characterized by an average age of 13 to 14 years and a generally uniform academic ability, as indicated by prior report card results.

The main instruments in this study were critical thinking skills tests and problem-solving ability tests (Goastellec & Välimaa, 2019). The critical thinking test was developed based on indicators proposed by Ennis, which include the ability to analyze, evaluate, and draw conclusions logically. Meanwhile, the problem-solving test was compiled based on the stages of problem solving according to Polya, namely understanding the problem, planning a solution, implementing the plan, and evaluating the results. Before being used in the study, both instruments were tested for content validity through expert judgment by three experienced education lecturers. The reliability test was carried out using the Cronbach Alpha test on a small group (trial), and the results showed that both instruments had reliability coefficients in the high category (> 0.7), so they were suitable for use in the study.

Table 1. Critical Thinking Skills Instrument Grid (Ennis)

No	Critical Thinking Indicators (Ennis)	Item Description	Question Format
1	Identifying arguments	Distinguishing facts and opinions in text	Multiple Choice
2	Analyzing information	Drawing logical conclusions from data	Multiple Choice
3	Evaluating evidence or reasons	Assessing the strength of arguments in statements	Multiple Choice
4	Drawing conclusions based on logic	Making inferences from specific situations	Short Essay

Table 2. Grid of the Problem Solving Ability Instrument (Polya)

No	Problem Solving Stages (Polya)	Item Description	Question Form
1	Understand the problem	Identifying important information in the question	Description
2	Plan a solution	Determining the right strategy or formula	Description
3	Implement the plan	Solving the question based on the chosen strategy	Description
4	Evaluate the results	Reassessing the answer and checking the accuracy	Description

The research data were gathered by administering pre-tests and post-tests to both the experimental and control groups. The pre-test was administered prior to the treatment to assess students' baseline competencies in critical thinking and problem-solving. The post-test was administered following the treatment to assess the modifications or enhancements resulting from the deployment of the Problem Based Learning approach (Irfan Syahrone, 2023). The pre-test and post-test data were statistically analyzed using SPSS software version 22 (Mvududu & Shannon, 2023). Prior to executing the hypothesis test, precondition analyses were conducted, specifically the normalcy test and the homogeneity test. The normality test assesses if the data follows a normal distribution, employing the Shapiro-Wilk or Kolmogorov-Smirnov test, whilst the homogeneity test utilizes the Levene test to verify the equality of variance among groups. Upon fulfillment of these conditions, data analysis proceeds with an independent t-test to compare post-test findings between the experimental and

control groups, alongside a paired t-test to evaluate the enhancement in learning outcomes within each group pre- and post-treatment. A normalized gain score (N-Gain) calculation was conducted to assess the efficacy of enhancing students' critical thinking skills and problem-solving abilities. The interpretation of the analysis results pertains to the significance value ($p < 0.05$) and effect size, aiming to offer a more thorough understanding of the impact of the Problem Based Learning paradigm on education.

RESULTS

The data from this study begins with the presentation of descriptive statistics of critical thinking skills test scores and problem-solving abilities, both in the experimental group and the control group. Descriptive statistics include the average value (mean), median, standard deviation, and minimum and maximum scores from the pre-test and post-test results. This presentation aims to provide an initial picture of the condition and development of students' abilities before and after the learning treatment with the Problem Based Learning (PBL) model in the experimental group, as well as conventional learning in the control group.

Table 3. Descriptive Statistics of Critical Thinking Scores

Group	Test	N	Mean	Median	Std. Deviation	Minimum	Maximum
Experiment	Pre-test	32	65.34	66.00	8.72	48	82
Experiment	Post-test	32	78.91	79.50	7.45	65	92
Control	Pre-test	32	64.78	65.00	9.15	45	85
Control	Post-test	32	70.25	71.00	8.83	52	88

Table 4. Descriptive Statistics of Problem Solving Scores

Group	Test	N	Mean	Median	Std. Deviation	Minimum	Maximum
Experiment	Pre-test	32	62.19	63.00	9.34	42	80
Experiment	Post-test	32	76.84	77.00	8.12	60	95
Control	Pre-test	32	61.53	62.50	10.21	38	83
Control	Post-test	32	67.41	68.00	9.67	48	85

The descriptive statistics indicate that both groups exhibit comparable pre-test scores for the two variables. The experimental group exhibited a more significant rise in scores compared to the control group across both measures. The modest standard deviation signifies that the data is largely uniform within each group. Prior to performing inferential analysis, a precondition assessment was undertaken to verify that the data satisfied the fundamental assumptions of parametric tests, specifically the normality test and the homogeneity test. The Shapiro-Wilk Test was employed to assess normality, as the sample size in each group was below 50. Concurrently, Levene's Test was employed to assess the equality of variance among the groups. The outcomes of these two assessments are displayed in the subsequent table.

Table 5. Normality Test Results

Variable	Group	Test	Statistic	df	Sig.	Conclusion
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Critical Thinking	Experiment	Pre-test	0.965	32	0.362	Normal
Critical Thinking	Experiment	Post-test	0.971	32	0.485	Normal
Critical Thinking	Control	Pre-test	0.963	32	0.328	Normal
Critical Thinking	Control	Post-test	0.968	32	0.421	Normal
Problem Solving	Experiment	Pre-test	0.972	32	0.502	Normal
Problem Solving	Experiment	Post-test	0.969	32	0.445	Normal
Problem Solving	Control	Pre-test	0.961	32	0.285	Normal
Problem Solving	Control	Post-test	0.966	32	0.385	Normal

Table 6. Homogeneity Test Results

Variable	Test	Levene Statistic	df1	df2	Sig.	Conclusion
Critical Thinking	Pre-test	0.142	1	62	0.708	Homogeneous
Critical Thinking	Post-test	1.853	1	62	0.178	Homogeneous
Problem Solving	Pre-test	0.685	1	62	0.411	Homogeneous
Problem Solving	Post-test	2.145	1	62	0.148	Homogeneous

The Shapiro-Wilk normality test results indicated that all data exhibited a significance value greater than 0.05, signifying a normal distribution of the data. The outcomes of Levene's homogeneity test revealed a significance value over 0.05 for all variables, signifying that the variation among groups was homogeneous. Upon satisfying these two assumptions, parametric analysis with the t-test may proceed. Following the confirmation that the data satisfied the requirements for parametric testing, the study proceeded with hypothesis testing to assess the impact of the Problem Based Learning model on students' critical thinking skills and problem-solving capabilities. The independent t-test compared the post-test scores of the experimental and control groups, whereas the paired t-test assessed the pre-test and post-test scores within each group. The test results include an effectiveness value (Cohen's d) to quantify the magnitude of the treatment's effect.

Table 7. Independent Samples t-test for Post-test Scores

Variable	t	df	Sig. (2-tailed)	Mean Difference	Cohen's d	Interpretation
Critical Thinking	4.205	62	0.000	8.66	1.05	Large Effect
Problem Solving	4.089	62	0.000	9.43	1.02	Large Effect

Table 8. Paired Samples t-test in Experimental Group

Variable	Pair	t	df	Sig. (2-tailed)	Mean Difference	Cohen's d
Critical Thinking	Pre-Post	-8.245	31	0.000	-13.57	1.67
Problem Solving	Pre-Post	-9.134	31	0.000	-14.65	1.71

Table 9. Paired Samples t-test in Control Group

Variable	Pair	t	df	Sig. (2-tailed)	Mean Difference	Cohen's d
Critical Thinking	Pre-Post	-3.256	31	0.003	-5.47	0.62
Problem Solving	Pre-Post	-3.178	31	0.003	-5.88	0.59

Hypothesis 1: Differences Between Groups Post-Test. The independent t-test results indicated a significant difference ($p < 0.001$) between the post-test scores of the experimental and control groups

for both variables. A Cohen's d greater than 1.0 signifies a substantial effect size, indicating that the difference is both statistically significant and practically relevant. Hypothesis 2: Enhancement Within Groups. The paired t -test indicated a substantial enhancement from pre-test to post-test in both groups ($p < 0.05$). The experimental group had a markedly greater effect size (Cohen's $d > 1.6$) compared to the control group (Cohen's $d = 0.6$). Moreover, the N-Gain analysis results indicated that the experimental group exhibited a substantial rise (N-Gain = 0.39) in both variables, whereas the control group demonstrated a minimal increase (N-Gain ≈ 0.15 -0.16). This suggests that the learning strategy utilized for the experimental group is more efficacious in enhancing critical thinking and problem-solving abilities. As illustrated in the subsequent table.

Table 10. N-Gain Analysis Results

Variable	Group	Pre-test Mean	Post-test Mean	Gain	N-Gain	Category
Critical Thinking	Experimental	65.34	78.91	13.57	0.39	Currently
Critical Thinking	Control	64.78	70.25	5.47	0.16	Low
Problem Solving	Experimental	62.19	76.84	14.65	0.39	Currently
Problem Solving	Control	61.53	67.41	5.88	0.15	Low

The statistical analysis indicates that the research data satisfies the criteria for parametric approaches, exhibiting a normal distribution and homogeneous variance. The Problem Based Learning model implemented in the experimental group has demonstrated efficacy in enhancing students' critical thinking and problem-solving skills, achieving a moderate gain as indicated by an N-Gain value of 0.39. The t -test results indicated a significant difference between the experimental and control groups in the post-test scores of both variables ($p < 0.001$), corroborated by a large effect size (Cohen's $d > 1.0$), signifying that the difference is both statistically significant and practically substantial. While both groups shown an improvement from pre-test to post-test, the experimental group had a significantly greater enhancement compared to the control group. The findings substantiate the premise that the problem-based learning paradigm is superior in fostering critical thinking skills and problem-solving abilities among junior high school students.

DISCUSSION

The notable enhancement observed in the experimental group can be elucidated by the primary attributes of the Problem Based Learning (PBL) model, which promotes active student engagement in advanced cognitive processes, including analysis, synthesis, and evaluation. Problem-based learning engages students as active participants in knowledge construction through collaborative resolution of real-world issues, aligning with Vygotsky's constructivist principle that knowledge is developed through social interaction and the mediation of a meaningful learning context. The results demonstrate that the experimental group exhibited a markedly greater enhancement in critical thinking skills and problem-solving abilities compared to the control group, as evidenced by the statistically significant difference in post-test scores ($p < 0.001$) and a large effect size (Cohen's $d > 1.0$). Consequently, the findings of this study reinforce the efficacy of PBL in cultivating important 21st-century competencies, evidenced

not only by the enhancement of numerical scores but also by their practical significance within the junior high school learning context.

The study's results indicated that the application of Problem-Based Learning (PBL) significantly enhanced the critical thinking skills of students in the experimental group, as evidenced by their higher post-test scores compared to the control group. The rise was both statistically significant ($p < 0.001$) and practically important, exhibiting a substantial effect size (Cohen's $d > 1.0$). This finding can be elucidated by the attributes of PBL that regularly promote students' engagement in problem-oriented, reflective, and collaborative learning processes. This methodology presents students with contextual dilemmas necessitating logical reasoning, decision-making, and comprehensive argumentation. This method fosters an environment conducive to the active and independent development of critical thinking skills among pupils. Research by (Worachak et al., 2023) substantiates this assertion, indicating that PBL fosters logical reasoning and self-assessment, which are fundamental skills in critical thinking. (Hidayati et al., 2022) similarly asserted that the inquiry-based learning environment and autonomous learning fostered in PBL can enhance the quality of students' higher-order thinking. Conversely, (Ismail & Imawan, 2022) asserted that engagement in the PBL process enhances students' confidence in articulating ideas and participating in conversations, so indirectly fortifying their critical thinking skills. This study's findings indicate that collaborative interactions in PBL enable students to generate shared meaning, engage in reflective discussion, and assess their cognitive processes, aligning theoretically with Vygotsky's social constructivism approach.

Besides enhancing critical thinking, the PBL paradigm has demonstrated efficacy in markedly augmenting pupils' problem-solving skills. The study results indicated that the experimental group had a greater increase in post-test scores compared to the control group, with an average difference that was both statistically and practically significant. The learning process via PBL necessitates that students comprehensively grasp the problem, devise a solution strategy, execute the solution, and reassess the outcomes. This cycle aligns with Polya's stages of problem solving, which also underpins the development of the instrument in this study. (N. Hidayati et al., 2019) demonstrated that Problem-Based Learning (PBL) cultivates a systematic thinking pattern through the integration of a scientific approach at every stage of the educational process. The research data clearly indicate that students in the experimental group exhibited superior improvement in answering contextual problems compared to the control group. Moreover, PBL facilitates students in connecting abstract concepts with their practical applications in real-world scenarios. In this context, (Minarni & Barus, 2023) discovered that Problem-Based Learning (PBL) enhances students' comprehension of mathematical topics through actual problem-solving, hence augmenting engagement and knowledge. Consistent with this, (Septiana & Ibrahim, 2020) underscored the significance of incorporating real-world situations in Project-Based Learning (PBL) to establish a systematic and organized problem-solving methodology. This study also demonstrates that students in the experimental group developed a more systematic solution method

and articulated their solutions with logical reasoning. PBL facilitates the internalization of reflective and directed thinking processes essential for cultivating problem-solving skills.

The results of this study align with prior research indicating that PBL is an effective pedagogical method for cultivating critical thinking and problem-solving abilities, essential competences for addressing 21st-century concerns (Suryaningtyas et al., 2020). Through the incorporation of real-world contexts, collaborative efforts, and inquiry-based learning, Project-Based Learning (PBL) enhances students' academic performance while simultaneously fostering reflective and strategic thinking skills vital for sustained success in both academic and professional realms (Asih et al., 2022; Narmaditya et al., 2018)

The integration of Problem-Based Learning (PBL) within educational curricula plays a crucial role in cultivating critical thinking and problem-solving skills in students. Research indicates that PBL fosters an active learning environment where students engage with real-world problems, thereby promoting deeper understanding and cognitive skills that align with school cultures centered around inquiry and collaboration (Dharma & Lestari, 2022; Worachak et al., 2023). For example, Samadun and Dwikoranto note that the application of the PBL model effectively enhances students' critical thinking abilities, particularly within the context of physics education, showcasing the model's versatility in bridging theoretical concepts with practical applications (Samadun & Dwikoranto, 2022). The emphasis on student-centered learning in PBL encourages an environment where questioning, reflection, and peer collaboration are normalized, resulting in comprehensive skill development that transcends rote memorization and passive learning.

The adaptability of the PBL approach is demonstrated across various subjects and educational levels, which aligns with diverse curricular goals aimed at preparing students for complex problem-solving scenarios in a rapidly changing world (T. Hidayati & Purwaningsih, 2023; Lestari & Wardani, 2022). Research by Hidayati and Purwaningsih illustrates that PBL not only enhances critical thinking skills in science but also supports the curriculum's objectives to nurture independent thinkers who can analyze and address multifaceted problems (N. Hidayati et al., 2019). Furthermore, as highlighted by Adnyani and Suniasih, the introduction of PBL fosters a culture of continuous inquiry and collaboration in classroom dynamics, thus reshaping conventional educational practices that may not fully engage students in meaningful learning experiences (Adnyani & Suniasih, 2023). This cultural shift within educational settings is paramount as it allows students to take ownership of their learning journeys while developing essential skills aligned with 21st-century educational demands, preparing them for both academic and real-life challenges (Muvid et al., 2022; Ningrum et al., 2021; Septiana & Ibrahim, 2020). Hence, the characteristics inherent to the PBL model not only enhance critical thinking and problem-solving skills but also significantly contribute to a curriculum and school culture that prioritizes active engagement and profound understanding. In summary, the intersection of PBL with curricular frameworks and school cultures significantly advances the development of critical thinking and

problem-solving skills in students. It serves as a transformative pedagogical approach that enriches educational outcomes and equips students with the necessary tools to thrive in a complex world.

Although this study employed a quasi-experimental design with comparable classes, several potential confounding variables may have influenced the outcomes. Student motivation, for instance, was not directly measured, yet it could significantly affect engagement levels and post-test performance—particularly in a student-centered approach like PBL. Similarly, differences in teacher teaching styles, classroom management strategies, or familiarity with active learning techniques may have introduced unintentional biases. While efforts were made to select instructors with similar teaching experience and subject background, qualitative differences in delivery methods or classroom rapport may have impacted the learning atmosphere. These factors, if unaccounted for, can partially mediate the observed effects of the intervention and should be considered in interpreting the results and in designing future research with tighter controls or mixed-methods approaches.

The findings of this study have direct implications for classroom learning practices, especially in encouraging teachers to apply the Problem-Based Learning (PBL) model as an effective strategy in developing students' critical thinking and problem-solving skills. Systematic implementation of PBL at the school level can be done through teacher training and strengthening teaching tools, given its potential in supporting the mastery of 21st-century competencies, such as collaboration, communication, and reflective thinking (Muvid et al., 2022; Septiana & Ibrahim, 2020). However, the generalization of these findings is limited by the scope of the study which only involved one school, limited intervention time, and the possibility of external variables such as differences in teacher teaching styles and student learning environments that were not fully controlled. Therefore, further studies are recommended to include a wider population and more diverse designs.

CONCLUSIONS

The study's results indicate that the implementation of the Problem-Based Learning (PBL) model greatly enhances the critical thinking and problem-solving capabilities of junior high school pupils. The experimental group exhibited a greater increase in scores than the control group, both statistically and practically. These findings confirm PBL's effectiveness as a relevant pedagogical strategy in promoting 21st-century competencies, particularly in contexts where active and reflective learning is underutilized. To support widespread implementation, schools should invest in targeted teacher training models that emphasize PBL facilitation techniques, classroom management for inquiry-based tasks, and strategies for guiding student collaboration. Adjustments to the academic calendar such as allocating time blocks for project cycles or interdisciplinary themes can also help integrate PBL more effectively into existing structures. Moreover, PBL holds promise not only for science or social studies, as studied here, but also for fostering student engagement and critical thinking in subjects like language arts, mathematics, and vocational education. Its adaptability makes it particularly suitable for rural or resource-limited schools, where learning can be grounded in local problems that resonate with students' daily experiences. Future research should explore these diverse contexts through expanded samples, longer



interventions, and mixed-method designs to capture both measurable outcomes and nuanced classroom dynamics.

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T.S.Q.: Writing the article and translating

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