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Promoting High-Order Thinking Skills through Problem-Based Learning: Design and Implementation

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Abstract

PBL (Problem-Based Learning) has significant importance in enhancing critical thinking, creative thinking, problem-solving, and promoting HOTS (Higher-Order Thinking Skills) and 21st-century skills. However, while there has been a lot of research on PBL, most of it has focused on the fields of medicine and physics, with few and often disorganized studies in the field of education, especially those using literature review methods. The purposes of this study are: (1) to classify and compare case studies on "Problem-Based Learning" and extract relevant conclusions, and (2) to summarize universally applicable "PBL" teaching strategies and provide recommendations. This review focuses on the specific implementation procedures of PBL teaching strategies over the past decade. The study finds that in teaching contexts such as group collaborative learning, role-playing, and STEAM (Science, Technology, Engineering, Arts, and Mathematics), problem-based teaching can effectively promote the development of students' critical thinking, creativity, problem-solving abilities, and other higher-order thinking skills. This research enriches the theoretical foundation of PBL operational procedures and provides important references for teaching practice.

Keywords: Group Collaboration, High Order Thinking, Problem-Based Learning, Student-Centered

Introduction

The importance of PBL teaching strategies for HOTS and 21st-century skills has prompted researchers to explore PBL teaching strategies. There have been two previous definitions of PBL. The first definition considers it a learner-centered teaching method, where learners can conduct research, integrate theory and practice, and apply knowledge and skills to develop feasible solutions for predetermined problems (Savery, 2015).They believe that higher-order thinking skills are cognitive skills based on analysis, evaluation, and synthesis as outlined in Bloom's Taxonomy. Critical thinking and logical thinking fall under "analysis," creative thinking and reflective thinking fall under "synthesis," and problem-solving skills and decision-making

fall under "evaluation" (Kim et al., 2018; Bloom, 1956). The second definition considers PBL a cognitive effort that encourages the activation of prior knowledge, understanding, and articulation of current knowledge in a group environment. This approach helps in comprehending new relevant information and enhancing long-term memory (Schmidt et al., 2011).In this study, PBL is a teaching strategy based on student-centered principles, falling under discovery teaching and non-directive teaching models. It promotes the development of students' higher-order thinking skills, such as problem-solving, critical thinking, and creativity, through teaching contexts like role play, group work, case-based teaching, induction and deduction, and STEAM. It also fosters the development of 21st-century skills.

The theoretical foundation of PBL is Vygotsky's constructivism (Boye & Agyei, 2023; Fitria et al., 2022).It emphasizes social interaction and collaboration, serving as a teaching strategy that promotes active learning (Vygotsky, 1986; Doolittle et al., 2023). It posits that teachers are not only the subject of learning but also guides for students' learning, rather than traditional curriculum lecturers (Fitria et al., 2022). This is distinct from Piaget's traditional constructivism (Piaget & Cook, 1952). Problem-Based Learning aids in fostering higher-order thinking skills such as creativity and critical thinking (Birgili, 2015; Loyens et al., 2023; Afikah et al., 2022; Apipah & Novaliyosi, 2023). It also helps in improving students' academic performance (Merritt et al., 2017).

HOTS originated from Bloom's Taxonomy of Educational Objectives, first published in 1956. In this taxonomy, Bloom categorized learning objectives into HOTS (Higher-Order Thinking Skills) and LOTS (Lower-Order Thinking Skills), where HOTS encompassed analysis, evaluation, and creation, while LOTS involved remembering, understanding, and applying (Bloom, 1956). Subsequently, researchers defined HOTS as the provision of analytical, critical, and creative methods to students . Many factors influence HOTS, such as learning motivation and the use of video as a learning resource (Lu et al., 2021; Kwangmuang et al., 2021). This study primarily investigates the impact of PBL on HOTS.

Although teachers purposefully and persistently practicing higher-order thinking strategies are beneficial for developing critical thinking skills (Miri et al., 2007), HOTS contribute to guiding teaching practices both in entirety and in part (Othman & Kassim, 2017). However, we cannot blindly employ higher-order thinking strategies, as the necessity for using higher-order thinking also depends on the nature of the task and students' knowledge history (Lewis & Smith, 1993).

Different researchers have various definitions of 21st-century skills. Some researchers point out that 21st-century skills (4C skills) include communication and collaboration skills, critical thinking skills, problem-solving skills, and creativity and innovation skills, while HOTS summarizes and encapsulates these skills (Yulıanto et al., 2019). Other researchers believe that 21st-century skills encompass critical thinking, problem-solving abilities, computer and technology skills, communication, and self-direction skills (Trilling & Fadel, 2012). Furthermore, some researchers suggest that the 4C skills in 21st-century learning are critical thinking, communication skills, collaboration skills, and creativity based on problem-solving learning. Despite the differing definitions among researchers, they all include problem-solving ability or problem-based learning. PBL teaching can meet the demands of 21st-century skills and is significant for developing them (Suwastin et al., 2021). In this study, researchers believe that: (1) 21st-century skills, or 4C skills, include communication and collaboration skills, critical thinking skills, problem-solving skills, and innovation skills; (2) PBL is not only beneficial for the development of HOTS but also belongs to one of the 21st-century skills.

Despite the introduction of PBL in the 1960s, school teachers lack understanding of HOTS, and most currently teach using LOTS. Relevant research is primarily concentrated in the medical field, with few studies in the field of education. In particular, studies employing literature review methods are scarce and the research conclusions are often inconsistent (Anggraeni et al., 2020; Rustam et al., 2022; Polyzois et al., 2010).The implementation of PBL (Problem-Based Learning) in education also faces numerous challenges and various complex obstacles (Tefera et al., 2024). For instance, decreased student engagement, poor support for the practice of critical self-reflection, and issues that hinder group functionality can negatively impact both the implementation process and the outcomes of PBL (Khoiriyah et al., 2015; Li et al., 2023). Some researchers believe that PBL, as a higher-order thinking teaching method, is becoming increasingly important in teaching practice due to the limitations of subject-based, teacher-centered curricula in education (Frost, 1996). However, other researchers hold a different view, arguing that the evidence for the effectiveness of PBL over traditional teaching methods is still inconclusive (Kulo & Cestone, 2023).Therefore, even though PBL holds significant importance, its role in education needs to be viewed dialectically. The relatively scarce research on PBL, the numerous debates surrounding it, and the many implementation obstacles have driven researchers to actively explore PBL and HOTS.

This review focuses on comparative research, examining and comparing specific implementation methods of the PBL teaching strategy in previous case studies. It aims to extract relevant conclusions, summarize the advantages and disadvantages, and strive to derive a universally applicable teaching model.

Search Parameters

Systematic Literature Review (SLR) is a well-known research method (Thomé et al., 2016).The literature sources for this study include electronic databases such as Google Scholar, Web of Science, Mendeley, CNKI, etc., encompassing academic journals, conference papers, books, etc. The key thematic terms are "PBL," "HOTS," and "21st-century skills," and the retrieval period spans from 2014 to 2024.

Selection Process

Two researchers from the education field were responsible for the literature selection and verification for this review, while one researcher from the computer field was responsible for data processing and coding (Hu Xiaoling et al., 2024).

In the first stage of literature screening, using the keywords "problem-based learning" AND "High order thinking," 592 open-access articles were retrieved. In the second stage, 21 articles not belonging to the period of 2014-2024 were excluded, leaving 571 articles. In the third stage, after preliminary screening of titles and abstracts, 417 irrelevant articles were removed, leaving 150 articles. In the fourth stage, after reading the full texts, 128 articles were further excluded. Finally, 22 articles were selected for this study. Duplicate citations were removed using the Zotero software.

To ensure the quality of the review, strict inclusion and exclusion criteria were applied throughout the literature selection process. Here is a summary of the inclusion and exclusion criteria for literature selection:

1. Inclusion Criteria:

(1) Published between 2014 and 2024.

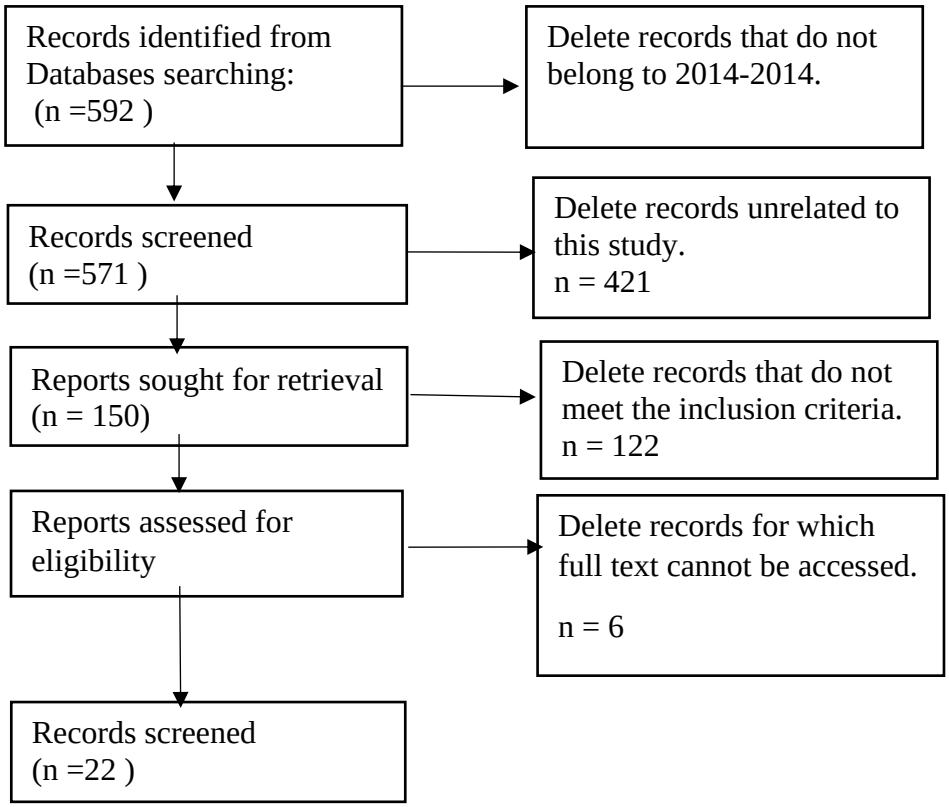
(2) Abstract includes "PBL & HOTS" or "PBL & 21st century skills" or "HOTS & 21st century skills."

(3) PBL is the main variable under study.
(4) Types of literature include journals, books, and conference papers.
(5) Literature is open-access and full-text is available.

2. Exclusion Criteria
(1) Articles not published between 2014 and 2024.
(2) PBL is not the main variable under study among several independent variables.
(3) Study conclusions are unrelated to PBL, HOTS, or 21st-century skills.
(4) Literature from non-authoritative sources.
(5) Literature is not open-access, and full-text is not available.

Table 1 of the PRISMA flowchart illustrates the literature selection process of this study (Zakaria et al., 2019; Haddaway et al., 2022).

Table 1
PRISMA Flow Diagram



The researcher analyzed the distribution of literature used for this study after strict screening. Table 2 shows the distribution of literature. From Table 2, it can be observed that studies related to Problem-Based Learning are mainly concentrated in the field of natural sciences, with the most studies conducted in the field of mathematics, and there are few literature studies related to PBL in the social sciences. In terms of research methods, most PBL studies are quantitative. Therefore, it is concluded that there are relatively few related studies on PBL in social science fields such as education and psychology, especially qualitative studies. In this study, the researcher adopted a qualitative research strategy and conducted a literature review to investigate the specific implementation of PBL teaching strategies in case-based teaching. The researcher categorized this study into three types using content analysis: (1)

the implementation of PBL in quantitative research; (2) the implementation of PBL in qualitative research; (3) the implementation of PBL in mixed research.

Table 2
Distribution of Literature on PBL Case Studies

Research Field	Application	N	Percentage
	Mathematics	6	26.1%
	Science	3	13%
	Physics	3	13%
	Computer Science	2	9%
	Education	2	9%
	Chemistry	1	9%
	STEAM Education	1	4%
	Geography	1	4%
	Engineering	1	4%
	Psychology	1	4%
	Medicine	1	4%
Research Method	Quantitative	13	59.1%
	Qualitative	7	32%
	Mixed	2	9%

Findings

1. Implementation of PBL Teaching Strategies in Quantitative Research

Table 3
Implementation of PBL Teaching Strategies in Quantitative Research

Sequence	Author	Source & Year	Method	Implementation	Outcome Measurement
1	Suhirman et al.	International Journal of Emerging Technologies in Learning(2020)	Single-factor independent group design; teachers conduct ten teaching sessions and compare the difference between pre-test and post-test.	Propose questions - Students independently and autonomously search for information to solve problems through role-playing, group cooperation, and discussions.	The PBL CE group showed significantly higher scores in Higher Order Thinking Skills compared to the PBL group, with no significant difference compared to

					the RL group.*
2	Prastiti	Bolema: Boletim de Educação Matemática (2020)	Cluster random sampling; covariance analysis (linear correlation, Kolmogorov-Smirnov, ANOVA) IV: Experimental group (PBL), control group (traditional learning methods, teachers, subject centers);DV: Problem-solving ability Control variables / covariates: Initial problem-solving ability;Tools: Initial (traditional), final (PBL) mathematics problem sets;Method: Two classes, eight different courses.	1. Explaining the importance of learning objectives and outcomes; 2. Guiding students to define and organize given mathematical problems; 3. Encouraging students to collect information and attempt problem-solving methods; 4. Forming groups and facilitating discussions; 5. Guiding reflection and evaluation of mathematical problems and solutions (Experimental class ≠ Traditional class: Teacher lectures, students listen).	Despite students facing difficulties in solving mathematical problems and lacking Higher Order Thinking Skills, research has found that Problem-Based Learning can enhance students' problem-solving abilities, thereby improving their Higher Order Thinking Skills.*
3	Suprapto and Basri	International Education Studies (2017）	Non-equivalent control group design; "KR20" for measuring reliability and validity; Kolmogorov-Smirnov test for normality > 0.05, Levene's test for	Pre-test for both groups, followed by post-test for both groups (2 classes, after eight sessions); Experimental group: PBL;	Post-test results revealed a significant difference between the two groups (P < 0.05), with the PBL group outperformi

			homogeneity > 0.05 (pre-test); descriptive analysis, t-test (P < 0.05).	Control group: Conventional learning.	ng the traditional group. The application of PBL can enhance Higher Order Thinking Skills and academic performance. PBL can also promote memory retention, teamwork, and motivation.
4	Lespita et al.	Jurnal Pendidikan Fisika (2023)	Experimental study; purposive sampling (1 class, 31 participants); Tools: Implementation form, pre-test, post-test, social science software package 20 (Cognitive Analysis Technique); Descriptive analysis, Kolmogorov-Smirnov normality test, N-Gain formula (g-value measuring pre-test, post-test values).	1. Pre-test: Provide "problems" to measure the initial level of Higher Order Thinking Skills. 2. Post-test	Using PBL with the assistance of Augmented Reality (AR) media, students showed a significant increase in Higher Order Thinking Skills scores from pre-test to post-test. However, the increase was relatively small.
5	Wijayanto et al.	Journal of Technology and Science Education(2023)	Quasi-experimental study; purposive sampling; 32 participants in	Students in the experimental group undergo problem-	There is a difference in HOTS between the experimental and control

			each experimental and control group; Normality test, Homogeneity test, t-test, simple linear regression, ANOVA.	based learning with pre-test and post-test assessments, while those in the control group receive conventional learning. Use N-gain to measure the growth of Higher Order Thinking Skills.	groups, with the experimental group showing better performance. PBL has a positively significant impact on HOTS.*
6	Sains	Jurnal Geliga Sains: Jurnal Pendidikan Fisika(2022)	Quasi-experimental study; Post-test only; Analyzed using SPSS.	1. Determine sample using purposive sampling. 2. Design learning tools. 3. Conduct learning activities. 4. Propose problems. 5. Observe. 6. Post-test. 7. Analyze using SPSS.	In high school physics teaching, PBL does not have a significant impact on Higher Order Thinking Skills(P > 0.05).
7	Soleh	International Journal of Instruction（2020）	Quasi-experimental; Both experimental and control groups use the same materials and undergo the same tests.	Pre-test - Post-test；SPSS analysis results (t-test, ANOVA, Normalized Gain)	Positive, significant difference.*
8	Tambunan	International electronic journal of mathematics education（2019）	Quasi-experimental study; Random sampling; Reliability testing using SPSS.	Non-equivalent pre-test post-test control group design	Positive impact
9	Wahyuningtyas, et al.	Jurnal IPA & Pembelajaran IPA(2023)	Quasi-experimental study; Non-equivalent control group	Pose questions (initial skills and knowledge) -	The experimental group of students using the

			with random sampling; HOTS assessment using multiple-choice questions covering 10 domains of indicators.	Pre-test - Receive treatment - Post-test - Pose questions (test final skills)	Problem-Based Learning model with the STEAM approach showed a significant increase in Higher Order Thinking Skills.*
10	Ramdiah	Jurnal Pendidikan Biologi Indonesia （2018）	Quasi-experimental study;Non-equivalent pre-test post-test control group design; Random sampling; ANOVA	1. Pre-test for both groups (to understand students' interests). 2. Use learning observation sheets to observe model teachers during the course. 3. Collect PBL data and present. 4. Post-test.	Problem-Based Learning has a positive impact on Higher Order Thinking Skills.
11	Wildan et al.	Acta Chimica Asiana	Quasi-experimental study; Pre-test, post-test; ANOVA	The syntax of PBL is as follows: 1. Problem identification 2. Organizing students 3. Guiding individual and group investigations 4. Formulating and presenting results 5. Analyzing and evaluating the PBL process and outcomes	1. PBL involves individual problem presentation followed by group discussion. 2. PBL can significantly enhance Higher Order Thinking Skills.

12	Darmayanti et al.	Journal of Educational Sciences （2021）	Quasi-experimental study; Pre-test, post-test;Experimental group, control group; N-Gain, descriptive analysis, MANOVA (to test hypotheses).	Pre-test (data collection) - Post-test (assessment of learning outcomes: 20 multiple-choice questions)	Applying mind mapping to PBL can enhance Higher Order Thinking Skills.*
13	Kim et al.	Educational Psychology Review(2018)	Meta-analysis	1. Databases: Education Resources Information Center (ERIC), PubMed, CiteSeer, Academic Search Premier, etc. 2.Literature inclusion criteria	Problem-Based Learning has a positive impact in STEAM education.

Significant Impact*

Table 3 summarizes the implementation methods and steps of Problem-Based Learning teaching strategies in quantitative research. From the results, it is evident that the implementation methods of PBL in quantitative research are mostly experimental studies, with specific steps as follows: (1) Sample selection: Independent and dependent variables are the experimental and control groups, respectively; (2) Testing steps: posing questions, pre-testing, application of PBL, post-testing; (3) Result analysis: descriptive or inferential analysis of the test results. Inferential analysis mainly includes calculations of Kolmogorov-Smirnov normal distribution, homogeneity test, ANOVA, and t-test. From the results in Table 3, it can be concluded that the implementation of PBL measured in quantitative studies has a positive impact on the development of higher-order thinking skills.

Implementation of PBL Teaching Strategies in Qualitative Research

Table 4
Implementation of PBL Teaching Strategies in Qualitative Research

Sequence	Author	Source and Year	Method	Implementation	Outcome Measurement
1	Siska & Fauzi	Jurnal Sains, Matematika dan Terapan(2023)	Library research (literature review); Qualitative study	Collecting library data, reading, recording, and processing research materials.	The Problem-Based Learning learning model can enhance problem-solving abilities.
2	Ismawati & Pertiwi	Indonesian Journal of Biology Education （2019）	Literature review	Collect and evaluate relevant articles, then compile the relevant information into an article.	The inclusion of social science issues and seeking solutions can enhance Higher Order Thinking Skills.
3	Abubakar& Arshad	Asian Social Science（2015）	Qualitative research with an interpretive design; teacher guidance; student-centered.	1. Select sample to participate in 6-week PBL course; 2. On-site observation and data collection through interviews; 3. Data analysis (transcription, triangulation analysis, content analysis)	Cooperative learning based on problem-solving promotes Higher Order Thinking Skills.
4	Prastiti et al.	Pancaran Pendidikan(2020)	Qualitative research	Searching, selecting, organizing, and analyzing theoretical literature	In Thailand, Malaysia, and Singapore, Problem-Based Learning promotes Higher Order Thinking Skills.
5	cholik Cholik et al.	Jurnal At-Tarbiyat: Jurnal Pendidikan Islam(2022)	Qualitative research; descriptive data analysis; measurement standards.	The study is divided into three stages, each consisting of planning (observation sheet), action (written:	Problem-Based Learning is correlated with critical thinking.

				observation results), observation (three observers recording all activities), and reflection (analyzing observation results to improve the next cycle), and this cycle repeats.	
6	Syahputra& Surya	Journal of Education and Practice （2014）	Questionnaire survey, interviews, pre-test/post-test; Developmental research; Teacher guidance for students; Group collaboration	1. Definition: Problem, group characteristics (prior knowledge, background, attitudes, cognitive development, etc.); 2. Design (e.g., mathematical books); 3. Development (verification and scientific design); 4. Dissemination (revision and implementation)	Through the structured steps of Problem-Based Learning, it can effectively promote problem-solving and the development of Higher Order Thinking Skills.
7	Fuaidah et al.	Jurnal Penelitian Pendidikan Sains(2020)	Survey, observation, interviews, literature review; Descriptive analysis	Interviewing 9th-grade middle school science teachers; Researching early literature	Support: Science learning requires problem-solving abilities to enhance Higher Order Thinking Skills.

Table 4 analyzed the implementation strategies of PBL in qualitative research, and the results showed that the common implementation strategies of PBL are in the form of interviews or literature reviews. The implementation steps of PBL interviews are as follows: (1) Research design: constructing research questions, determining samples, preparing observation forms and interview guides; (2) Classroom observation and recording, post-class interviews and recording; (3) Reviewing, analyzing, evaluating, and reapplying the results. The implementation steps of PBL literature review are: (1) Constructing research questions; (2)

Literature search, criteria formulation, and implementation of literature selection; (3) Literature summarization and coding; (4) Result analysis and reporting. The research conclusions extracted from all the literature reviewed unanimously acknowledge the mutual influence between PBL and HOTS.

Implementation of PBL Teaching Strategies in Mixed Research

Table 5
Implementation of PBL Teaching Strategies in Mixed Research

Sequence	Author	Source and Year	Method	Implementation	Outcome Measurement
1	Kusuma et al.	Jurnal Pendidikan MIPA(2022)	Mixed methods research; questionnaire survey; descriptive analysis	1. Preliminary analysis of the latest research results on Higher Order Thinking Skills through literature review; 2. Develop an electronic book for Problem-Based Learning; 3. Create a questionnaire using Google Forms and distribute it; 4. Analyze data using SPSS.	An interactive electronic book based on Problem-Based Learning has a positive impact on enhancing Higher Order Thinking Skills, but most teachers have not utilized HOTS.
2	Jailani et al.	Jurnal Riset Pendidikan Matematika（2017）	Mixed methods research; Inferential analysis of quantitative data using multivariate (MANOVA) and univariate (post-test) analyses, while qualitative data are analyzed descriptively following standard procedures.	1. Random sampling of 648 participants divided into two groups: experimental group (355 participants) and control group (293 participants). 2. Data collection: Students complete tests and self-assessment, while teachers complete questionnaires. 3. Analysis of results.	Problem-Based Learning can effectively enhance students' Higher Order Thinking Skills.

Significant Impact*

From Table 5, it can be observed that the application of PBL in mixed research has a promoting effect on higher-order thinking skills. Mixed research based on problem-based learning combines quantitative and qualitative research methods, with quantitative research conducted first followed by qualitative research analysis. This requires us to integrate the implementation strategies of both quantitative and qualitative research mentioned above and conduct more systematic and complex analysis of the data.

Results

Through the selection, summarization, and analysis of literature, we have come to understand that there is still a gap in research on PBL in the field of education, with PBL research mainly

concentrated in the natural sciences. Consistently across qualitative, quantitative, and mixed research, it has been found that PBL has a positive impact on higher-order thinking skills and 21st-century skills. Therefore, we can actively explore PBL teaching strategies in teaching practice. In this study, researchers summarized the PBL teaching strategies in qualitative, quantitative, and mixed research as follows:

Implementation steps of PBL in quantitative research:

1. Sample selection: Independent and dependent variables are assigned to the experimental and control groups, respectively.
2. Testing steps: Pose questions, pretest, implement PBL, post-test.
3. Result analysis: Descriptive or inferential analysis of test results.

Implementation steps of PBL in qualitative research:

Method 1:

1. Research design: Formulate research questions, determine samples, prepare observation and interview forms.
2. Classroom observation and recording, post-class interviews and recording.
3. Review, analyze, evaluate, and reapply results.

Method 2:

1. Formulate research questions.
2. Develop and implement criteria for literature search and selection.
3. Summarize and code literature.
4. Analyze and report results.

Implementation steps of PBL in mixed research: Combine the above steps from quantitative and qualitative research.

Discussion

This study summarizes qualitative, quantitative, and mixed-method research on the implementation of PBL teaching and uses the PRISMA flowchart for literature quality assessment. Mixed-method research designs integrate quantitative and qualitative data, producing better results than using a single method alone (Minc et al., 2022). This enhances the credibility and validity of the research findings. This study refutes the views that PBL teaching has negative impacts or that its effectiveness is inconclusive (Sains, 2022; Kulo & Cestone, 2023). This aligns with the consensus of the majority of researchers (Darmayanti et al., 2021; Wahyuningtyas et al., 2023; Syahputra & Surya, 2014).

This study, by summarizing and analyzing previous research, avoids duplication, identifies research gaps, and summarizes general teaching strategies. It enriches and extends the existing theories of PBL teaching strategies and develops new theories for the implementation of PBL teaching.

The universally applicable PBL teaching implementation model proposed in this study can be used as a tool for curriculum design, implementation, and collaborative innovation, providing important references for educational practice (Shimizu et al., 2021).

Specifically, the implementation of PBL teaching strategies is guided by teaching models such as role-playing, STEAM education, group collaboration, and inductive-deductive methods. Teaching through PBL helps deepen students' understanding and retention of knowledge, and promotes problem-solving. It also aids in developing students' teamwork skills and autonomous learning abilities, enhancing higher-order thinking skills such as critical thinking,

creativity, and problem-solving abilities. Additionally, it supports the development of educational practice (Prastiti, 2020; Syahputra & Surya, 2014; Wildan et al., 2021). However, PBL teaching strategies also face some challenges. They can potentially lead to time wastage, some students may develop negative emotions, and the assessment of PBL teaching is fraught with uncertainties.

However, PBL teaching strategies also face challenges, including the potential for time wastage, the possibility of negative emotions among some students, and uncertainties in PBL teaching evaluation.

This study has limitations as it involves analyzing and commenting on previous research results, and the selection of literature and conclusions may be subjective and should be treated with caution.

Future research suggestions:(1)Apply the general teaching strategies identified in this study to specific PBL teaching practices and evaluate their universal applicability.(2)Focus more on evaluating PBL teaching strategies and innovating a universally applicable teaching model.(3)Pay more attention to the impact of teaching strategies on Higher Order Thinking Skills.(4)Develop relevant technologies for PBL teaching to make it more systematic and scientific.

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