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Exploration of Constructivist Learning Models in Developing Critical Thinking Skills: A Systematic Literature Review

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ABSTRACT

Critical thinking is vital for academic and professional success in the 21st century. However, many students, particularly in Indonesia, face difficulties in developing higher-order thinking skills. This challenge necessitates effective instructional strategies that promote critical thinking in educational environments. This study employed a Systematic Literature Review (SLR) using the PRISMA protocol to identify and evaluate constructivist learning models that support critical thinking development. A total of 30 empirical studies published between 2015 and 2024 were selected through systematic identification, screening, and inclusion processes. Thematic analysis was conducted to extract insights on the implementation and effectiveness of five constructivist approaches: Problem-Based Learning (PBL), Project-Based Learning (PjBL), Inquiry-Based Learning (IBL), Collaborative Learning (CL), and Discovery Learning (DL). Findings indicate that all five models significantly enhance students' critical thinking skills. PBL and PjBL were the most frequently studied and demonstrated strong outcomes in problem-solving, analysis, and collaboration. IBL and DL promoted curiosity and autonomous learning, while CL was effective in fostering group discussion and collective problem-solving. Constructivist learning models offer substantial benefits in cultivating critical thinking. However, their effectiveness relies heavily on factors such as institutional support, teacher preparedness, and cultural context. Constructivist approaches are effective pedagogical tools for enhancing critical thinking. Future studies should further investigate model-specific challenges and explore their adaptation in varied educational contexts.

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1. INTRODUCTION

To thrive in today's fast-paced, 21st-century workplace and society, individuals must possess a balanced combination of soft skills and character traits. These include learning skills such as creativity, critical thinking, and communication; literacy skills like information literacy and media and digital competency; and life skills encompassing flexibility, initiative, social competence, productivity, and

leadership (Kennedy & Sundberg, 2020). These competencies are fundamental for successfully navigating the complexities of modern life (Chiva Long et al., 2024).

Among these, critical thinking stands out as a cornerstone of learning and innovation—key drivers of academic and professional achievement (Evans, 2020). It involves the mental discipline to analyze and evaluate information, communication, and arguments using logic and reasoning (Akpur, 2020). As a high-order cognitive function, critical thinking plays a vital role in logical reasoning, effective decision-making, and strategic problem-solving (Liu et al., 2024). Conversely, poor critical thinking skills often lead to flawed judgments and suboptimal outcomes (Pshembayeva et al., 2022).

Critical thinking is widely regarded as an essential skill in the 21st century and has been a concern in education for a long time (Akbar, 2023). In the last decade, education in Indonesia has undergone a significant transformation in learning orientation from a teacher-centred to a student-centred approach. This paradigmatic shift reflects the need to improve the quality of learning and students' global competitiveness (Tang, 2023). However, the PISA study 2022 showed that Indonesian students' abilities in analyzing information, complex problem-solving, and critical thinking were ranked 65th out of 81 countries (OECD, 2023). Similar findings were also seen in the TIMSS study in 2019; most Indonesian students had difficulty solving questions requiring complex analysis, applying theory in new situations and multi-step problem-solving (Mullis et al., 2020). This phenomenon illustrates that higher-order thinking skills remain a significant problem in Indonesian education.

Some empirical studies show that although learning approaches have been more student-focused, learning outcomes related to critical thinking have not been fully optimized. The study by Sari et al. (2021) shows that many students have not achieved optimization in critical thinking. Research by Sarwanto et al. (2021) states that internal factors from students' and teachers' learning approaches are the leading causes of low critical thinking skills. Setiawan et al. (2023) also confirmed that students' higher-order thinking skills are still in the low category, in line with previous findings. Wardani et al. (2024) added that the critical thinking skills score in conventional learning only reached 52.80%. Consistent findings in different periods indicate that this low critical thinking ability is an essential problem.

Constructivist theory is considered one of the potential approaches to improve students' thinking skills (Ghaedi et al., 2020). The main idea of constructivist theory is that meaningful knowledge and critical thinking are actively constructed, both cognitively, culturally, emotionally, and socially (Zajda, 2021). This process occurs through interaction with the environment and meaningful learning experiences (Murtazoevna, 2024). Constructivism-based learning involves active interaction between students, teachers, and other components (Saleem et al., 2021)

Constructivism-based learning models have shown their effectiveness in various studies in developed countries. Problem-based learning (PBL) leads students to think critically, solve problems, synthesize, and build understanding through unstructured problems (Dabbagh, 2019). Collaborative learning (CL) aims to develop students' cooperation, communication, and social responsibility skills(Qureshi et al., 2023). Inquiry-Based Learning (IBL) allows students to ask questions, formulate hypotheses, and conduct in-depth investigations, thus promoting the development of analytical and evaluative thinking (Chikaluma et al., 2022). Discovery learning (DL) shapes students into active thinkers and independent learners (Nusantari et al., 2021). Project-Based Learning (PJBL) effectively develops students' thinking abilities, social skills, and collaboration skills (Chen et al., 2022).

While numerous systematic literature reviews have examined constructivist learning models in educational settings, most tend to focus on a single approach—such as the effectiveness of Problem-Based Learning (PBL) or Inquiry-Based Learning (IBL). Comprehensive reviews that compare multiple models within the same framework remain limited. This gap highlights the need for a broader investigation that explores various constructivist models to uncover new, more relevant approaches aligned with the evolving needs of modern students.

This paper aims to: (1) identify constructivist learning models that effectively enhance students' critical thinking skills; (2) analyze how each model is implemented in the classroom and how it

supports the development of critical thinking; and (3) evaluate the strengths and limitations of each model within this context. By conducting a systematic literature review, this study seeks to provide deeper insights into the effectiveness and challenges of different constructivist learning models, and to offer evidence-based recommendations for improving educational practices that foster critical thinking among students.

2. METHODS

This research uses the *Systematic Literature Review* (SLR) method, a structured method for reviewing existing research evidence by systematically identifying, evaluating, and synthesizing all available studies on a particular topic (Tomczyk et al., 2024). The main objective of using SLR is to minimize potential bias, resulting in more accurate and reliable conclusions (Ofori-Boateng et al., 2024)

This SLR uses a structured approach based on the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) protocol to increase transparency and completeness of reporting in systematic reviews (Shaffril et al., 2021). Our protocol consists of three stages: *identification, screening, and inclusion*. It is briefly presented in Figure 1 as a PRISMA *Flow Diagram*.

2.1 Identification Stage

A systematic review begins with the literature identification stage, determining the focus, research questions, source types, source quality, search mechanisms, periods, and keywords. This review used a Scopus search to extract literature relevant to the field of study. Research articles published from 2015 to 2024 were retrieved for this review, written in English, and available with full open access. The keywords developed to review empirical research on our research focus were (TITLE-ABS-KEY *("Critical Thinking" AND ("Problem-Based Learning" OR "Inquiry-Based Learning" OR "Inquiry-Based Learning" OR "Project-Based Learning" OR "Collaborative Learning" OR "Discovery Learning")).* The keywords we used are combination keywords adjusted to the focus of our research, which is exploring constructivist learning models to develop critical thinking skills. Based on the literature search on November 04, 2024, we found 336 papers.

2.2 Screening Stage

The literature screening process in this SLR followed the inclusion and exclusion criteria, which was done in two steps, namely;

Step one: We applied filters to find articles that matched the research focus. We limited the subject areas to social sciences and education. Document type and source were limited to journal articles; papers published in non-journal academic forms, such as editorials, book reviews, or short reports, were also excluded as they did not meet the scientific research standards required for this review. After applying this filter, we found 162 articles.

Step two: From the 162 articles that passed the initial screening stage, we conducted further screening by reviewing the titles and abstracts. The selected articles addressed constructivist learning models in the context of developing learners' critical thinking skills at secondary and higher education levels in social science studies. We limited empirical research to experimental methods, so theoretical studies, systematic reviews, meta-analyses, and developmental studies were excluded from our review. Articles not supported by empirical data or did not focus on constructivist learning models were also excluded due to their incompatibility with the research questions, resulting in only 58 articles being included in the next stage.

The next step after the screening stage is the *full-text* evaluation or eligibility testing stage, *where* the analysis is conducted in-depth through a thorough reading to ensure that the article meets the inclusion criteria. Experimental research must clearly state the experimental design. Articles will be excluded from this review if they do not explicitly include measurement or discussion of developing critical thinking skills. With the elimination of the full text of the articles, we decided on 30 articles to include in the systematic review.

2.3 Included Stage

Based on the PRISMA protocol, the *included* stage in the *Systematic Literature Review* (SLR) process involved the final selection of articles that met the inclusion criteria after a rigorous screening stage. Of the total articles screened, 30 were selected and deemed relevant for further analysis. These articles underwent an in-depth evaluation, including examination of the title, abstract, and full content, to ensure they met the research objectives and methodological criteria. This stage marked the end of the selection process and the beginning of systematic data analysis.

Data analysis techniques on the selected articles used a thematic approach to identify the main patterns relevant to the research. This analysis focused on three main aspects, namely identifying the type of constructivist learning model used, identifying the syntax of the application and the role of educators and learners in the classroom of each model, and comparing the effectiveness or implementation of these models in developing critical thinking. The results of the thematic analysis are presented in the form of descriptive narratives that describe the main findings of the reviewed literature, thus providing a comprehensive understanding of constructivist learning models to develop critical thinking.

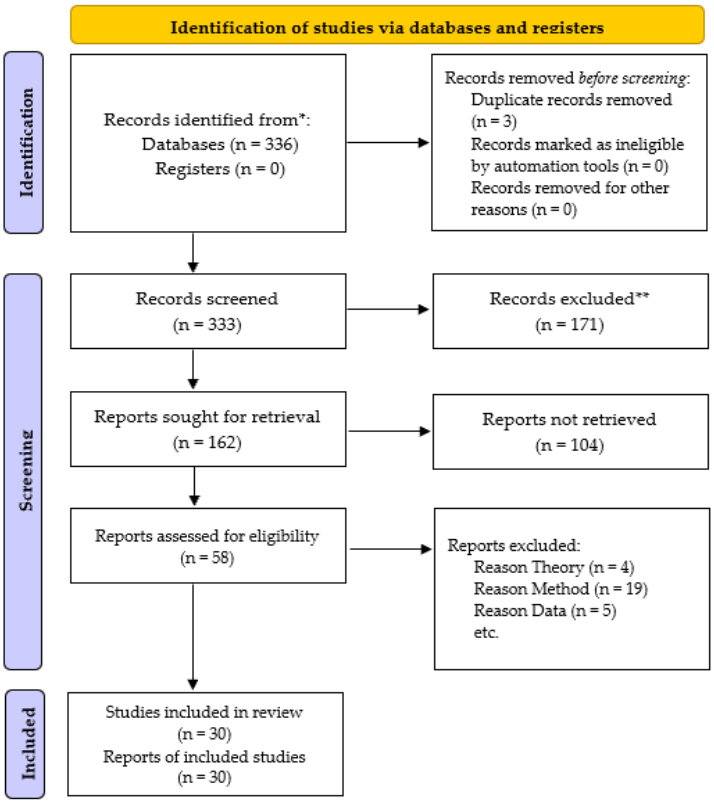

Figure 1. PRISMA Flow Diagram
Source: (Haddaway et al., 2022)

3. FINDINGS AND DISCUSSION

Table 1 lists all 30 articles reviewed in this study. It shows that Problem-Based Learning (PBL) and Project-Based Learning (PjBL) are the most commonly studied models, with the majority of studies focusing on these approaches. The research employs a quasi-experimental design in most cases.

The research questions formulated in this review are;

RQ1. How is each constructivist learning model implemented in the classroom?

RQ2. What are the advantages and disadvantages of each constructivist learning model in the context of critical thinking?

Table 1. Articles included in the review (n 30)

Author (Year)	Research method	Model studied	Main findings
Ding, (2016)	Quasi-experimental design	*Problem-Based Learning (PBL)*	PBL improved all critical thinking subscales, the most in Independent Inquiry
Carbogim, et al., (2017)	Quasi-experimental design		The intervention group showed more improvement in critical thinking skills
Kumar, (2017)	Quasi-experimental design		PBL improves learners' critical thinking skills in writing: Audience, purpose, content, support, unity, and coherence.
Saputra et al. (2019)	Pre-experimental design		There is a significant increase in students' critical thinking skills after applying the critical thinking model.
Yusuf et al., (2020)	Quasi-experimental design		PBL with LBK media improved critical thinking in the experimental group.
Saputro et al., (2020)	Quasi-experimental design		PBL is more effective in improving self-efficacy and critical thinking
Silviarza et al., (2020)	Quasi-experimental design		There was an increase in critical thinking skills in the experimental class.
Amin et al., (2020)	Quasi-experimental design		The experimental group showed a higher score increase in critical thinking.
Suryanti & Nurhuda, (2021)	Quasi-experimental design		PBL with an assessment rubric has the potential to improve critical thinking
Hursen, (2021)	Experimental design		Web 2.0-based PBL improved critical thinking more than the control group.
Orhan, (2024)	Quasi-experimental design		Online and face-to-face PBL showed equal effectiveness in improving critical thinking skills.
Sasson et al., (2018)	Experimental-based educational effectiveness research (EER)	*Project-Based Learning (PjBL)*	The innovative PjBL class improved critical thinking more after two years than the traditional class.
Adekantari, (2020)	Quasi-experimental design		The Instagram-assisted PjBL model improved focus, reasoning, conclusions, situation, and clarity in critical thinking.
Sari & Prasetyo, (2021)	Experimental design		PjBL increased critical thinking skills by 19%. Learners agreed that it helped develop critical thinking.
Cortázar et al., (2021)	Quasi-experimental design		PjBL in the experimental group improves argumentation, analysis, and evaluation through social regulation scaffolding.
Listiqowati & Ruja, (2022)	Quasi-experimental design		The PjBFC model is more effective in improving critical thinking skills than traditional PjBL.
Witarsa & Muhammad, (2023)	Quasi-experimental design		At all ability levels, PjBL improved critical analysis, problem-solving, and critical thinking.
Hao, L. et al., (2024)	Quasi-experimental design		PjBL flipped classroom was more effective than traditional learning in improving critical thinking.
Dias-Oliveira et al., (2024)	Quasi-experimental design		The experimental group showed increased critical thinking skills, especially in defining problems and induction ability.

Author (Year)	Research method	Model studied	Main findings
Arsal, (2017)	Quasi-experimental design	Inquiry-Based Learning (IBL)	There was no significant difference in critical thinking disposition. The experimental group showed a slight improvement.
Irwanto et al., (2018)	Quasi-experimental design		POGIL improved critical thinking and problem-solving skills over traditional lectures
Wale & Bishaw, (2020)	Quasi-experimental design		Inquiry-based learning improved critical thinking's interpretation, analysis, evaluation, and self-regulation.
Adnan et al., (2021)	Pre-experimental design		The research showed a "moderate" improvement in the cognitive and critical thinking skills of students after the lesson,
Dewi, et al., (2021)	Experimental design		IBL improved critical thinking, especially for convergent learning styles
Huang et al., (2017)	Experimental design	Collaborative Learning (CL)	The PBCL model improved critical thinking skills, especially in the low initial ability group.
Warsah et al., (2021)	Quasi-experimental design		The experimental group showed increased critical thinking, analysis, argumentation, and problem-solving skills.
Kurniawan & Indrawati, (2024)	Quasi-experimental design		The experimental group showed improved writing skills, creativity, and argument development.
Akihary et al., (2023)	Pseudo-experimental	Discovery Learning (DL)	YouTube-assisted learning improved cognitive and critical thinking skills
Mardi et al. (2021)	Experimental design		GDL+PBL showed improvement in critical thinking skills.
Pramusinta et al., (2019)	Quasi-experimental design		DL improved critical thinking and metacognitive skills more than discussion in field-independent learners.

Source: Authors' elaboration, 2024

The articles discussed in this review come from various countries that have diverse backgrounds and approaches related to the application of constructivist learning models,

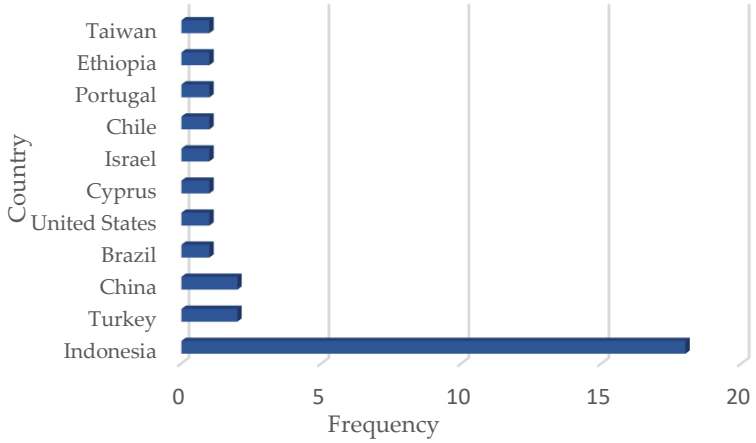

Figure 2. Frequency of Documents by Country

Source: Author's elaboration, 2025

Figure 2 shows that most of the research originates from Indonesia. This reflects the urgent need to improve higher-order thinking skills among students, as reflected by the results of international surveys such as PISA, which ranked Indonesia low in critical thinking and problem-solving (OECD,

2023). Constructivist approaches, which emphasize active engagement and problem-solving-based learning, are relevant to address this challenge.

The geographical variations reflect the constructivist model's ability to adapt to various cultural contexts. In developing countries such as Indonesia, China, and Brazil, the model helps shift the learning paradigm from teacher-centered to student-centered. In developed countries such as the United States and Portugal, the focus is more on implementation enhancements, such as technology integration and 21st-century skills-based curriculum. Cultural appropriation is key, especially in countries with hierarchical education systems, such as Asia, requiring modifications to fit local values without compromising their effectiveness.

The distribution of this research confirms the global relevance of constructivist models in improving the quality of education. The model is a reform tool in developing countries to improve students' skills. In contrast, in developed countries, although well-established, its relevance is maintained to maintain and improve the quality of learning. With proper adaptation, the model can support the development of critical thinking in various cultural contexts, making it a flexible and relevant educational strategy.

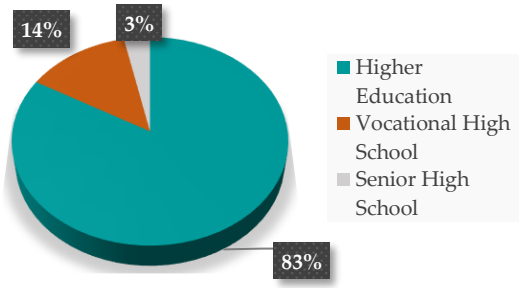

Figure 3. Frequency of Documents by Level of Education
Source: Author's elaboration, 2025

As shown in Figure 3, most articles were from higher education, reflecting that constructivist models are more widely explored in environments with greater access to research resources, such as faculty, facilities and policies. This model's adoption level is strongly influenced by educational progress and country conditions. Developed countries, such as America, with innovation-based education systems and adequate budgetary support, are better equipped to implement constructivist approaches effectively. In contrast, developing countries often face barriers, especially in secondary and vocational schools, due to limited budgets, infrastructure and teacher training.

The adaptability of this model also depends on the type of institution. The constructivist model is better implemented in higher education through project-based research and critical discussions. Although teacher training is lacking, the model can be adapted in secondary schools through collaborative approaches and case studies. In vocational schools, project-based approaches relevant to the world of work have great potential but require synergy between education, industry, and government to succeed.

Overall, constructivist models are highly relevant in developing critical thinking at various levels of education. Their successful implementation depends on institutional readiness, government policy support, and human resource capacity. Developed countries have a greater opportunity to implement them optimally, while developing countries must build an ecosystem supporting this learning innovation.

3.1 Problem-Based Learning (PBL)

PBL is an effective model for developing critical thinking skills by engaging students directly in solving real-world problems. Research consistently shows that PBL enhances critical thinking, particularly in analysis, evaluation, and decision-making. It broadens students' knowledge and fosters their ability to think independently and seek solutions critically. Furthermore, PBL encourages

collaboration, improves communication, and develops 21st-century skills such as creativity and technology use (Carbogim et al., 2017; Ding, 2016).

The PBL process generally follows a similar structure across studies, including stages like problem presentation, group discussion, information gathering, problem analysis, solution development, and presentation of results. Some studies also incorporate self-reflection and evaluation. Teachers act as facilitators, guiding the learning process, promoting discussions, and providing constructive feedback, while students actively engage in problem identification, information search, solution formulation, and presentation, which promotes their critical, analytical, and communication skills.

Despite its effectiveness, PBL faces challenges, including longer implementation times than traditional methods (Kumar, 2017). To address this, PBL can be organized into more miniature stages to maximize time efficiency. Additionally, PBL requires both students and teachers to be prepared for complex procedures (Saputro et al., 2020), and training and clear guidelines can mitigate this issue. Technology access can also be a barrier (Silviarza et al., 2020), but schools can use simple tools to support collaboration and provide necessary training. Lastly, some students may struggle with unfamiliarity with PBL, but providing relevant case studies and early mentoring can help build their confidence (Orhan, 2024).

3.2 Project-Based Learning (PjBL)

PjBL involves students working in teams to solve real-world problems, fostering the development of critical thinking skills by encouraging creative and practical solutions (Hussein, 2021; Maryati et al., 2022). Studies consistently show improvements in critical analysis, argumentation, problem-solving, and evaluation, with experimental groups showing better post-test results. This learning model also enhances students' ability to make decisions and work independently.

Students begin by selecting a relevant project, planning, goal-setting, and data collection. They then analyze and produce a project, culminating in a presentation and evaluation. Although some variations exist, the process typically includes individual and group reflections. Educators act as facilitators, guiding students through the process, ensuring the project runs smoothly, and providing feedback without being the primary source of information (Chimwayange, 2024). Students actively participate at each stage, from project selection to final presentation, strongly emphasizing collaboration, independent research, and skill development (Lalujan & Pranjol, 2024).

PjBL strengthens collaboration, enhances motivation, and provides meaningful, contextualized learning experiences (Adekantari, 2020; Sari & Prasetyo, 2021). The main challenges in PjBL include more teacher training, time constraints, and limited access to technology (Hao et al., 2024; Listiqowati & Ruja, 2022). Solutions to these issues include focusing on project management skills, using simple tools that support collaboration, and working with small groups for more efficient time management and supervision (Dias-Oliveira et al., 2024).

3.3 Inquiry-Based Learning (IBL)

Inquiry-based learning (IBL) follows the constructivist philosophy, where knowledge is actively constructed through individual and collaborative experiences. The model improves critical thinking by promoting skills like interpretation, analysis, evaluation, and problem-solving (Sam, 2024). Research consistently shows that IBL enhances students' critical thinking, especially when they engage in active, participatory learning experiences.

The IBL process typically begins with a problem that sparks curiosity, followed by exploration, data collection, collaboration to uncover new concepts, and revision of understanding. At the final stage, students evaluate and conclude. While some variations exist, the core elements of IBL remain consistent across studies. Educators in IBL act as facilitators, guiding students through the discovery process, providing feedback, and ensuring the smooth execution of projects (Huang et al., 2024). Students actively formulate hypotheses, collect and analyze data, and reflect on their findings (Carracedo, 2025).

IBL enhances critical thinking by encouraging active learning, independent knowledge building, and scientific inquiry. It fosters collaboration and strengthens the connection between theory and practice (Irwanto et al., 2018; Wale & Bishaw, 2020). However, IBL can be less effective for students who lack supporting skills, are unmotivated, or have low learning independence (Arsal, 2017; Dewi et al., 2021). To overcome these challenges, it is essential to provide adequate mentorship, plan time efficiently, and offer initial support to students.

3.4 Collaborative Learning (CL)

Collaborative Learning (CL) focuses on cooperation between students to share knowledge, address social issues, and develop innovative solutions (Hidayah et al., 2024). This model effectively improves critical thinking, especially in groups with low initial ability, by promoting analysis, argumentation, problem-solving, and evaluation skills. CL also enhances writing skills, such as idea organization and argument development (Kasimovna, 2024).

The typical CL process includes problem identification, data collection, analysis, task preparation, and group discussions, where students collaborate to solve problems and reflect on their learning (Mudrikah et al., 2024). Teachers play a crucial role as facilitators, guiding group discussions, ensuring smooth interactions, and providing feedback to help students improve their work. In CL, students actively engage in discussions, share ideas, and solve problems while learning from each other and developing independence (Ghavifekr, 2020).

CL strengthens 21st-century skills such as communication, creativity, and digital literacy (Kurniawan & Indrawati, 2024). However, CL can be time-consuming and relies heavily on student participation, which may be challenging for some. To address this, structured discussions and small group practices help build confidence. Additionally, a more concrete, case-based approach can aid students who struggle to engage in critical thinking (Huang et al., 2017; Warsah et al., 2021).

3.5 Discovery Learning (DL)

The Discovery Learning (DL) model encourages active and independent learning by engaging students in exploring and discovering concepts (Niman et al., 2024). This approach fosters critical thinking by enhancing students' rational reasoning, analytical, and reflective abilities. Research indicates that combining DL with technology or active learning strategies significantly improves cognitive learning outcomes and critical thinking.

The DL process begins by stimulating curiosity, followed by problem identification, data collection, verification, and conclusion. Teachers act as facilitators, guiding students in data analysis and ensuring the accuracy of their findings. Students are responsible for conducting research, participating in group discussions, and reflecting on their learning (Inde et al., 2020).

Effective in improving critical thinking, independence, creativity, and metacognitive skills, the DL model also faces challenges such as dependence on technology, limited internet access, and the need for less directive guidance from teachers (Akihary et al., 2023; Mardi et al., 2021). Solutions include training teachers to use simpler technology, adopting more flexible learning approaches, and providing targeted support for students with structured cognitive styles.

4. CONCLUSION

This research shows that the five constructivist learning models, namely Problem-Based Learning (PBL), Project-Based Learning (PjBL), Inquiry-Based Learning (IBL), Collaborative Learning (CL), and Discovery Learning (DL), have significant contributions to developing students' critical thinking skills. Each model has unique characteristics that can be adapted to the learning needs and implementation context. PBL effectively hones critical thinking skills through a collaborative real-world problem-solving approach, while PjBL encourages relevant and meaningful project-based learning. IBL fosters curiosity and critical analysis, CL maximizes group social interaction to share ideas, and DL allows students to learn independently with hands-on discovery.

The successful implementation of each model is highly dependent on institutional support, teacher readiness, and the socio-cultural context. With proper adaptation, these models can be relevant strategies to improve the quality of education at various levels and countries. Further research is needed to explore each model's potential and overcome its limitations in developing critical thinking.

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