Jurnal Pendidikan Ekonomi
DOI 10.17977/UM014v18i1p001

Research Article

Effectiveness of Implementing Problem-Based Learning to Improve Critical Thinking Skills

Veri Aryanto Sopiansah*, Yudho Ramafrizal
Faculty of Teacher Training and Education, Pasundan University, Bandung
*Corresponding email: veriaryanto@unpas.ac.id

Abstract
The realization of a quality society is not sufficiently responsible for the world of education, especially in preparing participants to become increasingly hot topics playing a role in showing their strong, creative, independent and professional excellence in their respective fields. The purpose of this study is to determine the effectiveness of the application of problem-based learning in the course of improving critical thinking skills in social studies subjects. This study uses a type of experimental learning with a quantitative approach. The method used in this study is pre-experiment with a learning design, namely one-shot case study. The sample used in this study was determined by using the purposive sampling method, namely 17 students in grade VIII. In-depth data collection in this study uses test instruments, namely pre-test and post-test which are then analyzed using the N-gain score test. The results of the analysis show that the N-gain score (%) = 60.88 so that it can be concluded that the application of problem-based learning is quite effective in improving critical thinking skills in social studies subjects, placing participants in an active position as problem solvers, encouraging them to analyze, evaluate, and synthesize information. This condition provides an opportunity for students to develop critical thinking skills which are much needed in this era of globalization.

Keywords: problem-based learning, critical thinking, learning effectiveness

INTRODUCTION

21st century education requires students to have critical thinking skills as one of the essential competencies needed to face global challenges (Trilling, 2009). Critical thinking includes the ability to analyze, evaluate, and solve problems logically and rationally (Ennis, 2011). Fisher (2011) explained that although critical thinking is a valued outcome of education, assessments often reveal that students exhibit limited proficiency in analyzing and evaluating information critically. This can be caused by a learning approach that tends to focus on memorizing material rather than developing high-level thinking skills. Basically, the most important ability for students to have is high-level thinking skills including critical thinking skills (Facione, 2011) emphasizes that critical thinking is the most important skill in the context of 21st century learning. This skill includes the ability to analyze, evaluate, and synthesize information logically, which is very much needed to face challenges in the era of globalization and digitalization.

Critical thinking is one of the key skills that students must have in this modern era. This ability allows students to analyze information in depth, make the right decisions, and solve problems effectively. Some experts emphasize that critical thinking is not only

Received: 10 September 2024; Revised: 01 December 2024; Accepted: 13 January 2025

important for learning in school but also in everyday life, especially in facing complex challenges in the global world (Walter, 2024; Rivas et al., 2022). Facione (1990) defines critical thinking as "a purposeful process involving self-assessment, resulting in logical interpretation, analysis, evaluation, and conclusions." The aforementioned study emphasized that critical thinking enables students to evaluate information carefully and deeply, so that they can make decisions based on strong and relevant reasons. Paul (2007) argued that critical thinking is the ability to improve the quality of thinking through continuous analysis, evaluation, and improvement. They state that students who have critical thinking skills will be better prepared to face academic and everyday life challenges. Brookfield (2017) stated that critical thinking is the key to empowering students, because they can identify assumptions, produce evidence, and formulate innovative solutions.

In addition, research conducted by Facione (2011) showed that one of the reasons for low critical thinking skills is that the education system focuses too much on memorizing facts rather than analyzing and evaluating information. Students are often trained to memorize materials without understanding the nature and context that hinders the development of their critical thinking (Sarwari & Kakar, 2023). This condition is exacerbated by the lack of opportunities for students to discuss, debate, or question the material being taught. In a passive learning environment, students are not given space to develop their critical thinking skills optimally (Paul, 2007).

So far, global challenges such as climate change, health crises, and social inequality increasingly show the urgency of mastering critical thinking skills. To deal with these complex problems, individuals must be able to analyze data, evaluate various arguments, and formulate appropriate and effective solutions. Research by Brookfield (2017) underlines that critical thinking skills are not only important in the context of education, but also in the world of work, where modern industries demand workers who are able to solve problems and innovate based on in-depth analysis.

Critical thinking skills are a person's ability to analyze ideas or drafts in a certain way logically, reflectively, systematically, and productively. To help create, evaluate, and make decisions about what is believed or will be done so that it is successful in solving a current and future problems faced. The importance of critical thinking skills is also expressed in (National, 2013) on the implementation of the curriculum stating that student abilities are needed for future competencies closing the ability to communicate, think critically and creatively by considering the values and morals of *Pancasila* to become democratic and responsible citizens, tolerant of diversity, capable of life in a global society, have broad interests in life and job readiness, intelligence according to talents/interests, and concern for the environment. The curriculum must be able to answer the challenges of the word. Teachers as organizers of learning in the classroom have the task. To help develop students' critical thinking skills. This condition is in line with what happened in the subject of economics. Based on the results of observations in economics learning, students look passive and less enthusiastic in participating in learning. When the teacher explains the material, most of the students are just silent and busy with their own business. Students also look relaxed and do not try to think when the teacher asks questions related to the learning material. The results of the observations made show that students' critical thinking skills during the learning process remain low.

Students are not sufficiently involved in the learning process, learning is dominated by teachers, minimal use of interesting learning media, monotonous learning methods, teachers have not utilized the environment as an interesting media and learning

resource or only use textbooks as a learning resource (Rahmawati, 2016). This condition has an impact on the lack of development of students' thinking skills, especially critical thinking skills. This can cause students to have difficulty in solving the problems they face. Observing the conditions said, then need to quickly find a solution to solve the problem said.

In the problem-based learning, the teacher presents a problematic situation to students and asks them to investigate and determine their own solutions (Alreshidi & Lally, 2024; Sutarto et al., 2022). Therefore, students are encouraged to be more actively involved in learning materials and develop critical thinking skills, in the Problem-based learning model, students are guided to solve, analyze, and evaluate a problem. Students will be directly involved in the effort to detail the problem by using thinking skills, experiences, and concepts that will be found in solving the problems presented. In addition, students are trained to try to think critically and are able to develop their analytical skills and become independent learners (Ennis, 2011).

Problem-based learning has a strong relevance to the development of critical thinking skills. In problem-based learning, students are faced with real problems that require solving, which encourages them to think analytically and evaluate information in depth. According to Nicholus et al. (2023), problem-based learning emphasizes an active learning process in which students act as problem solvers and not just recipients of information. This triggers students to identify problems, search for relevant information, evaluate solutions, and make informed decisions based on evidence and logical arguments (Savery, 2001) This relevance is supported by research showing that problem-based learning is effective in improving critical thinking skills. Hmelo-Silver (2006) stated that problem-based learning requires students to continuously analyze and synthesize information, and justify their solution choices. This process is very much in line with critical thinking components such as identifying assumptions, assessing the validity of information, and drawing conclusions based on data analysis (Ennis, 2011). This research focuses on the effect of implementing problem-based learning on students' critical thinking skills. Many previous studies on problem-based learning have been conducted in higher education settings, such as health (e.g., Sistermans, 2020), engineering (e.g., Boelt et al., 2022), or teacher education programs (e.g., Bosica et al., 2021).

According to Barrows and Tamblyn (1980), who are pioneers in the development of problem-based learning, this learning model is based on constructivist learning theory, which states that learners construct knowledge actively rather than passively receiving information. In problem-based learning, students are presented with problems that do not have clear and proven solutions that have been previously determined, requiring them to analyze the problem, generate hypotheses, gather information, and synthesize their findings in a collaborative manner. This process mirrors the details of real-life problems, encouraging better understanding and retention of knowledge. Hmelo-Silver (2004) emphasized that problem-based learning promotes metacognitive awareness, critical thinking, and the ability to apply knowledge in diverse contexts. By engaging in problem-solving tasks, students learn how to learn, developing skills such as information collection, hypothesis formulation, and critical analysis. problem-based learning also enhances long-term knowledge retention by facilitating meaningful learning experiences that connect new information to prior knowledge. Schmidt (2011) further go on to argue that problem-based learning facilitates the development of self-organized learning skills, which are essential for lifelong learning. In a problem-based learning environment,

students take responsibility for their own learning, set goals, monitor their progress, and adjust their strategies accordingly based on feedback, which helps them become more self-directed learners.

This research focuses on secondary education, to see how problem-based learning can be applied to different age groups. Research on problem-based learning has primarily emphasized broad educational benefits such as increased motivation and content mastery, rather than its potential role in fostering critical thinking (Hmelo-Silver, 2004). This research specifically highlights critical thinking skills, which include analysis, evaluation, and synthesis of information, as the main indicator of successful problem-based learning implementation. While the literature on problem-based learning is extensive, much of it focuses on its general effectiveness, with fewer studies examining its impact on specific cognitive outcomes, such as critical thinking dimensions (Dolmans, 2005). This research makes a new contribution by exploring the mechanisms by which problem-based learning encourages the development of critical thinking, as well as identifying obstacles or supporting factors in its implementation.

In addition, problem-based learning also provides opportunities for students to work in groups, allowing them to discuss, exchange ideas, and question each other's points of view. This interaction encourages critical thinking, because students must evaluate the opinions of others and build stronger arguments based on the discussions they have had (Halpern, 1998). This states that critical thinking involves the ability to analyze various information and points of view logically and objectively. It emphasizes that critical thinking includes a thorough evaluation of arguments and evidence before drawing conclusions. Thus, problem-based learning not only focuses on problem solving, but also directly trains students in developing critical thinking skills through problem exploration, collaboration, and reflective decision making. This makes problem-based learning a very relevant learning method to improve critical thinking skills in various educational contexts (Razak et al., 2022). Based on the background back to above, the purpose of this study is to know the effectiveness of the application of the problem-based learning model in improving critical thinking skills for economics courses. The benefits of this learning outcome, in addition to being able to provide information about the effectiveness of the application of the Problem-based learning model in improving critical thinking skills for economics courses, can also be used as a reference or see in doing similar learning in the future.

METHOD

This research was conducted in the odd semester of the 2022/2023 academic year. The selected participants were students who actively attended learning classes, so not all participants in the selected classes were involved in this study, this research itself was conducted outside of school hours and was not related to official school learning activities. The participants in this study were 34 students in class VIII, the reason being that class VIII students were assumed to answer critical questions and have adequate thinking skills to be used as research subjects. Class VIII students should have adequate critical thinking skills so that they can be used as research participants. The method used in this study is the experimental learning method. This study uses quasi-experimental as the method used. The research design used in the study is a one-shot case study design where there is no comparison group. The type of one-shot case study is intended to show the strength of measurement and scientific value of a research design.

The learning instrument is in the form of a test written in the form of descriptive questions combined with learning indicators on the material on economic actors and their roles. To measure students' critical thinking skills in the subject of economics on the material of economic actors and their roles, a critical thinking ability test was created consisting of 5 descriptive questions where each question has a critical thinking indicator and uses operational verbs C4-C6 which are high-level thinking skills. The analysis of the instrument used is the average of the total number of correct answers of students, the data produced is interval data so that the analysis uses parametric with N-Gain Score.

Measuring critical thinking skills requires valid and reliable instruments, which are generally adopted from theories or models that have been developed by experts. One of the models that is often used is the one adopted from Ennis (2011) and Facione (2011). Both of these models provide indicator guidelines that can be used to assess students' critical thinking skills. The critical thinking model and Indicators were developed from the Ennis model. Ennis (2011) defines critical thinking as rational and reflective thinking that focuses on making decisions about what to believe or do. The indicators used in the questions include analyzing, evaluating, making conclusions, clarifying, and arranging strategies. Furthermore, this indicator is used as a model for the critical thinking assessment rubric. The instruments used are essay tests or case studies where students are given situations or problems of economic actors and their roles, then asked to analyze, evaluate, and provide solutions with logical reasons.

In this study, the group observed or given a new posttest after being given treatment is learning with indicators of producers, consumers and distributors. This design involves One group (X) in a particular treatment which will then be continued with observation and measurement (O). Normalized gain or N-gain score goal to know the effectiveness of using a method or treatment is sure in the research design pretest posttest one group (one group pretest posttest design) experiment or pre-experimental design) or learning using a control group (quasi-experiment) or actual experiment). The N-gain score test is carried out by calculating the difference between the pretest score (test) before the implementation of a particular method/treatment) with the posttest score.

In terms of the procedure, this study uses one class by giving a pretest with five questions, then providing treatment, namely problem-based learning where researchers apply problem-based learning observed by teachers at this school so as not to deviate from the problem-based learning steps, then provide a posttest. Pretest and Posttest in the form of essay questions related to critical thinking skills in economic subjects about economic actors and their roles, both types of questions have the same material with the same level of difficulty according to operational verbs, only have differences in case studies and sentence structures. The analysis carried out only analyzes N-gain because this learning only wants to see the increase in critical thinking skills after the learning model treatment is completed, by calculating the difference in pretest and posttest values or obtaining a score, it can be seen whether using or implementing the method is definitely effective or not. The N-Gain score acquisition category can be determined based on the N-gain value in forming a percentage (%), the greater the increase means that this learning model is more effective in learning to improve critical thinking skills.

RESULT

The research data was obtained from the pretest and posttest scores of students. The results of the pretest and posttest data analysis showed that the average learning outcomes

of students before and after being given treatment increased, namely from an average of 68.29 to 86.18. This shows that the application of the Problem-based learning model can improve students' critical thinking skills in economics. Where in the problem-based learning model, students are given problems that will be solved or resolved by conducting discussion activities with group members. Then the results of the discussion will be presented in front of the class. This can train critical thinking skills and foster students' self-confidence. The increase in student scores before and after being given treatment can be seen in Table 1.

Table 1
Critical thinking ability score obtained before converting to a scale of 100

Res	Pretest							Pretest						
	1	**2**	**3**	**4**	**5**	**Total**	**Average**	**1**	**2**	**3**	**4**	**5**	**Total**	**Average**
1	3	4	2	4	3	16	3.20	4	2	4	4	14	28	5.60
2	4	4	2	3	2	15	3.00	4	2	4	3	13	26	5.20
3	4	4	2	3	2	15	3.00	4	2	4	4	14	28	5.60
4	4	3	1	3	1	12	2.40	4	1	4	4	13	26	5.20
5	5	3	2	2	2	14	2.80	3	2	4	4	13	26	5.20
6	4	4	2	3	3	16	3.20	4	2	4	4	14	28	5.60
7	1	3	2	4	4	14	2.80	4	2	4	4	14	28	5.60
8	3	3	1	3	2	12	2.40	4	2	4	3	13	26	5.20
9	3	2	1	2	3	11	2.20	4	2	4	4	14	28	5.60
10	3	3	2	3	3	14	2.80	4	2	3	3	12	24	4.80
11	4	4	2	4	2	16	3.20	4	2	4	3	13	26	5.20
12	4	3	1	3	2	13	2.60	4	1	4	3	12	24	4.80
13	3	3	2	4	2	14	2.80	4	2	4	3	13	26	5.20
14	3	3	2	3	2	13	2.60	4	2	4	4	14	28	5.60
15	3	2	1	3	2	11	2.20	4	1	3	3	11	22	4.40
16	2	3	2	3	4	14	2.80	3	2	3	4	12	24	4.80
17	3	3	2	3	3	14	2.80	3	2	3	4	12	24	4.80
18	2	2	2	4	3	13	2.60	3	2	4	4	13	26	5.20
19	2	4	2	2	2	12	2.40	4	2	4	4	14	28	5.60
20	2	2	2	3	2	11	2.20	3	2	3	3	11	22	4.40
21	2	4	2	2	2	12	2.40	4	2	4	4	14	28	5.60
22	2	2	1	3	3	11	2.20	2	1	4	4	11	22	4.40
23	4	3	2	1	1	11	2.20	4	2	3	3	12	24	4.80
24	2	3	1	2	3	11	2.20	4	1	4	3	12	24	4.80
25	3	2	2	3	3	13	2.60	2	2	2	4	10	20	4.00
26	2	2	2	4	2	12	2.40	2	2	4	3	11	22	4.40
27	2	2	2	2	2	10	2.00	2	2	3	3	10	20	4.00
28	3	1	1	2	2	9	1.80	2	1	3	3	9	18	3.60
29	3	1	2	2	4	12	2.40	1	2	3	4	10	20	4.00
30	3	2	1	3	3	12	2.40	4	2	4	4	14	28	5.60
31	2	3	1	3	3	12	2.40	4	2	4	4	14	28	5.60
32	2	4	2	4	3	15	3.00	4	2	4	4	14	28	5.60
33	3	4	2	3	2	14	2.80	4	2	3	3	12	24	4.80

Note. Res-Respondent

The data provided includes the results of the pretest and posttest of students' critical thinking skills based on five indicators (It 1 to It 5). Each indicator is given a score, which is then added up to get a total score, followed by an average for each student.

The average pretest score of students varies from 1.80 to 3.20. This shows that students' critical thinking skills before the intervention (treatment). The average posttest score of students increased significantly, with the highest score reaching 5.60. This indicates an increase in critical thinking skills after the implementation of the problem-based learning method intervention. Even so, this data is raw data that will be processed and the score will be converted on a scale of 100. The reason for the conversion is so that the results of this study can be better understood by teachers and students because schools usually use a range of 100 (see Table 2).

Table 2
Average pretest and posttest scores of students in the range of 100

No	Pre test	Post test
1	50	76
2	53	79
3	83	92
4	63	77
5	55	79
6	68	81
7	90	100
8	80	93
9	60	84
10	63	87
11	78	91
12	75	86
13	61	82
14	65	86
15	88	100
16	81	97
17	48	75
Means	**68.29**	**86.18**

The lowest pretest score of students before the implementation of the Problem-based learning model was 48 and the highest was 90. After the implementation of the Problem-based learning model, the students' posttest scores increased where the lowest posttest score of students was 75 and the highest was 100. Based on the results of the pretest and posttest conducted on grade VIII students, there was an increase in critical thinking skills in the subject of Economics. Comparison of student learning outcomes can also be seen from the N-Gain test as in Table 3.

Table 3
N-gain test analysis

No	N Get Score	N Profit Value (%)
1	0.52	52.00
2	0.55	55.32
3	0.53	52.94
4	0.38	37.84
5	0.53	53.33
6	0.41	40.63
7	1.00	100.00
8	0.65	65.00

No	N Get Score	N Profit Value (%)
9	0.60	60.00
10	0.65	64.86
11	0.59	59.09
12	0.44	44.00
13	0.54	53.85
14	0.60	60.00
15	1.00	100.00
16	0.84	84.21
17	0.52	51.92
Means	**0.61**	**60.88**
Minimum	**0.38**	**37.84**
Maximum	**1.00**	**100.00**

Based on the results of the N-gain score test calculation above, it shows that the average N-gain score (%) is 60.88 which is included in the fairly effective category. This shows that the application of the problem-based learning model is quite effective in improving the critical thinking skills of class VIII students in the Economics subject in the 2022/2023 academic year.

DISCUSSION

This study revealed that the application of the problem-based learning model was significantly able to improve critical thinking skills in the context of Economics subjects in grade VIII students. The results of the significant increase can be seen from the difference in the average posttest score which reached 86.18 compared to the average pretest score of 68.29. In addition, the N-Gain analysis showed a value of 0.61 with a moderate category, and the N-Gain Value (%) of 60.88 which showed that the level of effectiveness of problem-based learning was quite effective in improving students' critical thinking skills. (Barell, 2007) emphasized that problem-based learning encourages students to think critically, ask relevant questions, and find solutions based on testable evidence. problem-based learning, according to Barell (2007), provides space for students to develop critical thinking skills in depth through challenging learning experiences, which is in line with the finding that problem-based learning significantly improves critical thinking skills in the context of Economics learning.

Problem-based learning is known to be effective because it encourages students to develop their understanding through solving problems relevant to real contexts, thereby increasing student engagement and their ability to analyze, evaluate, and solve complex economic problems. Hmelo-Silver (2006) highlighted the effectiveness of problem-based learning in developing critical thinking skills. problem-based learning allows students to continuously analyze and evaluate information in the context of solving real problems. This process helps students not only understand concepts in depth but also develop the ability to identify and evaluate assumptions and draw conclusions based on evidence. In this context, the results of the study provide strong support for implementing problem-based learning as a learning strategy that can enrich students' learning experiences and improve their academic achievement in Economics, in line with Choi (2019) who studied the application of problem-based learning in teaching in secondary schools and found that problem-based learning significantly improved students' analytical and critical skills.

Students who engaged in problem-based learning showed clear improvements in their ability to solve problems and evaluate information, supporting your findings on the impact of problem-based learning on the development of critical thinking skills in Economics. This study not only provides practical contributions to the development of learning strategies in schools but also provides a strong empirical basis for further development in the context of problem-based learning for other disciplines. This is in accordance with the opinion of Strobel (2009) who conducted a meta-analysis showing that problem-based learning has a significant positive impact on understanding and developing critical thinking skills. This study found that problem-based learning is superior in improving problem-solving skills compared to traditional learning approaches. This meta-analysis supports the findings of your study, especially in terms of how problem-based learning facilitates deeper understanding and critical thinking skills in solving economic problems.

Although the results of this study indicate the effectiveness of problem-based learning in improving students' critical thinking skills, there are several things that need to be considered for broader interpretation of the results. First, the effectiveness of problem-based learning which is categorized as “quite effective” (N-Gain Score 60.88%) indicates that there is still room for improvement. problem-based learning may require additional adjustments or support, such as more intensive teacher training or integration of relevant technology, to achieve more optimal results.

Second, this study was limited to a sample of eighth-grade students, so generalization of the results of this study to a wider population should be done with caution. Variations in school contexts, students’ prior abilities, and availability of learning resources may influence the effectiveness of problem-based learning in different settings. Therefore, further research with larger and more diverse samples is needed to ensure that these findings hold across learning contexts. Furthermore, although problem-based learning has been shown to be effective in improving critical thinking skills, it is also important to consider its impact on other aspects, such as students’ motivation to learn, collaborative skills, and communication skills. Research by Yew and Schmidt (2012) showed that problem-based learning helps students develop higher-order thinking skills through collaborative and investigative learning processes. Students engage in discussions and solve real-world problems, which require strong critical thinking, analysis, and evaluation skills. These results are in line with the findings in your study, which showed that problem-based learning can improve student engagement and critical thinking skills in studying Economics. Further research could examine the holistic impact of problem-based learning on various aspects of student development to provide a more comprehensive picture of its benefits and challenges.

CONCLUSION

Problem-based learning places students in an active position as problem solvers, encouraging them to analyze, evaluate, and synthesize information. This condition provides an opportunity for students to develop critical thinking skills that are much needed in today's era of globalization and technology. This is in accordance with constructivist theory which emphasizes learning based on experience and interaction. Although problem-based learning has shown positive results in terms of improving critical thinking skills and student engagement, there are several challenges that need to be overcome so that its implementation is more optimal. One of them is student adaptation

to more independent and investigation-based learning methods. Students who are accustomed to conventional learning methods, such as lectures and memorization, may have difficulty adapting to more interactive methods that require active involvement. Therefore, teachers need to introduce a problem-based learning approach gradually and provide adequate direction so that students can follow the rhythm of learning well. In addition, the effectiveness of problem-based learning also depends on the availability and quality of learning resources. A supportive environment, both in terms of learning materials and facilities such as access to technology and information, can enrich students' experiences in solving more complex and relevant problems. Technological support, such as internet access and digital devices, will help students find the information they need to solve the problems they face.

Implication

The results of this study have a number of important implications the application of the Problem-based learning model has been proven effective in improving students' critical thinking skills, especially in economics lessons. This is to encourage teachers to adopt and adapt the problem-based learning method in their classes as a learning approach that can activate student engagement and motivate them to think more deeply. Teachers need to be trained to design problems that are relevant to real contexts and manage group discussions in a certain way effectively to maximize the benefits of problem-based learning. The integration of problem-based learning in the curriculum allows students to learn holistically and interdisciplinary, connecting knowledge from various fields to solve complex problems. Policies should also encourage pedagogical innovation and provide space for teachers to implement new learning methods such as problem-based learning. In addition, policies need to consider ongoing evaluation of the effectiveness of problem-based learning in various contexts to ensure that its implementation remains relevant and useful.

Limitation and Future Direction

This study has limitations in the research subjects where the subjects are only at the level or subject of economics, so the results are less generalizable to other contexts, such as subjects other than those studied. The implementation time of problem-based learning in the study may be limited so that it has not been able to fully describe the long-term impact of this method on the development of critical thinking skills. The success of problem-based learning is highly dependent on the ability of the facilitator in managing the class. Variations in teacher experience and skills can affect the consistency of the research results. The instruments used, such as essay tests or assessment rubrics, may have limitations in capturing all dimensions of critical thinking in depth. In addition, subjectivity in assessment can also affect the accuracy of the results. This study may not have considered non-cognitive factors, such as student learning motivation, self-confidence, and cooperation skills, which also play an important role in the success of problem-based learning. Future research can expand the research subjects to higher levels of education (such as college) or lower (elementary school), as well as to other subjects such as art, sports, or mathematics. Longitudinal research is needed to evaluate the impact of problem-based learning on critical thinking skills over a longer period of time, including its influence on students' academic success and life skills. Research can integrate the use of technology, such as e-learning or AI-based applications, to support the implementation of problem-based learning and explore its impact on students' critical

thinking development. Further research can examine the relationship between problem-based learning, critical thinking skills, and other factors such as creativity, collaboration, or communication, thus providing a more holistic understanding. Future research can develop more sophisticated measurement instruments, such as computer-based tests or scenario-based assessments, to assess critical thinking skills more accurately and objectively.

REFERENCES

Alreshidi, N. A. K., & Lally, V. (2024). The effectiveness of training teachers in problem-based learning implementation on students' outcomes: A mixed-method study. *Humanities and Social Sciences Communications, 11*(1), 1-10. https://doi.org/10.1057/s41599-024-03638-6

Barell, J. (2007). *Problem-based learning: An inquiry approach*. Corwin Press.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education. Springer Publishing Company* .

Boelt, A. M., Kolmos, A., & Holgaard, J. E. (2022). Literature review of students' perceptions of generic competence development in problem-based learning in engineering education. *European Journal of Engineering Education, 47*(6), 1399-1420. https://doi.org/10.1080/03043797.2022.2074819

Bosica, J., Pyper, J. S., & MacGregor, S. (2021). Incorporating problem-based learning in a secondary school mathematics preservice teacher education course. *Teaching and Teacher Education, 102*, 103335. https://doi.org/10.1016/j.tate.2021.103335

Brookfield, S. D. (2017). *Becoming a critical and reflective teacher (2nd ed.). Jossey-Bass.*

Choi, E., & Kang, J. (2019). The effectiveness of problem-based learning in developing critical thinking: A systematic review. *Journal of Problem-Based Learning*, *6*(1), 1–13. https://doi.org/10.24313/jpbl.2019.6.1.1

Dolmans, D. H. J. M., De Grave, W., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education*, *39*(7), 732–741. https://doi.org/10.1111/j.1365-2929.2005.02205.x

Ennis, RH (2011). *The nature of critical thinking: An outline of critical thinking tendencies and abilities. University of Illinois* . https://www.criticalthinking.net/definition.html

Fisher, A. (2011). Critical thinking: An introduction (2nd ed.). Cambridge University Press.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. The California Academic Press.

Facione, P.A. (2011). *Critical thinking: What it is and why it matters. Insight Assessment*.

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist*, *53*(4), 449–455. https://doi.org/10.1037/0003-066X.53.4.449

Hmelo-Silver, C.E., & Barrows, H.S. (2006). *Goals and strategies of problem-based learning facilitators. Interdisciplinary Journal of Problem-Based Learning*, *1*(1), 21-39. https://doi.org/doi:10.7771/1541-5015.1004

Hmelo-Silver, C.E. (2004). *Problem-based Learning: What and how do students learn? Educational Psychology, 16(3),* 235–266.

https://doi.org/doi:10.1023/B.0000034022.16470.f3

National., KP (2013). *Regulation of the minister of education and culture number 81A of 2013 concerning curriculum implementation. Jakarta: Ministry of Education and Culture of the Republic of Indonesia.*

Nicholus, G., Muwonge, C. M., & Joseph, N. (2023). The role of problem-based learning approach in teaching and learning physics: A systematic literature review. *F1000Research, 12*, 951. https://doi.org/10.12688/f1000research.136339.2

Paul, R., & Elder, L. (2008). *The miniature guide to critical thinking: Concepts and tools. Foundation for Critical Thinking Press.*

Rahmawati. (2016). Developing critical thinking skills through economic learning. *Journal of Economic Education* , *4(2),* 101–115.

Razak, A. A., Ramdan, M. R., Mahjom, N., Zabit, M. N. M., Muhammad, F., Hussin, M. Y. M., & Abdullah, N. L. (2022). Improving critical thinking skills in teaching through problem-based learning for students: A scoping review. *International Journal of Learning, Teaching and Educational Research, 21*(2), 342-362. https://doi.org/10.26803/ijlter.21.2.19

Rivas, S. F., Saiz, C., & Ossa, C. (2022). Metacognitive strategies and development of critical thinking in higher education. *Frontiers in Psychology, 13*, 913219. https://doi.org/10.3389/fpsyg.2022.913219

Savery, Jr., & Duffy, T. M. (2001). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology*, *35*(5)*,* 31–38.

Sarwari, K., & Kakar, A. F. (2023). Developing students' critical thinking skills through contextual teaching and learning. *Journal of Cognition, Emotion & Education, 1*(1), 29-42. https://doi.org/10.22034/cee.2023.172192

Schmidt, H. G., Loyens, S. M. M., Van Gog, T., & Paas, F. (2011). *Problem-based learning.* The International Handbook of Collaborative Learning, 370.

Sistermans, I. J. (2020). Integrating competency-based education with a case-based or problem-based learning approach in online health sciences. *Asia Pacific Education Review, 21*(4), 683-696. https://doi.org/10.1007/s12564-020-09658-6

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *The Interdisciplinary Journal of Problem-Based Learning*, *3*(1), 44–58. https://doi.org/10.7771/1541-5015.1046

Sutarto, Dwi Hastuti, I., Fuster-Guillén, D., Palacios Garay, J. P., Hernández, R. M., & Namaziandost, E. (2022). The effect of proble-based learning on metacognitive ability in the conjecturing process of junior high school students. *Education Research International, 1,* 2313448. https://doi.org/10.1155/2022/2313448

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our time. Jossey-Bass.*

Yew, EHJ, & Schmidt, HG (2012). Evidence for constructive, self-regulated, and collaborative processes in problem-based learning. *Advances in Health Sciences Education, 17*(2), 251-272. https://doi.org/https://doi.org/10.1007/s10459-011-9311-x

Walter, Y. (2024). Embracing the future of Artificial Intelligence in the classroom: The relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education, 21*(1), 15. https://doi.org/10.1186/s41239-024-00448-3