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Application Of the Problem Based Learning Model to Improve The Understanding of Science Concepts and Critical Thinking Skills of Grade VI Students at SDN 2 Damparan

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Abstract

This study was motivated by the low level of science conceptual understanding and critical thinking skills among sixth-grade students at SDN 2 Damparan. Preliminary observations revealed that the classical mastery of science concepts reached only 33%, while students' critical thinking skills were merely 25%, primarily due to teacher-centered instructional practices. This study aimed to improve both aspects through the implementation of the Problem-Based Learning (PBL) model. The study employed Classroom Action Research (CAR) based on the Kemmis and McTaggart model, consisting of planning, action, observation, and reflection conducted over two cycles. The participants were 12 sixth-grade students enrolled in the 2025/2026 academic year. Data were collected through tests, observations, and documentation, and analyzed using qualitative and quantitative descriptive techniques. The findings demonstrated that the implementation of PBL improved students' classical mastery of science concepts from 33% in the pre-cycle to 75% in Cycle I and 100% in Cycle II. Similarly, students' critical thinking skills increased from 25% in the pre-cycle to 58.33% in Cycle I and 91.67% in Cycle II. These findings indicate that the PBL model is effective in enhancing students' science conceptual understanding and critical thinking skills.

***Keywords*:** *Critical Thinking Skills, Classroom Action Research, Science Conceptual Understanding, Problem-Based Learning (PBL).*

Abstrak

Penelitian ini dilatarbelakangi oleh rendahnya pemahaman konsep IPA dan keterampilan berpikir kritis siswa kelas VI SDN 2 Damparan. Hasil observasi menunjukkan ketuntasan klasikal pemahaman konsep IPA hanya mencapai 33% dan keterampilan berpikir kritis sebesar 25% akibat pembelajaran yang masih berpusat pada guru. Penelitian ini bertujuan meningkatkan kedua aspek tersebut melalui penerapan model Problem Based Learning (PBL). Penelitian menggunakan metode Penelitian Tindakan Kelas (PTK) model Kemmis dan McTaggart yang meliputi perencanaan, pelaksanaan tindakan, observasi, dan refleksi dalam dua siklus. Subjek penelitian berjumlah 12 siswa kelas VI Tahun Ajaran 2025/2026. Data dikumpulkan melalui tes, observasi, dan dokumentasi, kemudian dianalisis secara deskriptif kualitatif dan kuantitatif. Hasil penelitian menunjukkan bahwa penerapan PBL meningkatkan ketuntasan klasikal pemahaman konsep IPA dari 33% menjadi 75% pada siklus I dan 100% pada siklus II. Keterampilan berpikir kritis juga meningkat dari 25% menjadi 58,33% pada siklus I dan 91,67% pada siklus II. Dengan demikian, model PBL efektif meningkatkan pemahaman konsep IPA dan keterampilan berpikir kritis siswa.

Kata Kunci: Keterampilan Berpikir Kritis, Penelitian Tindakan Kelas, Pemahaman Konsep IPA, Problem Based Learning.

INTRODUCTION

Education is a strategic means of developing superior, creative and competitive human resources through a learning process that encourages students to develop knowledge, skills and attitudes optimally (Zafrullah, Sembiring, Ramadana, et al., 2024; Zafrullah, Gunawan, Haidir, et al., 2024; Zafrullah, Gunawan, Ramadana, et al., 2024), As mandated in Government Regulation of the Republic of Indonesia Number 4 of 2022 concerning National Education Standards, the success of the educational process is greatly influenced by the role of teachers in designing and implementing effective, engaging, and student-centered learning (Andini et al., 2024; Fitriya et al., 2025; Gunawan et al., 2026; Ramadana et al., 2025) In line with the Minister of Education and Culture Regulation Number 16 of 2022 Article 7, teachers are required to implement learning strategies and models that are able to create meaningful learning experiences (Ramadana & Widayati, 2025; On the other hand, learning that is still centered on the teacher tends to reduce learning motivation and hinder the development of students' high-level thinking skills (Lee & Boo, 2022). Therefore, learning innovations are needed that can increase student activity, involvement, and the quality of the learning process (Wijnia et al., 2024).

In 21st-century learning, education is not only oriented towards mastering knowledge, but also towards developing critical, creative, communicative, and collaborative thinking skills (4C), in line with the implementation of the Independent Curriculum which emphasizes meaningful, contextual, and student-centered learning (Fitriya et al., 2025; Khairiyah & Sultan, 2025). One of the competencies that students must have is a deep understanding of concepts as a basis for linking, applying and transferring knowledge in various real life situations. (Rahmadini & Soleh, 2025). In Phase C of sixth-grade science, the human locomotor system requires students to understand the relationship between the skeleton, joints, and muscles and analyze the various disorders that can occur. Therefore, science instruction needs to be designed to develop conceptual understanding and critical thinking skills so that students can solve problems related to everyday life.

Conceptual understanding is the ability of students to organize, relate, and apply knowledge meaningfully so that they are not only able to remember information, but also explain and use concepts in various situations (Azis et al., 2020; Jr & Adlaon, 2026). Based on the constructivist theory proposed by Jean Piaget and developed by Lev Vygotsky, knowledge is actively constructed through learning experiences, interactions, and students' thinking processes (Maharani et al., 2025). Therefore, learning needs to provide opportunities for students to construct their own understanding. In science learning, this

approach is crucial because students are required not only to understand scientific concepts but also to analyze phenomena, solve problems, and make decisions based on scientific evidence. Therefore, conceptual understanding and critical thinking skills are two interrelated competencies that must be developed simultaneously through active and meaningful learning.

Natural Science (IPA) is a subject that plays a crucial role in developing conceptual understanding and critical thinking skills through scientific observation, investigation, and problem-solving activitie (Ali et al., 2024). However, classroom observations in Grade VI at SDN 2 Damparan revealed that the learning process was still dominated by lecture-based instruction and teacher-centered approaches, resulting in limited student involvement. This condition affected students' conceptual understanding and critical thinking skills, as indicated by the low classical mastery levels of science conceptual understanding (33%) and critical thinking skills (25%) on the human movement system topic. Most students experienced difficulties in explaining the relationship between the skeletal system, joints, and muscles, as well as applying these concepts to analyze problems in real-life contexts.

If this condition is not addressed promptly, students may encounter difficulties in understanding more complex science concepts and developing logical analysis and problem-solving abilities. Therefore, innovative learning strategies are needed to improve conceptual understanding while continuously developing students' critical thinking skills. One potential alternative is the Problem-Based Learning (PBL) model, which emphasizes student-centered learning by using contextual problems as the starting point of the learning process. Through inquiry, discussion, and problem-solving activities, PBL provides meaningful learning experiences that support students in constructing scientific concepts and developing critical thinking skills in accordance with the objectives of the Merdeka Curriculum.

Various studies have shown that the Problem Based Learning (PBL) model is effective in improving students' conceptual understanding and critical thinking skills Yu & Zin, (2023) and Sajidan et al., (2022), demonstrated that PBL fosters critical thinking skills, conceptual understanding, and collaboration through authentic problem solving. These findings are supported by research Darmawati & Mustadi, (2023), Hidayati & Purwaningsih, (2023) and Rofiqoh et al., (2023) which shows that the application of PBL in elementary school science learning has a positive influence on improving students' critical thinking skills. In addition, classroom action research by Susilawati & Supriyatno, (2023), Yuliandari &

Anggraini, (2021) and Mangantjo, (2026) also reported that PBL was able to significantly increase learning activities, critical thinking skills, and student learning outcomes.

Nevertheless, classroom action research integrating the improvement of science conceptual understanding and critical thinking skills through the implementation of PBL on the topics of the skeletal system, joints, and muscles in sixth-grade elementary school students remains relatively limited. This research gap highlights the need for further investigation into the effectiveness of PBL in simultaneously developing both competencies. Therefore, this study aims to analyze the effectiveness of PBL implementation in improving science conceptual understanding and critical thinking skills among sixth-grade students at SDN 2 Damparan. The findings are expected to provide empirical evidence and serve as an alternative approach for improving science learning that is more active, contextual, and student-centered.

RESEARCH METHODOLOGY

This study employed a Classroom Action Research (CAR) approach aimed at improving the learning process continuously. The CAR model was based on the spiral model proposed by Kemmis and McTaggart (1988), consisting of four stages in each cycle: planning, acting, observing, and reflecting.The study was conducted at SDN 2 Damparan, Barito Selatan Regency, Kalimantan Tengah , involving 12 sixth-grade students (6 males and 6 females) in the 2025/2026 academic year. This study aimed to improve students' science conceptual understanding and critical thinking skills through the implementation of the Problem-Based Learning (PBL) model on the topic of body movement, particularly the skeletal system, joints, and muscles.The study was conducted in two cycles, with each cycle consisting of three learning meetings. Evaluation and reflection were carried out at the end of each cycle to determine the effectiveness of the implemented actions. The reflection results were used to improve subsequent actions. The study was terminated when the success indicators were achieved.

RESULTS AND DISCUSSION

This study began with a pre-cycle stage, followed by two cycles consisting of four stages: planning, action, observation, and reflection. Each cycle involved three meetings, with a written test conducted at the end of each cycle. The participants were 12 sixth-grade

students at SDN 2 Damparan. The Problem-Based Learning (PBL) model was implemented to improve students' science conceptual understanding and critical thinking skills. Data were collected through written tests and observations of teacher and student activities during the learning process. The following section presents the findings from each cycle.

Pre-cycle

Pre-cycle data obtained from initial observations revealed that science learning was still dominated by lecture methods, resulting in students being less active in discussions, unfamiliar with problem-solving, and having difficulty connecting the concepts of the skeleton, joints, and muscles to everyday life. A summary of the results of students' conceptual understanding and critical thinking skills is presented in Table 1.

Tabel 1. Classical Completion of Conceptual Understanding and Critical Thinking Pre-Cycle

No	Aspects assessed	Number of students completing the course	Average percentage	Category
1	Conceptual understanding	4	33 %	Low
2	Critical thinking skills	3	25 %	Low

Based on the pre-cycle results, it can be concluded that learning still needs to be improved through more student-centered learning, one of which is by implementing the PBL model.

Results of Cycle 1

Description of Teacher and Student Activities

Observations were conducted by the researcher and colleagues to assess teacher and student activities during the implementation of the Problem-Based Learning (PBL) model at each meeting.

Observations of Teacher Activities in Cycle I

Based on Table 2, teacher activity during Cycle I increased at each meeting. The percentage of teacher activity implementation increased from 59.61% in the first meeting to 67.30% in the second meeting, and reached 84.61% in the third meeting. Overall, the average implementation of teacher activities in Cycle I was 70.51%, categorized as good. Despite this improvement, observations indicate that time management, equitable student participation in reflection activities, and providing guidance to students experiencing difficulties still need to be optimized as a basis for improvement in Cycle II.

Tabel 2. Recapitulation of Observation Results of Teacher Activities Cycle I

Meeting	Material	Score Acquisition	Max Score	Percentage	Category
I	The Human Skeleton	31	52	59,61%	Enough
II	Joints and Disorders of the Musculoskeletal System	35	52	67,30%	Enough
II	Muscles and Their Functions	44	52	84,61%	Good
	Average	36,6		70,51%	Good

Observations of Student Activities in Cycle I

Based on Table 3, student activity in Cycle I increased at each meeting. The percentage of student activity increased from 61.67% in the first meeting to 71.67% in the second meeting, and reached 82.50% in the third meeting. Overall, the average student activity in Cycle I was 71.95%, categorized as good. This increase indicates that student engagement in PBL-based learning is improving. However, the active participation and self-confidence of some students still need to be improved as a basis for improvement in Cycle II.

Tabel 3. Recapitulation of Student Activity Observation Results Cycle I

Meeting	Material	Average %	Category
I	The Human Skeleton	61,67%	Enough
II	Joints and Disorders of the Musculoskeletal System	71,67%	Good
III	Muscles and Their Functions	82,50%	Good
	Cycle I Average	71,95%	Good

Results of the Cycle I Student Concept Understanding Test

Based on Table 4, the total score was 896, with an average score of 74.66, rounded to 75. The highest score achieved by students was 87, while the lowest was 63. Of the 12 students who took the test, 9 students achieved the Learning Objective Achievement Criteria (KKTP) of ≥ 70, while 3 students did not achieve the KKTP.

Tabel 4. Results of Student Concept Understanding Test Cycle I

Components	Result
Total score	896
Average score	74,66 (=75)
Highest score	87
Lowest score	63
Number of students who completed the course	9 Student
Number of students who did not complete the course	3 Student
Classical completion	75 %
Not completed	25 %

The classical completion percentage achieved in cycle I reached 75%, while the percentage of students who had not yet completed the task was 25%. These results indicate that students' conceptual understanding improved compared to the pre-cycle condition, which only achieved classical completion of 33%. The data can be seen in the following table:

Tabel 5. Comparison of understanding of pre-cycle and cycle I concepts

Rated aspect	Pre-Cycle	Cycle I	Improvement
Understanding Science Concepts	33 %	75 %	42 %

A comparison of the pre-cycle and Cycle I results showed that the classical mastery of conceptual understanding increased from 33% to 75%, or an increase of 42%. Despite the increase, the results did not reach the established success indicator, namely a minimum of 85% of students achieving KKTP ≥ 70. Therefore, corrective actions were continued in Cycle II.

Results of the First Cycle of Students' Critical Thinking Skills Test

Based on the data in Table 6, the average score for students' critical thinking skills was 67.92, which falls into the sufficient category. The highest score achieved by a student was 80, while the lowest was 50. Of the 12 students who took the test, none were in the excellent category; 7 were in the good category, 4 were in the sufficient category, and 1 was in the poor category.

Tabel 6. Results of Students' Critical Thinking Skills Test in Cycle I

Components	Result
Number of students	12
Average score	67,92 (Enough)
Highest score	80
Lowest score	50
Number of excellent students	-
Number of good students	7
Number of adequate students	4
Number of poor students	1
Classical Completion	58,33 %

The classical completion percentage for critical thinking skills in cycle I reached 58.33%. This result indicates an improvement compared to the pre-cycle condition, which only achieved classical completion of 25%. The data can be seen in the following table:

Tabel 7. Comparison of Critical Thinking Skills Pre-Cycle and Cycle I

Aspects assessed	Pre-Cycle	Cycle I	Improvement
Critical Thinking Skills	25 %	58, 33 %	33, 33 %

Based on the results of the pre-cycle and Cycle I, students' critical thinking skills increased from 25% to 58.33%, a 33.33% increase. Although this indicated improvement, the results did not reach the established success indicator, which was a minimum of 85% of students achieving mastery. Therefore, learning improvements were continued in Cycle II.

Cycle I Reflection

The results of the Cycle I reflection showed that the implementation of the Problem-Based Learning (PBL) model improved students' understanding of science concepts and critical thinking skills, but did not meet the research success indicator, which required at least 85% of students to achieve mastery. The reflection identified several aspects that needed improvement, including equitable student participation in discussions and reflections, strengthening teacher guidance during the investigation process, increasing student confidence during presentations, and deepening the material on disorders and maintenance of the musculoskeletal system. Based on these findings, actions in Cycle II focused on optimizing the implementation of PBL syntax, providing more intensive scaffolding, clearer role allocation within groups, and presenting more challenging contextual problems to enhance students' conceptual understanding and critical thinking skills.

Results of Cycle II

Description of Teacher and Student Activities in Cycle II

Observations in Cycle II were conducted by the researcher, along with the principal as observer, to assess teacher and student activities during the implementation of the Problem-Based Learning (PBL) model. Observations were conducted at each meeting using the same instruments as in Cycle I. The results of the observations of teacher and student activities are presented in the following table.

Observations of Teacher Activities in Cycle II

Teacher activities in Cycle II were observed using an observation sheet consisting of 13 indicators to assess the implementation of PBL syntax during the learning process. The results of the observations of teacher activities are presented in the following table.

Tabel 8. Comparison of Critical Thinking Skills Pre-Cycle and Cycle I

Meeting	Material	Score Acquisition	Max Score	Percentage	Category
I	Skeletal Problems	43	52	82,69%	Good
II	Solutions for Joint Disorders and Efforts to Maintain a Healthy Muscular System	47	52	90,38%	Verry Good
II	Human Muscular System	50	52	96,15%	Verry Good
	Average	46,67		89,74%	Verry Good

Based on Table 22, teacher activity in Cycle II increased at each meeting, from 82.69% to 90.38%, reaching 96.15% at the third meeting. Overall, the average implementation of teacher activity reached 89.74%, categorized as very good. These results indicate that the implementation of PBL syntax in Cycle II is increasingly optimal. A comparison of teacher activity in Cycle I and Cycle II is presented in the following table:

Tabel 9. Comparison of Average Achievement of Teacher Activities in Cycles I and II

Cycle	Average	Increase
Cycle I	70,51%	19,23%
Cycle II	89,74%	

Table 9 shows a 19.23% increase from Cycle I to Cycle II. This indicates that the implementation of the PBL model is increasingly effective in improving the quality of learning and student engagement in the classroom.

Observations of Student Activity in Cycle II

According to Table 10, student activity in Cycle II showed an increase at each meeting, from 78.33% in the first meeting to 83.33% in the second meeting, and reaching 89.17% in the third meeting. Overall, these results indicate that student engagement in learning using the PBL model is increasingly optimal.

Tabel 10. Results of Observations of Student Activities in Cycle II

Meeting	Material	Average %	Category
I	Skeletal Problems	78,33%	Good
II	Solutions for joint disorders and efforts to maintain a healthy musculoskeletal system	83,33%	Good
III	Human Musculoskeletal System (Skeletal System, Joints, and Muscles)	89,17%	Verry Good
	Cycle I Average	83,61%	Good

The increase in student activity indicates that their engagement in each stage of PBL is improving, from identifying problems, discussing, conducting investigations, to presenting

results and concluding the learning. A comparison of average student activity in Cycle I and Cycle II is presented in the following table:

Tabel 11. Comparison of Average Student Activity Achievements in Cycles I and II

Cycle	Average	Increase
Cycle I	71,95%	11,66%
Cycle II	83,61%	

Berdasarkan data pada tabel tersebut di atas menunjukkan nilai rata-rata pada siklus I sebesar 71,95% dan siklus II sebesar 83,61% dan terjadi peningkatan sebesar 11,66%.

Cycle II Conceptual Understanding Test Results

The results of the student conceptual understanding test in Cycle II showed an improvement compared to Cycle I. This improvement was evident in the classical completion percentage, which reached 100%. Thus, all students met the established Learning Objective Achievement Criteria (KKTP). Complete results can be found in the appendix. A summary of the results of the Cycle II student conceptual understanding test is presented in the following table:

Tabel 12. Results of Cycle II Concept Understanding Test

Components	Result
Total score	1039
Average score	86,58
Highest score	93
Lowest score	83
Number of students who completed the course	12
Number of students who did not complete the course	0
Classical completion	100 %
Not completed	0 %

Based on the test results obtained in cycle II, a comparison of student scores in the pre-cycle, cycle I, and cycle II is presented as shown in the following table:

Tabel 13. Comparison of Concept Understanding Test Results from Pre-Cycle, Cycle I and II

Number of Students	Aspect	Average Completion		
		Pre-Cycle	Siklus I	Siklus II
12	Understanding Science Concepts	33%	75%	100%

The data in Table 27 shows that the classical completion of conceptual understanding in the pre-cycle was 33%, then increased to 75% in Cycle I and reached 100% in Cycle II. From Cycle I to Cycle II, there was an increase of 25%. The number of students achieving

the KKTP (≥70) increased from 4 students in the pre-cycle to 9 students in Cycle I, and reached 12 students in Cycle II. Thus, all students had met the KKTP at the end of the action. These results indicate that the implementation of the Problem Based Learning (PBL) model successfully improved understanding of science concepts, with classical completion reaching 100%, thus meeting the research success indicators.

Cycle II Critical Thinking Skills Test Results

The results of the critical thinking skills test in Cycle II showed an improvement compared to Cycle I. The average student score reached 79.58, categorized as good, with the highest score being 90, and the lowest score being 65. Eleven students were in the good category and one student was in the fair category, resulting in a classical completion rate of 91.67%.

Tabel 14. Results of Students' Critical Thinking Skills Test in Cycle II

Components	Result
Number of students	12
Average score	79,58 (Good)
Highest score	90
Lowest score	65
Number of excellent students	0
Number of good students	11
Number of adequate students	1
Number of poor students	0
Classical Completion	91,67%

Based on Table 15, the classical completion of critical thinking skills increased gradually from 25.00% in the pre-cycle to 58.33% in Cycle I and 91.67% in Cycle II. Thus, there was an increase of 33.34% from Cycle I to Cycle II.

Tabel 15. Comparison of Critical Thinking Results from Pre-Cycle, Cycle I and II

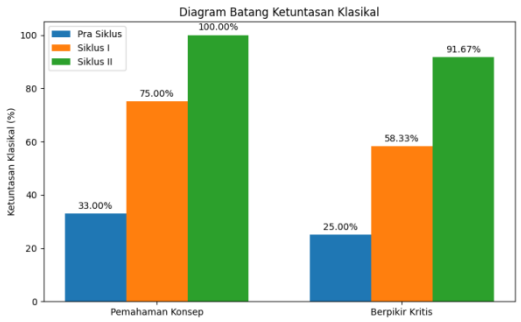
Number of Students	Aspect	Average Completion			
		Pre-Cycle	Cycle I	Cycle I	Cycle II
12	Critical Thinking Skills	25%	58,33%	58,33%	91, 6%
	Improvement	33,33 %		33,34 %	

This increase is also reflected in the number of students who achieved a score of ≥70, namely from 3 students in the pre-cycle to 7 students in Cycle I, and increased to 11 students in Cycle II. Conversely, the number of students who have not achieved completeness decreased from 9 students in the pre-cycle to 5 students in Cycle I, and only 1 student in Cycle II. Overall, these results indicate that the implementation of the Problem

Based Learning (PBL) model is effective in improving students' critical thinking skills. The classical completeness of 91.67% has exceeded the established research success indicator, namely a minimum of 85% of students obtaining a score of ≥70.

Cycle II Data Reflection

Overall, the research results show a consistent increase in students' understanding of science concepts and critical thinking skills from pre-cycle to Cycle II. A comparison of the classical completion rates for both variables is presented in Figure 1. Science concept understanding increased from 33% in the pre-cycle to 75% in Cycle I, and reached 100% in Cycle II. Meanwhile, critical thinking skill completion increased from 25% in the pre-cycle to 58.33% in Cycle I, and then reached 91.67% in Cycle II. These results indicate that the implementation of the Problem-Based Learning (PBL) model is effective in improving students' understanding of science concepts and critical thinking skills. All indicators of research success were achieved in Cycle II, so the study was discontinued at that time.



Gambar 1. Comparison of Classical Completeness of Pre-Cycle, Cycle I and Cycle II

Teacher and Student Activities as Supporting Factors

The increase in teacher and student activity indicates that the implementation of the PBL model syntax is increasingly effective in each cycle. Teachers are increasingly optimal in guiding the learning process by providing contextual problems, organizing students into groups, facilitating investigations, guiding presentations of results, and conducting evaluations and reflections. Meanwhile, students are becoming more actively involved in all stages of learning. The success of the Problem Based Learning (PBL) model implementation is greatly influenced by the consistent implementation of each learning syntax. Teachers act as facilitators who guide the investigation and problem-solving process, thus encouraging active student participation in constructing knowledge. This student-centered learning contributes to an increased understanding of science concepts and critical thinking skills through authentic learning experiences and problem-solving(Irsyad et al., 2024; Mutiara et al., 2024; Su et al., 2025).

Improving Understanding of Science Concepts

The research results show that the implementation of the Problem-Based Learning (PBL) model gradually improved students' understanding of science concepts in each learning cycle. This improvement was evident in students' improved ability to understand relationships between concepts, explain material, and apply science concepts to solve contextual problems. However, results in Cycle I did not meet the success indicators because some students still had difficulty fully understanding the material, actively participating in discussions, and connecting problems to the concepts being studied. Therefore, improvements were made to the learning implementation in Cycle II through material reinforcement, more intensive guidance, and optimization of problem-based learning activities.

In Cycle II, students' conceptual understanding improved significantly as each PBL syntax was implemented more effectively. Student involvement in identifying problems, conducting investigations, discussing, presenting results, and reflecting fostered a deeper and more meaningful understanding of concepts, in line with the constructivist perspective. These findings indicate that PBL not only improves learning outcomes but also strengthens students' abilities to construct, connect, and apply science concepts through authentic learning experiences. These research findings align with the findings of Hardiyanti, (2022) and Mbuik et al., (2025), which states that PBL is effective in increasing understanding of science concepts through active investigation and problem-solving activities.

Improving Critical Thinking Skills

The results of this study indicate that the implementation of the Problem-Based Learning (PBL) model gradually improved students' critical thinking skills across each learning cycle. This improvement was demonstrated by the development of students' abilities to identify and analyze problems, evaluate alternative solutions, and construct arguments based on the scientific concepts being learned. However, in Cycle I, students' critical thinking skills had not yet reached an optimal level, as some students still encountered difficulties in evaluating solutions, drawing conclusions, and logically explaining their analytical results. Therefore, improvements were implemented in Cycle II through strengthened teacher guidance, the presentation of more contextual problems, and the provision of broader opportunities for students to engage in discussions and express their opinions.

In Cycle II, students' critical thinking skills improved more optimally as each phase of the PBL model was implemented more effectively. Students' involvement in identifying problems, conducting investigations, engaging in discussions, presenting findings, and reflecting on the learning process contributed to the development of critical thinking skills across all indicators. These findings are consistent with constructivist theory, which positions students as active learners who construct knowledge through meaningful learning experiences and problem-solving activities. The results of this study are also consistent with the findings, Mariskhantari et al., (2022) and Sari & Mawardi, (2022) and Hardiyanti, (2022) which demonstrated that the Problem-Based Learning (PBL) approach effectively enhances students' critical thinking skills by fostering active participation throughout each phase of the learning process.

Relationship Between Teacher and Student Activities and Improvements in Science Conceptual Understanding and Critical Thinking Skills.

The improvement in teacher activity indicates that the teacher became increasingly proficient in implementing each phase of the Problem-Based Learning (PBL) model in a systematic manner. This included orienting students to authentic problems, organizing learning activities, facilitating both individual and collaborative inquiry, guiding students in presenting their findings, and encouraging reflective evaluation of the problem-solving process. The consistent implementation of these instructional phases provided students with greater opportunities to actively engage in meaningful learning experiences.

Similarly, students demonstrated progressively higher levels of participation throughout the learning process. They became more actively involved in identifying problems, engaging in collaborative discussions, gathering and analyzing information, expressing and justifying their ideas with logical reasoning, evaluating alternative solutions, and presenting the outcomes of their investigations. This active engagement enabled students to construct knowledge through direct learning experiences, resulting in a deeper understanding of scientific concepts and the gradual development of their critical thinking skills.

These findings are consistent with constructivist theory, which posits that knowledge is actively constructed through meaningful learning experiences. In the implementation of the Problem-Based Learning (PBL) model, the teacher acts as a facilitator who provides meaningful learning opportunities, while students actively construct their knowledge through inquiry, collaborative discussion, presentations, and reflective activities. These

findings are also consistent with previous studies demonstrating that PBL enhances students' conceptual understanding and critical thinking skills by engaging them in authentic problem-solving and active knowledge construction. Hardiyanti, (2022); Mariskhantari et al., (2022) ; Sari & Mawardi, (2022), The findings indicate that the successful implementation of Problem-Based Learning (PBL) is influenced by the consistent execution of its instructional syntax and the high level of students' active participation throughout the learning process. Therefore, the increased engagement of both teachers and students served as a key factor in enhancing students' conceptual understanding of science and critical thinking skills among sixth-grade students at SD Negeri 2 Damparan.

CONCLUSION

This study demonstrates that the implementation of the Problem-Based Learning (PBL) model effectively improved the quality of science learning among sixth-grade students at SD Negeri 2 Damparan. The learning process, implemented in accordance with the PBL syntax, promoted active engagement from both teachers and students, resulting in a more collaborative, student-centered, and problem-oriented learning environment. The implementation of PBL also significantly enhanced students' understanding of science concepts, as evidenced by the achievement of complete learning mastery by all students at the end of the study. Furthermore, students' critical thinking skills developed through learning activities that required them to identify problems, analyze information, evaluate alternative solutions, and draw conclusions based on the results of their investigations. These findings support the constructivist perspective, which posits that knowledge is actively constructed through meaningful learning experiences. From a practical perspective, this study suggests that the PBL model can serve as an effective instructional strategy for improving both conceptual understanding and critical thinking skills in elementary science education while fostering a more active, contextual, and student-centered learning environment

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