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Implementation of Deep Learning through the Problem-Based Learning Model to Improve Fifth Grade Students' Science Learning Outcomes

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Abstract

Students' learning outcomes in science at the elementary school level were still not optimal, indicating the need for effective learning approaches to improve students' achievement. One approach that can be implemented is deep learning through the Problem Based Learning (PBL) model. This study aimed to improve fifth-grade elementary students' science learning outcomes through the implementation of deep learning using the Problem-Based Learning model. The study employed Classroom Action Research involving 21 fifth-grade students at SDN Bantarkemang 6. The research was conducted in two cycles from March to April 2026. Data were collected through learning achievement tests and observation sheets, then analyzed using descriptive statistics and Criterion-Referenced Evaluation (PAP). The success criteria were determined based on improvements in students' learning outcomes and the achievement of the school's minimum mastery criterion. The results showed that the percentage of students achieving learning mastery increased from 73.8% in Cycle I (moderately high) to 83.85% in Cycle II (high), representing an improvement of approximately 10%. These findings indicate that implementing deep learning through the Problem-Based Learning model effectively improved fifth-grade elementary students' science learning outcomes. Practically, by promoting active participation, critical thinking, and meaningful learning experiences, the combined model provides teachers with an effective instructional framework to foster meaningful science comprehension in primary education.

Keywords: Deep Learning, Problem-Based Learning, Primary School, Science Learning

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Abstrak

Hasil belajar peserta didik pada mata pelajaran Ilmu Pengetahuan Alam masih belum optimal sehingga diperlukan pendekatan pembelajaran yang dapat meningkatkan hasil belajar peserta didik. Salah satu pendekatan yang dapat diterapkan adalah pembelajaran mendalam melalui model Problem Based Learning (PBL). Penelitian ini bertujuan untuk meningkatkan hasil belajar peserta didik kelas V sekolah dasar pada mata pelajaran Ilmu Pengetahuan Alam melalui implementasi pembelajaran mendalam dengan model Problem Based Learning. Metode penelitian yang digunakan adalah Penelitian Tindakan Kelas (PTK) dengan subjek penelitian sebanyak 21 peserta didik kelas V SDN Bantarkemang 6. Penelitian dilaksanakan dalam dua siklus pada bulan Maret hingga April 2026. Keberhasilan penelitian ditentukan berdasarkan peningkatan hasil belajar peserta didik dan ketercapaian nilai di atas kriteria ketuntasan yang ditetapkan sekolah. Data dikumpulkan menggunakan tes hasil belajar dan lembar observasi aktivitas pembelajaran, kemudian dianalisis menggunakan teknik statistik deskriptif dan Penilaian Acuan Patokan (PAP). Hasil penelitian menunjukkan bahwa persentase ketuntasan hasil belajar meningkat dari 73,8% pada siklus I (cukup tinggi) menjadi 83,85% pada siklus II (tinggi) atau mengalami peningkatan sekitar 10%. Temuan penelitian menunjukkan bahwa implementasi pembelajaran mendalam melalui model Problem Based Learning efektif meningkatkan hasil belajar peserta didik pada mata pelajaran Ilmu Pengetahuan Alam. Secara praktis, melalui partisipasi aktif, penalaran kritis, dan pengalaman belajar bermakna, kombinasi model ini dapat menjadi alternatif strategi pembelajaran bermakna bagi guru sekolah dasar.

Kata Kunci: Pembelajaran Mendalam, Problem-Based Learning, Sekolah Dasar, Pembelajaran IPA

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INTRODUCTION

Learning is a collaborative process between teachers and students to achieve specific learning objectives. In learning, information is organized, managed, and transformed from the teacher to the students, resulting in direct collaboration and integration as teaching and learning activities (Khadijah in Azani et al., 2024). Teaching and learning activities are structured and planned based on students' learning needs to achieve good learning outcomes. Through these learning outcomes, students can assess their achievement levels as a measure of their learning progress.

Learning outcomes are determined by various factors, one of which is the implementation of learning models in education. Since education today has become the main foundation for building a quality generation or human resources, the demands on learning outcomes in education are becoming more complex. According to Realitawati et al. (2024), the focus of education today is based on 4C Skills, which are Critical Thinking Skills, Creativity and Innovation, Communication Skills, and Collaboration Skills. Based on this, learning outcomes become an important aspect that must be improved through mastery of knowledge accompanied by skills. In this context, it is very good to implement this in elementary schools as part of laying the foundation for student development.

In the current educational context, one key issue that needs to be highlighted is the improvement of learning quality and the effectiveness of learning strategies (Nasikhah, 2020). In learning activities, this presents a challenge because the quality and strategies of learning can influence the achievement of students' learning outcomes. The learning process must be student-centered, as this approach actively engages students in developing their attitudes, knowledge, and basic skills. This aligns with IPAS (Natural and Social Sciences) instruction in elementary schools, which plays a crucial role in fostering students' ability to think scientifically and critically in Science learning.

Natural and Social Sciences is one of the core subjects in elementary school and plays a very strategic role in instilling a scientific attitude in students and helping them understand natural phenomena. Therefore, in Science learning, the emphasis is on the process of discovery and understanding concepts as well as hands-on experience, not just on students memorizing the material. According to the Ministry of Education, Culture, Research, and Technology, the main focus of learning outcomes in IPAS at elementary school is not about how much content students absorb, but how well they can use the knowledge they have (Ervitasari et al., 2025). Therefore, good IPAS learning outcomes should help students apply their knowledge effectively in everyday life. However, in practice, students' learning outcomes in Science learning have not fully met instructional objectives and have not demonstrated a shift toward more scientific thinking patterns (Resvania et al., 2025). This aligns with Sukma's research (in Rahayu et al., 2025), which found that the average learning outcomes of students in science subjects remain low and have not met the minimum competency criteria (KKM). Additionally, Hadi et al. (2024) noted that a lack of instructional innovation in Science learning can make learning boring, thereby reducing students' motivation and learning outcomes. Learning outcomes are the manifestation of changes in student behavior encompassing cognitive, affective, and psychomotor dimensions. In line with the perspective of Harlin & Susilawati (2024), learning outcomes are the results achieved by a student after participating in learning activities or taking tests administered by the teacher in the classroom. Therefore, meeting learning needs to improve learning outcomes in the Science learning subject is encouraging, as there is a correlation between students' learning activities and their learning outcomes (Darsono, 2021).

To achieve such comprehensive understanding, learning needs to emphasize deep learning principles rather than superficial memorization (Rahmawati et al., 2025). The issue of low student achievement in science is also consistent with the results of observations and assessments conducted at one of the elementary schools we visited. It was found that in science instruction, many students have not yet met the minimum competency criteria. This is evidenced by the results of the diagnostic assessment or pretest, which showed that student achievement remained at 63.5. Furthermore, the implementation of deep learning to support science education has not yet been evident. Therefore, efforts are needed to address this issue. Consequently, the researcher intends to conduct a classroom action research by implementing deep learning using the Problem-Based Learning (PBL) model as an effort to improve students' learning outcomes in science lessons at the elementary school level.

Problem-Based Learning is carried out by connecting everyday problems, so it can be used as an alternative to improve students' thinking skills (Safitri et al., 2023). Problem-Based Learning (PBL) involves designing problems that can stimulate students' thinking processes to gain knowledge, so students can solve problems and challenges in the learning process (Areros et al, 2026). Based on this, the implementation of Problem-Based Learning (PBL) can be applied in IPAS learning to make learning deeper. By adjusting the learning process to students' knowledge and skills, it can also help improve students' learning outcomes in Science learning. The use of the Problem-Based Learning (PBL) model is expected to help support the implementation of deep learning. As stated by Nisa (in Apriliansyah et al., 2024), Problem-Based Learning (PBL) is a problem-based learning model that serves as one of the innovative learning models capable of providing students with active learning experiences.

Based on this, this research is very important to carry out to examine the application of the problem-based learning model in improving student learning outcomes in science learning at elementary schools. This study aims to analyze the implementation of the problem-based learning (PBL) model in deep learning to improve the learning outcomes of fifth-grade elementary school students in Science subjects.

METHODS

This study employs the Classroom Action Research (CAR) method. Classroom Action Research (CAR) can be defined as a form of research aimed at improving the quality of classroom learning (Nurhayati et al., 2024). Additionally, Kemmis and Taggart (as cited in Nurhayati et al., 2024) state that CAR is implemented in the form of repeated cycles to gain confidence in the actions taken. Each cycle consists of four stages: action planning, action implementation, observation and evaluation, and reflection. This study was conducted from Thursday, March 5, to April 23, 2026, at SDN Bantarkemang 6. The following Figure 1 below illustrates the design of the classroom action research conducted in each cycle.

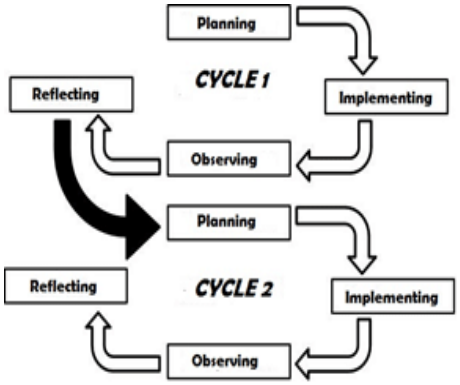

Figure 1. Classroom Action Research Cycle

1. The Planning Stage consists of the following steps: 1) Determining the topic or learning material 2) Profiling students' interests, learning styles, and learning needs 3) Developing a Deep Learning Design (RPM) tailored to the profiling results 4) Creating instructional materials such as teaching resources, learning media, worksheets, and assessment questions 5) Organizing student learning groups 6) Preparing research instruments.
2. Implementation Phase: In this phase, the intervention was implemented based on the lesson plan developed for two learning cycles on the digestive system topic in the IPAS subject. The learning activities followed the Problem-Based Learning (PBL) syntax while integrating the three principles of the Deep Learning approach, as presented in Table 1.
3. Observation/Evaluation: During this stage, the implementation of the learning activities and students' learning process were observed to support the reflection stage. Students' learning outcomes were evaluated at the end of each cycle using an achievement test to determine the effectiveness of the implemented intervention.
4. Reflection is conducted to review and reflect on the learning outcomes achieved in Cycle 1. The results of this reflection and evaluation can be used to determine the continuation of actions to be taken in the next cycle. Thus, the actions taken in the next cycle can be more effective and support students' learning success.

The intervention applied a Deep Learning approach integrated with the Problem-Based Learning (PBL) model in teaching the digestive system material to fifth-grade elementary school students. The implementation of the intervention was carried out by integrating the three principles of Deep Learning, namely meaningful learning, mindful learning, and joyful learning, into each stage of the PBL syntax. The operational mapping of these principles is presented in Table 1.

Table 1. Mapping of Deep Learning Principles into the Problem-Based Learning (PBL) Syntax

Deep Learning Principle	PBL Syntax	Learning Activities
Meaningful Learning	Phase 1: Orienting students to the problem	The teacher presents a contextual problem related to the digestive system through videos and questioning. Students identify the problem and relate it to their daily experiences.

	Phase 4: Developing and presenting the work	Students present the results of their investigations, explain their solutions, and relate scientific concepts to the contextual problem.
Mindful Learning	Phase 2: Organizing students for learning	Students work collaboratively in groups to identify learning tasks, formulate questions, and plan investigations to solve the problem.
	Phase 3: Guiding individual and group investigation	Students collect information, conduct investigations, discuss findings, complete worksheets, and develop solutions under teacher guidance.
Joyful Learning	Phase 5: Analyzing and Evaluating the Problem-Solving Process	Students participate in the Teams Games Tournament (TGT) activity, complete the evaluation, reflect on the learning process, and receive feedback from the teacher.

The research was conducted from March 5 to April 23, 2026, at SDN Bantarkemang 6, involving 21 fifth-grade elementary students in the second semester of the 2025/2026 academic year. Data collected from the achievement tests were analyzed using descriptive statistics to calculate the class mean score and learning mastery percentage (Martias, 2021). Furthermore, student learning outcome levels were categorized based on the Criterion-Referenced Evaluation (PAP) scale adapted from Agung (in Ekayogi, 2022), as shown in Table 2.

Table 2. The Criterion-Referenced Assessment Guidelines (Ekayogi, 2022)

Percentage	Category
90 – 100	Very High
80 – 89	High
65 – 79	Fairly High
55 – 64	Low
0 – 54	Very Low

To determine the success of the actions taken, success criteria or indicators can be established. The success criteria determined in this classroom action research are as follows: 1) An increase in the average learning outcomes of students on the digestive system material in the 5th grade of elementary school from cycle 1; 2) The average learning outcomes of students exceed the specified minimum mastery criterion (≥ 80).

RESULTS AND DISCUSSION

This classroom action research was conducted from March 5, 2026, to April 23, 2026. The study consisted of two cycles. The research subjects were fifth-grade students in the second semester at SDN Bantarkemang 6 during the 2025/2026 academic year. There were 21 students who served as research subjects, and the intervention involved teaching the digestive system unit in the fifth-grade IPAS (Natural and Social Sciences) curriculum. The instruction was delivered using a deep learning approach and the Problem-Based Learning (PBL) model.

Cycle I

Cycle I began on Thursday, March 5, 2026, with a lesson on the digestive system. The approach employed was deep learning using a problem-based learning model. In Cycle I, the primary source of information provided to students was instructional videos, interspersed with group-based educational games. However, student learning outcomes in Cycle 1 did not yet meet the success indicators of the classroom action research, as the average learning outcome score, when converted to the PAP scale, showed a low percentage of 73.8%. The students' average score had not yet reached the established minimum passing criterion (KKM) of 80.

Upon reflecting on the actions taken in Cycle I specifically the lesson plan designed using a deep learning approach with a problem-based learning model several challenges or obstacles were identified. These challenges or obstacles were experienced by both teachers and students. The challenges faced included the following: 1) Insufficient instructional time to accommodate the designed learning activities; 2) A lack of emphasis and reinforcement of the material after watching instructional videos, resulting in students failing to deeply understand the material intended to solve the presented problems; 3) The grouping implementation based on learning styles had not operated effectively during classroom activities, 4) Rules in the games that have not been fully understood by students, 5) Students with higher cognitive levels tend to dominate group work, resulting in less visible involvement and participation from other students.

By reviewing the constraints or obstacles identified in Cycle I, various efforts or interventions were implemented to address the issues found in Cycle I and to improve student learning outcomes in the subsequent cycle. Among the efforts made to address these issues are the following: 1) Allocating the learning time for a single session to 3 Class Hours (3CH), 2) Teachers provided reinforcement and emphasized the material after students watched the instructional video, 3) Students were grouped according to their learning styles, consisting of audiovisual and kinesthetic groups, 4) Information regarding the game rules was clarified and reinforced before the game began, 5) Monitoring and guidance were provided so that students could cooperate and be active in their study groups.

Cycle II

The implementation of actions in Cycle II was carried out following the evaluation and reflection results from Cycle I. The actions or interventions implemented in Cycle II addressed the shortcomings or obstacles experienced and identified in Cycle I to improve students' learning outcomes on the digestive system curriculum in the fifth grade of elementary school. In Cycle II, it can be stated that there was an improvement in student learning outcomes compared to Cycle I. The average student learning outcome in Cycle II was 83.85. This represents a significant increase compared to the average student learning outcome in Cycle I, which was 73.8. When converted to the PAP percentage criteria, the average student learning outcome in Cycle II was 83.85% (High). This indicates an increase of 10% compared to Cycle I.

Based on the success criteria established in this study, it can be concluded that the interventions implemented in Cycle II met the success criteria. First, Cycle II demonstrated an improvement in student learning outcomes compared to Cycle I. Second, the average student learning outcomes met the established minimum passing score of 80.

In addition to the improvement in the average learning outcomes, the percentage of students meeting the minimum passing criterion (KKM ≥ 80) also increased from Cycle I to Cycle II. In Cycle I, 12 out of 21 students (57.1%) met the minimum passing criterion. This number increased to 15 students (71.4%) in Cycle II. These findings indicate that the implementation of the Deep

Learning approach through the Problem-Based Learning model improved not only the average learning outcomes but also the percentage of students who achieved the expected learning outcomes. A summary of each cycle conducted in this Classroom Action Research (CAR) is presented in Table 3 below.

Table 3. Improvement in Students' Learning Outcomes

Cycle	Mean Score	PAP Category	Students Meet KKM (n)	Percentage (%)
Cycle I	73.8	Fairly High	12	57.1
Cycle II	83.85	High	15	71.4

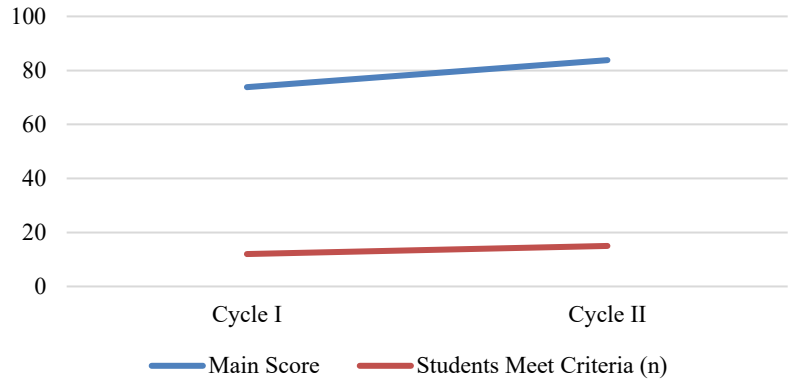

Figure 2. Improvement of Students' Mean Scores and Percentage of Students Meeting the Criteria

Table 3 and Figure 2 show that students' learning outcomes improved from Cycle I to Cycle II. The mean score increased from 73.8 (Fairly High) in Cycle I to 83.85 (High) in Cycle II based on the PAP criteria. Likewise, the number of students meeting the minimum passing criterion increased from 12 students (57.1%) to 15 students (71.4%). These findings indicate that the implementation of the Deep Learning approach integrated with the Problem-Based Learning model not only improved students' average learning outcomes but also increased the proportion of students who successfully achieved the expected learning outcomes.

Based on the implementation of Cycle II interventions, the following findings were identified during the implementation of Cycle II interventions: 1) The instruction provided was aligned with the Deep Learning Plan that had been developed; 2) Students gained a better understanding of the digestive system through instruction tailored to their learning styles; 3) The reinforcement provided by the teacher further deepened students' understanding of the taught material, 4) The 3-hour learning time was sufficient to accommodate learning activities, 5) Students' active engagement was more evident, 6) Students were more enthusiastic and competitive in the games conducted. Furthermore, overall, the average learning outcomes of students in Cycle II have improved and have exceeded the minimum passing score.

Discussion

Based on a review of the research results from the cycles, the classroom action research can be concluded at Cycle II. This is because the success criteria for the classroom action research have been met. Furthermore, this indicates that learning using a deep learning approach can help students understand the material in depth, thereby improving their learning outcomes. This aligns

with the findings of Rahayu et al. (2025), who state that deep learning can help students understand concepts deeply and connect them to real-life situations. According to the Ministry of Basic and Secondary Education, deep learning itself can be understood as a learning approach that prioritizes students and aims to improve the quality of education in Indonesia. Deep learning is based on three principles: mindful learning, meaningful learning, and joyful learning (Mustaghfirin & Zaman, 2025). The learning experiences emphasized in deep learning go beyond mere memorization or recall of material; they involve understanding, applying, and reflecting. This aligns with what Fullan (Rahmawati et al., 2025) stated: in deep learning, students do not merely grasp the material conceptually but are able to connect the interrelationships within the material and apply them in real-life contexts. Consequently, students' learning experiences can be significantly enhanced.

The increase in the average learning outcomes and the percentage of students meeting the minimum passing criterion indicates that the implementation of the Deep Learning approach integrated with the Problem-Based Learning model provided a more meaningful learning experience for students. Through contextual problem-solving activities, group discussions, investigations, and presentations, students were encouraged to actively construct their understanding of the digestive system concepts. As a result, more students were able to meet the minimum passing criterion in Cycle II than in Cycle I.

On the other hand, the use of the Problem-Based Learning (PBL) model also helped improve student learning outcomes in this study. According to Darwati & Purana (2021), the Problem-Based Learning model can help students develop critical thinking skills, understand concepts, and connect those concepts to real-world or everyday issues. This is also supported by the findings of Handayani et al. (2025), who state that the use of the problem-based learning model successfully improved elementary school students' science learning outcomes. Ngatman et al. (2025) also explained that with the Problem-Based Learning (PBL) model, students can explore more and gain more learning experiences. In addition, Zuryanti et al. (2019) also noted that the Problem-Based Learning (PBL) model can help improve students' thinking skills in science education. Thus, the use of the Problem-Based Learning model can support the implementation of deep learning to improve student learning outcomes. With the use of the Problem-Based Learning (PBL) model, students do not merely focus on memorizing or understanding the material but actively apply their understanding to solve existing problems. This helps students gain a deeper mastery and understanding of the material.

Thus, the use of the Problem-Based Learning (PBL) model is highly compatible with the deep learning approach. Through the PBL model, the learning experiences associated with deep learning—as defined by the Ministry of Primary and Secondary Education—can be accommodated, consisting of the experiences of understanding, applying, and reflecting. Through deep learning, students can develop conceptual understanding, interdisciplinary connections, and reflective thinking—all of which serve as a foundation that strengthens the effectiveness of PBL, as students are actively engaged in solving authentic problems through projects and collaborative work (Nurdianti & Kurino, 2026).

In addition, grouping students based on their learning styles also helps make learning more effective. This aligns with Asmawati et al. (2025), which indicates that differentiated instruction can improve science learning outcomes by utilizing learning styles tailored to students' characteristics. The implemention of audio-visual and kinesthetic-based learning in instructional activities can also encourage student engagement and participation science learning.

Thus, based on the research conducted, it can be concluded that deep learning using the Problem-Based Learning (PBL) model can help improve students' learning outcomes on the digestive system material in the 5th-grade elementary school IPAS curriculum. Additionally, the interventions implemented in this study also helped students become more active and collaborative in participating in classroom learning. Students can also understand the interrelationships between the concepts they learn and connect them to real life. Adapting instruction to account for students' learning styles also makes learning more effective and better aligned with their learning needs. Thus, overall, the implementation of deep learning using the PBL model is an appropriate approach for classroom instruction.

CONCLUSION

Based on the classroom action research conducted over two cycles at SDN Bantarkemang 6, the implementation of the deep learning approach integrated with the Problem-Based Learning (PBL) model successfully improved fifth-grade students' science learning outcomes on the digestive system topic. This success is evidenced by the continuous progression of both class mean scores and classical learning mastery. The class average increased from 63.5 on the pretest to 73.8 (Fairly High) in Cycle I, and ultimately reached 83.85 (High) in Cycle II, exceeding the established minimum passing criterion (KKM ≥ 80). Concurrently, the proportion of students achieving learning mastery improved from 57.1% (12 students) in Cycle I to 71.4% (15 students) in Cycle II. Pedagogically, the integration of deep learning principles into the PBL syntax fostered a more mindful, meaningful, and joyful learning environment. Aligning problem-solving tasks with students' learning styles and reinforcing key conceptual insights after video investigations significantly reduced cognitive dominance by higher-achieving students and enhanced collaborative inquiry. Consequently, students moved beyond superficial rote memorization to active, contextual concept construction regarding the human digestive system. Based on these findings, it is recommended that elementary school teachers implement structured student profiling and contextual problem scenarios to operationalize deep learning effectively. Furthermore, future researchers are encouraged to explore the integration of deep learning across other science topics or multidisciplinary subjects, while investigating longitudinal effects on students' critical thinking and retention.

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