

Improving Fourth-Grade Students' Science Learning Outcomes and Motivation through Experimental Methods with a Deep Learning Approach: A Classroom Action Research Study

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ABSTRACT

Background: Experimental learning combined with a pedagogical through deep learning approach is a new activity in elementary school. This deep learning approach in pedagogic activities encourages students to conduct experiments in the classroom through Sciences subjects. **Aim:** This study aims to improve science subject outcomes and learning motivation by using experimental methods and pedagogical through deep learning approaches. **Method:** This study is a Classroom Action Research (CAR) which conducted in two cycles. Each cycle is conducted twice. The number of subjects in this consisting of eighteen students. Data collection was using tests and non-tests. Data collection instruments were test items, observation sheets, and document checklists. Data analysis techniques were descriptive comparative analysis techniques and critical analysis. The results of this study in the first cycle are student learning outcomes showing that ten students who have not reached the Minimum Completion Criteria, while eight students have reached the Minimum Completion Criteria. **Result:** The results of observations of student learning motivation show that the percentage of science learning motivation is in sufficient category. The results of the study in the second cycle are that only two students are incomplete Minimum Completion Criteria, and sixteen students are declared complete. The results of observations of the learning motivation of fourth grade students at Klumprit State Elementary School shows that the total average percentage of motivation to learn science is being increase. **Conclusion:** Thus, it can be concluded that the application of the Experimental Method with a pedagogical deep learning approach can improve students' learning outcomes and motivation in Science in fourth-grade at elementary school.

Keywords: Experimental Method, Deep Learning Approach, Science Learning Outcomes, Learning Motivation.



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INTRODUCTION

Educational needs are crucial because a nation's progress is measured by its development. Efforts to improve educational quality involve refining existing learning support systems. Developing educational support systems can be seen through continually evolving learning approaches. The Pedagogical Deep Learning approach is one approach developed to assist students in the process of acquiring knowledge. IPAS Learning challenges in elementary school are often caused by the sheer volume of material students must cover. This difficulty stems from a lack of instructional approaches designed to foster deep understanding. Deep learning in education has a positive impact on building mindfulness, creating meaningful learning experiences, and making learning more enjoyable for students (Darnaningsih, 2025).

One of the supporting factors for learning activities is subjects with constantly evolving material. This subject is Natural and Social Sciences (IPAS). IPAS plays a crucial role in the changing times. These developments are followed by the

educational process, with the emergence of new curricula. The curriculum that follows the developments of Industry 4.0 is the Merdeka Belajar curriculum. The IPAS subject in the Merdeka Belajar curriculum serves as a foundation for knowledge about the natural and social environment. IPAS is a subject often considered difficult by students due to its broad scope (Alfatonah et al., 2023). Learning IPAS requires both practical activities and experiences that students can experience firsthand. Science learning in the independent curriculum consists of three phases: Phase A, Phase B, and Phase C, each tailored to the students' ages. Fourth-grade elementary school science learning includes Phase B, where students observe natural phenomena and events through their five senses (Standar et al., 2022). IPAS learning in the Merdeka curriculum requires a deep understanding of the material, as it emphasizes students' critical thinking skills. This in-depth understanding of the material will be facilitated by the use of experimental methods learning approach. Critical thinking skills in science learning can be practiced through observation using experimental methods. Students are provided with practical

guidance and questions to be answered through observation. This scientific work process trains students in critical thinking. IPAS learning requires methods that enable students to interpret the material through direct experience. Direct experience can be gained through environmental observations and practical demonstrations, both in the laboratory and through simple classroom exercises. Deep learning approaches in education through pedagogical learning is a suitable method for Merdeka curriculum in elementary schools.

Practical work in science learning facilitates students' introduction to the material and theories being studied. Science learning, which is about the change in the form of objects, involves a wealth of material concepts (Hasanah et al., 2024). Science material must be practiced to motivate students to learn. Students' attitudes during science learning reflect their motivation. Highly motivated students will display logical, critical, and creative attitudes during learning. Students with high learning motivation during science lessons do not appear bored or engrossed in their own learning, but rather actively follow each stage.

Science subjects are well-suited for teaching through experiments to prove theories or investigate phenomena. Experiments in science subjects can be found using the experimental method. The use of experimental methods helps teachers foster student learning motivation (Zulaekho & Kelas SD Negeri, n.d. 2022). Students are motivated to participate in each stage of the experiments in science subjects. Science learning is expected to be not only enjoyable but also foster students' learning awareness and deepen their understanding of each material. Science learning requires an approach that accommodates students' learning awareness.

Learning awareness in science subjects can be fostered through a deep learning approach. This approach is suitable when combined with methods that accommodate students' learning motivation (Khasanah, 2025). Students actively participate in learning activities, students know what they have to achieve after learning, this is in accordance with the self-awareness indicator, namely students are aware of their learning needs (Putri & Ferry, 2024). The deep learning approach emphasizes student learning awareness, the meaningfulness of the knowledge acquired, and a pleasant learning environment. The use of a deep learning approach is expected to improve student learning outcomes and motivation. Using experimental methods with a deep learning approach helps students understand their learning needs, thus motivating them to achieve higher levels of achievement (Nurgiansah, 2022).

Learning motivation is the driving force that drives a person's learning activities (Rahman, n.d. 2020). High learning motivation is demonstrated by good learning outcomes. Students' need to achieve high learning outcomes is influenced by the need to achieve which is driven by working or studying more for high achievement, this is in accordance with the

motivational theory of need for achievement put forward by McClelland (Atma et al., 2021).

Good learning outcomes can be seen from how students engage directly in science lessons. Science learning outcomes encompass three domains of student ability: cognitive, affective, and psychomotor (Apsari, 2021). Learning outcomes will be maximized if supported by teaching approaches and methods that can enhance learning outcomes. Learning outcomes are influenced by the selection of appropriate teaching methods and approaches.

Learning science in elementary schools using the experimental method can provide students with the opportunity to maximize learning outcomes. The experimental method allows students to focus more on the material by training them to practice the material, shifting the focus from teacher-centered to student-centered (Damayanti, 2024). Students practice the material themselves, with the teacher acting as a facilitator. Students experience firsthand how theories are tested and proven. This firsthand experience makes learning more meaningful.

Meaningful learning can be found in the deep learning approach. The deep learning approach focuses on a deeper understanding of the subject matter. The deep learning approach encourages students to gain a comprehensive learning experience, thereby developing higher-order thinking skills (Wandini et al., 2022). A deep learning approach combined with experimental methods will improve student motivation and learning outcomes, as students develop their abilities holistically.

Experimental methods can improve the quality of learning and provide meaningful learning for students (Aisyah et al., n.d.). Students are encouraged to experience for themselves, seek the truth, experiment, and draw conclusions based on the process. The learning process is at the heart of the independent learning curriculum. This learning process is strengthened by a deep learning approach to further enhance meaningful learning. Deep learning was chosen because it helps students understand concepts in depth, rather than simply memorizing (Darnaningsih, 2025).

Science is taught using a deep learning approach because it is expected that students will be able to understand the concepts of the material being taught. Using experimental methods in elementary schools is one option for teachers to improve student learning outcomes. Learning outcomes in science reflect the abilities students acquire through interactions during the learning process (Nurseptyani, 2022). High science learning outcomes, supported by strong motivation to learn science, will have a positive impact, namely high learning outcomes.

A documentary study of daily science test scores for fourth-grade students revealed that many students' scores fell below the school's Minimum Completion Criteria, which is 75. Thirteen out of 18 students, or 72.22%, failed to complete the task. This contributes to low science learning outcomes. One

factor contributing to this is the difficulty of understanding the science material. Experimental learning models are a learning model that can motivate students in learning science and improve student learning outcomes. The use of an experimental model is expected to facilitate student understanding of science and natural sciences material, as the material will be demonstrated and tested through experiments (Nuzula et al., 2022).

Student learning motivation fosters learning activities, enabling them to achieve learning objectives (Rusmiaty, 2021). Students with low motivation during science and natural sciences lessons typically experience low and unsatisfactory learning outcomes. Experimental methods and deep learning approaches are expected to improve science and natural science learning outcomes and motivation. The problem in this study is whether the learning outcomes and learning motivation of fourth grade students will increase if IPAS learning is carried out using an experimental method with a deep learning approach. Thus, the aim of this study is to improve IPAS learning outcomes and learning motivation of fourth grade students by using experimental methods with a deep learning approach.

METHOD

This research is a classroom action research dengan desain penelitian model Kurt Lewin conducted at SDN Klumprit, the research was conducted in two cycles with each cycle having two meetings. The number of subjects was 18 students. Data collection used tests and non-tests. The tests given to students were cognitive tests with multiple choice questions and essay questions. Non-tests used motivation questionnaires, student observation, and documentation. Data collection instruments used test items, observation sheets, and document checklists. The documents used in this study were a recap of grades before the Action was carried out, teaching modules, Learning Objective Flow (ATP), and activity photos. Data analysis techniques used descriptive comparative analysis techniques and critical analysis. Indicators of student learning motivation are: diligently completing assignments, actively participating in lessons, and students' enthusiasm in implementing the steps for practicing IPAS using the experimental method.

This research each cycle consists of four activities: planning, implementation, observation, and reflection. Comparative descriptive techniques are used for quantitative data, namely by comparing results between cycles. Quantitative data analysis techniques are carried out by calculating the completeness of learning outcomes which are compared in each cycle. Critical analysis techniques are related to qualitative data. Qualitative analysis is used to analyze observation data on student learning motivation obtained from the observation sheet instrument. A student is considered to have completed their studies if they achieve a score of 75, and a class is considered to have completed their studies if 85%

students who can achieve. The results of first cycle were compared with the results of second cycle to determine improvements in student learning outcomes through the percentage of completion.

RESULTS AND DISCUSSION

Results

The research conducted in fourth-grade students at SDN Klumprit aimed to improve learning outcomes and motivation in science through an experimental learning model with a deep learning approach. This research began with initial observations, the creation of learning tools including teaching modules, teaching materials, and learning media, and the implementation of research actions. The actions in this research were carried out in two cycles, each cycle tailored to the learning objectives of each cycle. The science subject in this study was energy and its transformation. Pre-cycle activities were conducted without using the experimental method with a deep learning approach.

Observations in fourth-grade students at SDN Klumprit during the learning activities before the action (pre-cycle) revealed a lack of student involvement in the learning process. Students demonstrated a lack of curiosity and were therefore reluctant to ask questions if they encountered difficulties. These learning conditions resulted in low learning outcomes and student motivation. Student learning outcomes in fourth-grade science at SDN Klumprit were not as expected because some students had not yet achieved the minimum mastery level. The results of student learning in pre-cycle activities through document studies showed that only 5 students or 22.78% had complete learning outcomes. Motivation to learn science was 69.5 before the cycle started, in the sufficient category. Motivation to learn science was 69.5 before the cycle started, in the sufficient category. Based on the results of the motivation questionnaire and observations conducted in the science subject, it was shown that some fourth-grade students at SDN Klumprit were not yet fully developed.

The observation result of the activeness of fourth grade students of SDN Klumprit shows that all students are actively participating in the lesson. The students' activeness in participating in IPAS learning has not been balanced with good learning motivation. Students in cycle I have not met the research success criteria because they have not reached a minimum of $\geq 80\%$ of all students. The students' learning outcomes after the test in cycle I show that there are 10 students who have not reached the Minimum Completion Criteria with a percentage of 55.56%, while 8 students have reached the Minimum Completion Criteria with a percentage of completion of 44.44%.

They were given follow-up support in Cycle II to improve their learning outcomes and motivation. The planning activities in Cycle II achieved the research's success criteria, necessitating improvements to the teaching materials. Observations of the learning motivation of fourth-grade students at SDN Klumprit showed improvement. Students'

learning outcomes in Cycle II met the research's success criteria. The results of the IPAS scores in Cycle II showed that two fourth-grade students, or 11.11%, were declared incomplete, and 16 students, or 88.89%, were declared complete. Therefore, a solution to this problem was considered to be using learning methods that help students test the material. The experimental method was chosen, accompanied by a deep learning approach, which makes

learning more meaningful for students. The use of the experimental method and the deep learning approach during the action was expected to improve student understanding and actively engage students in science learning.

Table 1. Pre-Cycle Student Learning Outcomes

Class	Amount	%	Description
IV	13	72.22	Passed
IV	5	22.78	Passed

Discussion

The results of the IPAS subject on fourth grade students of SDN Klumprit from the pre-cycle, cycle I, and cycle II showed an increase in student motivation and learning outcomes. In cycle I, the average score for student learning motivation was categorized as adequate. Influencing factor of improvement in student learning motivation included responses in the student questionnaire indicating that they did not enjoy IPAS lessons. As the learning motivation indicator had not been achieved, the researchers and teachers decided to take action in cycle II. In cycle II, the average learning motivation of students has increased. The increase in learning motivation was evident in the large number of students who felt excited to participate in IPAS lessons. The IPAS learning motivation category was classified as very good. Thus, in cycle II, the very good indicator was achieved. Cycle II was considered successful, so it was not continued to the next cycle.

The action activities in Cycle I and Cycle II were carried out in four meetings. In Cycle I, the results of the fourth-grade student motivation questionnaire at SDN Klumprit indicated that the percentage of students' motivation to learn science was categorized as sufficient. Students' motivation to learn science in Cycle I did not meet the research success criteria. Obstacles encountered in cycle I based on observation results were that students had difficulty working on questions and students still lacked good learning motivation. This result was indicated by many students still daydreaming, asking for permission to leave the classroom, and students who only watched their friends conduct experiments on the material of force and energy. Factors causing the need for Action to be continued to cycle II were factors from the students, students who were not focused on following the learning. The pedagogical deep learning approach has not been fully implemented in learning due to the obstacle encountered, namely that students are not yet accustomed to using effective learning methods through practice. This is consistent with previous research that the deep learning approach requires the habit of effective learning by carrying out practical activities

with limited instructions, which is often used in learning (Hervani Br Barus et al., 2025). Students were found to be not yet aware of the importance of conducting science experiments, so the deep learning approach had not been fully implemented well. The weakness of the experimental method was found during learning activities. Students did not practice if they could not find the appropriate equipment according to the instructional drawings. Consequently, not all experiments were carried out. This was found in previous research that the experimental method can pose difficulties for students who are not used to it (OMA, 2021). Students who are not accustomed to conducting experiments require special attention, so the deep learning approach is the primary approach in implementing the independent learning curriculum. Based on the results obtained in cycle I, it is necessary to continue the Action in cycle II.

The research in cycle II was conducted in two meetings. The action activities in cycle II were guided by the results of the research in cycle I. Learning observation activities were used to determine how students' learning motivation was. Observations of student learning motivation were carried out throughout the implementation of science lessons. A motivation questionnaire was given to students at the end of the lesson to measure their motivation to learn science. Students' science learning motivation in cycle II had met the success criteria. The students' science learning results showed that they had achieved the success criteria, most of students had exceeded the Minimum Completion Criteria score. The results of the action observations that had been carried out in cycle II had run well in accordance with the objectives to be achieved. Observations during the intervention revealed that students appeared more focused on learning, interpreting knowledge, as evidenced by their responses, not solely relying on textbooks but also by their own experiments.

Based on the results of the first and second cycles, it can be concluded that science learning using a deep learning approach within the experimental learning method can improve learning outcomes and motivation for fourth-grade students at SDN Klumprit. A contributing factor to the lack of improvement in student learning motivation was the students'

reluctance to express their opinions during discussions. Students who were reluctant to ask or answer questions resulted in low learning motivation. Therefore, the learning motivation indicator was not achieved. This condition led the researchers and teachers to decide to move to the second cycle. In cycle II, student learning motivation increased and it was categorized as very active. In cycle II, the action achieved very good indicators. Cycle II was deemed successful, so it was not continued to the next cycle. Based on previous research, the experimental method improves students' understanding, namely that students' learning outcomes in science subjects increase. (Seyra et al., 2024).

Learning outcomes in Cycle II were declared successful because they met the success criteria. Regarding improved student learning outcomes, the Experimental method is a learning strategy that uses images as a medium for conveying material. Research results from Cycle II have proven that it can improve student learning outcomes. The researcher and the fourth-grade teacher decided to end the research in Cycle II. The advantages of the Experimental Method is that method motivates students to engage in independent and collective learning. The experimental method encourages the development of 21st-century competencies such as critical thinking, communication, and collaboration (Qomariyah et al., n.d.). This research has advantages compared to previous research because it has not combined experimental methods with a deep learning approach in grade 4 of elementary school. The deep learning approach is one of the most suitable approaches for science subjects, due to its deep learning approach. A limitation of the study is the lack of time to accustom students to deep thinking through the use of the deep learning approach.

CONCLUSION

Experimental methods with a pedagogical deep learning approach can improve learning outcomes and motivation to learn science in grade IV students of Klumprit State Elementary School. The deep learning approach encourages students to build full awareness in learning, through the application of experimental methods, where this method helps students to practice theory consciously, so that science learning becomes more meaningful and enjoyable. Experimental learning methods with a deep learning approach can help teachers to find out how far students understand the material. Improvements in student learning outcomes are demonstrated by the average score in each cycle, from 64 in the pre-cycle to 67 in the first cycle, then 85 in the second cycle.

This method and approach can increase students' motivation to learn science. The increase in student learning motivation is demonstrated by the average score in each cycle, from 74 in the first cycle to 80 in the second cycle.

Experimental learning models with a deep learning approach can increase students' motivation to learn science. Experimental learning methods with a deep learning approach

can improve students' learning outcomes in science subjects for grade IV students.

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