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THE IMPLEMENTATION OF THE EXPERIMENTAL METHOD AND ITS EFFECT ON IPAS LEARNING ACHIEVEMENT AMONG FOURTH-GRADE STUDENTS AT MI MA'ARIF GONDANG, WATUMALANG, WONOSOBO

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ABSTRACT

Improving student learning outcomes and engagement in science remains a challenge in Indonesian elementary schools, highlighting the need for effective teaching methods. This study aims to determine the effect of the application of the experimental method on student learning achievement in the subject of science for grade IV at MI Ma'arif Gondang Watumalang Wonosobo, as well as to analyze the improvement in learning outcomes and student responses to learning. This study uses a quantitative approach with a quasi-experimental design of the non-equivalent control group design. The subjects of the study consisted of two classes, namely the experimental class and the control class with a total of 32 students each. Data collection techniques include tests (pretest and posttest) and student response questionnaires. The results of the study showed that there was a significant increase in student learning achievement in the experimental class after the application of the experimental method. The average pretest score of the experimental class was 45.81, increasing to 82.47 in the posttest, while the control class increased from 39.81 to 67.90. The results of the hypothesis test showed a significance value of 0.000 <0.05, which means there is a significant effect of the experimental method on student learning achievement. In addition, the results of the N-Gain analysis showed that the increase in learning outcomes in the experimental class was in the medium to high category (68.77), higher than the control class (50.61). Student responses to experimental learning also showed positive results, where students were more active, enthusiastic, and easily understood the material.

1. INTRODUCTION

Education is a fundamental aspect of human life, playing a role in developing knowledge and skills, and shaping individual character (Alpian et al., 2019). High-quality education produces human resources capable of adapting to changing times. However, in Indonesia, education still faces significant challenges, including low learning quality, limited innovation in teaching methods, and weak student engagement in the learning process (Fadia & Fitri, 2021). For example, recent PISA results show that Indonesian students rank below the OECD average in literacy, numeracy, and

science, indicating gaps in both theoretical understanding and practical application of scientific concepts in daily life (Dewi, Jumini, & Adi, 2022). These persistent issues highlight the need for research that explores effective strategies to improve student learning outcomes and engagement in the Indonesian educational context.

In the context of elementary school learning, the implementation of the Independent Curriculum has brought significant changes, one of which is the integration of science and social studies into Natural and Social Sciences (IPAS) (Anggraena et al., 2022). This integration aims to enable students to understand natural and social phenomena holistically. However, in practice, IPAS learning is still often dominated by lecture methods, which tend to make students passive, less actively involved, and have difficulty understanding abstract concepts (Imkhala and Ariyanto, 2024). Teachers often deliver material verbally without the support of media or activities that actively engage students. However, the use of varied learning methods is essential to stimulate students to actively observe and experiment, thus increasing their enthusiasm for learning (Chaeroh, Utami, & Jumini, 2023). This contradicts the essence of science learning, which should provide students with direct experience through exploration and experimentation..

Based on observations at MI Ma'arif Gondang Watumalang Wonosobo, it was found that the science learning process remains teacher-centered, with teachers primarily delivering material verbally without the support of media or activities that actively engage students. As a result, students struggle to understand the material, struggle to answer questions, and demonstrate low participation in learning. This situation impacts low student achievement and suboptimal achievement of learning objectives.

One alternative solution to address these issues is to implement the experimental method in learning. The experimental method is a learning approach that provides students with opportunities to conduct direct experiments, observe processes, analyze results, and draw conclusions based on real-life experiences. Through this method, students not only passively receive information but also actively participate in the learning process, thereby improving conceptual understanding and critical thinking skills (Mutmainah, 2021).

In science learning, particularly on the topic of changes in state of matter, experiments using simple media such as camphor can be an effective alternative. Camphor sublimates, changing from a solid to a gaseous state without passing through a liquid phase, and can also recrystallize under certain conditions. This phenomenon can be directly observed by students, helping them understand the concept of changes in state of matter in a more concrete and meaningful way (Sudrajat and Adri, 2026).

Achievement is an indicator of students' success in understanding the learning material. Improved achievement can be achieved if the learning process provides meaningful learning experiences that are tailored to student characteristics (Saputri et al., 2026). By implementing experimental methods, it is hoped that students gain hands-on learning experiences that can improve conceptual understanding, skills, and overall learning outcomes (Sari, 2019).

Based on the description, this study aims to: (1) determine the effect of the application of the experimental method on student learning achievement in the subject of science in grade IV, (2) analyze the increase in student learning achievement after the application of the experimental method, and (3) determine student responses to experimental learning on the material of changes in the state of matter. This study is expected to contribute to the development of innovative learning methods and improve the quality of science learning in elementary schools.

2. METHOD

This study employed a quantitative approach with a quasi-experimental approach because not all external variables could be fully controlled. A non-equivalent control group design was employed, involving two groups: an experimental group and a control group. Both groups were given a pretest to determine initial abilities, and a posttest to measure post-treatment outcomes. The experimental group received experimental learning, while the control group used conventional learning methods.

The study was conducted at MI Ma'arif Gondang Watumalang Wonosobo in the 2025/2026 academic year. The population was all 64 fourth-grade students. Saturated sampling was used, dividing the entire population into two classes: an experimental class and a control class, each with 32 students. The variables in this study consisted of the independent variable, the experimental method, and the dependent variable, student achievement in science. The experimental method employed involved experimenting with changes in the state of matter using camphor, allowing students to directly observe the sublimation and crystallization processes.

Data collection techniques used in this study included tests and questionnaires. The tests were used to measure student achievement through pretests and posttests. The test instruments consisted of objective questions structured around the topic of changes in the state of matter. The questionnaires were used to assess students' responses to the experimental learning using a five-level Likert scale. The research instruments used underwent validity and reliability tests to ensure the feasibility of data collection. Validity is used to measure the instrument's accuracy in measuring the variables studied, while reliability is used to determine the consistency of the measurement results.

Data analysis techniques were conducted quantitatively through several stages, namely prerequisite testing and hypothesis testing. The prerequisite testing included a normality test using the Kolmogorov-Smirnov test and a homogeneity test to determine the equality of variance between the two groups. After meeting the requirements, the analysis continued with a t-test to determine the difference in means between the experimental and control groups. Furthermore, an N-Gain test was used to determine the level of improvement in student learning outcomes after treatment. The results of the analysis were then interpreted to determine the effect of the experimental method on student achievement.

3. RESULTS AND DISCUSSION

This section presents the results of research on the effect of experimental methods on student achievement in science. The data analyzed include pretest and posttest results, learning improvement (N-Gain), hypothesis testing results, and student responses to learning. The results are presented systematically to provide an overview of the effectiveness of experimental methods in improving student achievement.

3.1. Pretest and Posttest Results

The research results at the initial and final stages of learning were obtained through pretests and posttests administered to the control and experimental classes. This data aimed to determine students' initial abilities and improvements in learning outcomes after the treatment.

Table 1. Recapitulation of Pretest and Posttest Results

Class	Test Type	Average	Highest Score	Lowest Score
Control	Pretest	39,81	67	20
Control	Posttest	67,90	100	40
Experiment	Pretest	45,81	73	20
Experiment	Posttest	82,47	100	53

Table 1 shows that both classes experienced improved learning outcomes after the learning process. In the control class, which used conventional methods, the average score increased from 39.81 on the pretest to 67.90 on the posttest. Meanwhile, in the experimental class, which used experimental methods, the average score increased from 45.81 to 82.47. Comparatively, the improvement in learning outcomes in the experimental class was higher than in the control class. Furthermore, the minimum score in the experimental class after the treatment was also higher (53) than in the control class (40), indicating that the experimental method not only increased the average score but also helped improve student learning outcomes more evenly.

Overall, these results indicate that learning using experimental methods has a more optimal impact on improving student achievement than conventional methods. This finding is an early indication that direct student involvement in the learning process through experimental activities can strengthen understanding of the concepts being studied.

3.2. Hypothesis Test Results

Hypothesis testing was conducted to determine whether there was a significant difference between learning outcomes before and after the application of the experimental method.

Table 2. Hypothesis Test Results (t-test)

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Learning outcomes	-36.750	12.155	2.149	-41.132	-32.368	-17.103	31	0.000

Based on Table 2, a significance value of 0.000 < 0.05 was obtained, thus concluding that there was a significant difference between learning outcomes before and after the implementation of the experimental method. Therefore, the research hypothesis stating that the experimental method influences student achievement in science is accepted. These results indicate that the experimental method has a positive impact on improving student achievement.

3.3. Learning Outcome Improvement (N-Gain)

Improvements in student learning outcomes were analyzed using the N-Gain test to determine the effectiveness of learning after treatment was given.

Table 3. N-Gain Test Results

Class	Mean N-Gain	Category
Experiment	68,77	Medium–High
Control	50,61	Medium

Table 3 shows that the average N-Gain score in the experimental class was 68.77, which falls into the moderate to high category. Meanwhile, the control class achieved an average score of 50.61, which falls into the moderate category. These results indicate that student learning outcomes improved significantly in the experimental class compared to the control class. Furthermore, the improvement in the experimental class was more even and stable. Therefore, it can be concluded that the use of experimental methods is more effective in improving student learning outcomes than conventional methods.

3.4. Student Response to Learning

Student responses to learning using the experimental method were obtained through a questionnaire given to students in the experimental class after the learning process. The questionnaire consisted of five statements with a Likert scale.

Table 4. Summary of Student Responses

Information	Value	Percentage
Questionnaires distributed	32	100%
Questions returned	32	100%
Questions can be processed	32	100%

Based on Table 4, all questionnaires distributed to respondents were returned and processed properly, allowing for comprehensive analysis of student responses. The results of the questionnaire analysis indicate that the majority of students responded positively to learning using the experimental method. Students felt more engaged and active in participating in the lesson, and understood the material more easily. Furthermore, the experimental activities provided a more enjoyable and meaningful learning experience than conventional learning. These positive responses indicate that the experimental method not only improves academic achievement but also increases student motivation and engagement in the learning process. Therefore, the experimental method can be an effective alternative learning strategy for improving the quality of science learning.

3.5. Discussion

The results of the study showed that the application of the experimental method had a significant impact on student achievement in science. This was evident in the difference in learning outcomes between the experimental and control classes, with the experimental class showing higher results. The results of the study showed that the application of the experimental method had a

significant impact on student achievement in science, as evidenced by the higher posttest scores in the experimental class compared to the control class. Based on the pretest results, the initial abilities of students in both classes were relatively low and showed no significant differences, indicating that both groups started at nearly the same level and that the treatment was the primary factor influencing learning outcomes.

After the treatment, the average posttest score in the experimental class increased from 45.81 to 82.47, while the control class increased from 39.81 to 67.90, demonstrating that the experimental method was more effective than the conventional method.The improved learning outcomes in the experimental class are inseparable from the characteristics of the experimental method, which emphasizes active student involvement in the learning process. Students not only passively receive material but also directly observe, experiment, and demonstrate. In the context of the material on changes in state of matter, the use of camphor as an experimental medium provides students with concrete experiences in understanding the processes of sublimation and crystallization. This makes learning more meaningful and easier to understand.

Theoretically, these findings align with behaviorist theory, which emphasizes the importance of stimuli in the learning process. The experimental method provides a powerful stimulus through hands-on activities, eliciting positive responses from students in the form of activeness, enthusiasm, and engagement in learning (Naibaho et al., 2023). These responses contribute to improved conceptual understanding and student learning outcomes. Furthermore, experimental learning aligns with the constructivist approach, where students construct knowledge through direct experience.

In contrast, in the control class using conventional methods, learning tended to be one-way and lacked active student engagement. This resulted in students lacking enthusiasm and experiencing difficulty understanding the material, resulting in less optimal learning outcomes than in the experimental class. The results of the student response questionnaire also showed that the majority of students responded positively to learning using the experimental method. Students felt more interested, more active, and understood the material more easily. This indicates that the experimental method impacts not only cognitive aspects but also affective aspects of students, particularly learning motivation.

The findings of this study support previous research that suggests the experimental method can improve student learning outcomes. Research by Maghfirah (2023) and Trisnawati (2023) demonstrated that experiment-based learning positively impacts student learning outcomes and engagement. Therefore, these results reinforce previous findings that the experimental method is an effective learning strategy. Overall, the results of this study indicate that the experimental method can create more active, engaging, and meaningful learning. Implementing this method not only improves student achievement but also encourages optimal student engagement in the learning process. Therefore, the experimental method can be used as an effective alternative learning strategy to improve the quality of science learning in elementary schools.

4. CONCLUSION

Based on the research results and discussion, it can be concluded that the implementation of the experimental method had a significant effect on student achievement in fourth-grade science. This was demonstrated by the greater improvement in learning outcomes in the experimental class compared to the control class. The average posttest score for the experimental class was higher, and

the N-Gain test results indicated a higher improvement category. Furthermore, the results of the hypothesis test indicated a significant difference between learning outcomes before and after the implementation of the experimental method. Student responses to the learning also showed a positive trend, with students becoming more active, interested, and easily understanding the material through the experimental activities. Thus, the experimental method has proven effective in improving student achievement and engagement in science learning.

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