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The Effect of the Light Property Box (Kosica) Media-Assisted Experimental Method on Students' Learning Outcomes in Science Learning at Grade IV of UPTD SD Negeri 122371 Pematangsiantar

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Abstract

This study aims to determine the effect of the Light Properties Box (Kosica) Media-Assisted Experimental Method on the science learning outcomes of fourth-grade students at the UPTD of Pematangsiantar State Elementary School 122371. This study employed a quantitative pre-experimental method with a One Group Pretest-Posttest design. The study population and sample size were 22 students. Data collection used a pretest and posttest, which had previously been tested for validity and reliability. Of the 50 questions tested, 30 were valid and suitable for use in the study. The reliability test results showed a value of 0.970, a high category, thus declaring the instrument consistent and reliable. The pretest was administered to determine students' initial abilities before the treatment, followed by the application of the Light Properties Box (Kosica) Media-Assisted Experimental Method to the topic of light properties. This method is designed to help students understand concepts concretely and increase student engagement during the learning process. After the treatment, students took a posttest to determine improvements in learning outcomes. The results showed that the average pretest score of 53.3 increased to 78.3 in the posttest. The N-Gain test obtained a score of 0.6525, which is in the moderate to high category, while the t-test results showed a calculated t value of 10.786, which is greater than the t table of 1.720. Thus, Ho is rejected and Ha is accepted. It can be concluded that the Experimental Method Assisted by the Light Properties Box (Kosica) Media has a significant effect on students' science learning outcomes.

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Keywords: experimental method, Light Properties Box (Kosica) media, science learning outcomes.

INTRODUCTION

The global education sector continues to face a serious learning crisis, particularly in the development of students' scientific literacy and problem-solving skills. According to the UNESCO Global Education Monitoring Report (2024–2025), although access to education has increased significantly worldwide, many students still experience low learning achievement and difficulties in applying knowledge to real-life situations. This condition is closely associated with the long-term impact of post-pandemic learning loss, which has affected students' concentration, cognitive abilities, and critical thinking skills. Consequently, educational systems are challenged not only to recover academic achievement but also to rebuild students' higher-order thinking competencies required in the twenty-first century.

In response to these challenges, educational practices have gradually shifted toward student-centered and interactive learning approaches. The OECD Education at a Glance (2024) emphasizes that learning success is not determined solely by technological advancement, but also by instructional methods that actively engage students in meaningful learning experiences. In science education, students are expected to develop critical thinking, creativity, collaboration, and communication skills. However, these competencies are difficult to achieve when classroom instruction still relies heavily on conventional lecture methods and memorization-oriented learning.

This issue is also evident in Indonesia. The Programme for International Student Assessment (PISA) 2022 reported that Indonesian students' scientific literacy remains below the OECD average. Many students still struggle to apply scientific concepts to everyday situations. In response, the Indonesian government introduced the Merdeka Curriculum, which promotes inquiry-based and project-oriented learning. Nevertheless, the implementation of innovative instructional approaches in elementary classrooms remains limited, especially in science learning.

Preliminary observations conducted at UPTD SD Negeri 122371 Pematangsiantar revealed that fourth-grade IPAS learning was still dominated by teacher-centered instruction, such as lectures and textbook assignments. As a result, students tended to be passive and less engaged during the learning process. The abstract nature of science concepts, particularly the topic of light properties, became difficult for students to understand because learning activities lacked concrete visualization and direct experimentation. This condition was reflected in

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students' semester examination scores, as presented in Table 1.

Table 1. Students' IPAS Semester Examination Results

Class	Minimum Mastery Criteria (KKM)	Total Students	Students Achieving KKM	Students Below KKM
IV	65	22	7 (31.82%)	15 (68.18%)

Source: UPTD SD Negeri 122371 Pematangsiantar

The data indicate that most students had not achieved the expected learning outcomes. Therefore, an innovative instructional strategy is needed to improve students' understanding and engagement in science learning. One learning approach considered effective in addressing this issue is the experimental method. According to Hamdani (2019), the experimental method enables students to directly observe, investigate, analyze, and conclude scientific phenomena through hands-on activities. This method encourages active participation and allows students to gain meaningful learning experiences.

The implementation of experimental learning is strongly supported by constructivist learning theory proposed by Piaget and Vygotsky. Constructivism emphasizes that knowledge is actively constructed through experience, interaction, and social collaboration. Students learn more effectively when they are directly involved in observation and experimentation activities. In addition, Kolb's Experiential Learning Theory states that meaningful learning occurs through concrete experiences followed by reflection and conceptual understanding. Therefore, experimental activities are considered highly suitable for elementary science learning because they help students connect theoretical concepts with real-world experiences.

Several previous studies have confirmed the effectiveness of experimental methods in improving science learning outcomes. Benu and Maria (2025) found that the experimental method significantly improved elementary students' understanding of matter properties. Similarly, Nurjannah et al. (2023) reported a substantial increase in students' science achievement after the implementation of experimental activities on heat transfer material. Wilani and Marjo (2025) also concluded that experimental learning effectively improved both students' learning outcomes and science process skills.

Despite these positive findings, many previous studies relied on digital or application-based learning media, which are often difficult to implement in schools with limited technological facilities. Therefore, there is a need for simple, affordable, and contextual learning media that can easily be used in elementary classrooms. In this study, the researcher developed

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the Light Properties Box (Kotak Sifat Cahaya/Kosica) as a simple experimental learning medium designed to help students understand the properties of light through direct observation and experimentation.

Based on the identified problems and previous research findings, this study aims to examine the effect of the Experimental Method Assisted by the Light Properties Box (Kosica) on the IPAS learning outcomes of fourth-grade students at UPTD SD Negeri 122371 Pematangsiantar. This study is expected to contribute to the development of innovative and contextual science learning strategies that support active student participation and improve learning outcomes in elementary education.

RESEARCH METHODS

1. Research Design

This study employed a Pre-Experimental approach using the One Group Pretest-Posttest Design. This research design involved only one class, namely Grade IV students of UPTD SD Negeri 122371 Pematangsiantar, which served as the experimental class without a comparison group. The purpose of this design was to obtain an understanding of the effect of the Experimental Method Assisted by the Light Properties Box (Kosica) media on students' IPAS learning outcomes in Grade IV at UPTD SD Negeri 122371 Pematangsiantar. The pretest was administered before the implementation of the Experimental Method Assisted by the Light Properties Box (Kosica), while the posttest was conducted after the implementation of the method. The research design used in this study is presented in Table 2.

Table 2. One Group Pretest-Posttest Design

Pretest	Treatment	Posttest
O1	X	O2

Source: Sugiyono (2013)

Description:
O1 : Initial measurement before the implementation of the Experimental Method Assisted by the Light Properties Box (Kosica) (pretest).
X : Treatment using the experimental method.
O2 : Final measurement after the implementation of the Experimental Method Assisted by the Light Properties Box (Kosica) (posttest).

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2. Research Location and Timeline

This research was conducted at the UPTD SD Negeri 122371 on Jalan Kesatria, Siantar Timur District, Pematangsiantar City. The researchers chose this school as the research site because it faces significant challenges in education, such as the lack of effective learning methods, resulting in low student learning outcomes, particularly in science. The research was conducted from December 2025 to May 2026 in fourth-grade students at the UPTD SD Negeri 122371 Pematangsiantar during the 2025/2026 academic year.

3. Population and Sample of the Study

The population of this study consisted of all fourth-grade students of UPTD SD Negeri 122371 Pematangsiantar, totaling 22 students, consisting of 10 female students and 12 male students. The sampling technique used in this study was saturated sampling (total sampling), which is a technique in which all members of the population are used as the sample. Therefore, the sample in this study included all fourth-grade students of UPTD SD Negeri 122371 Pematangsiantar.

The details of the research sample are presented in Table 3 below.

Table 3. Sample of Grade IV Students at UPTD SD Negeri 122371 Pematangsiantar

Class	**Gender**	**Number of Students**
IV	Female	10
IV	Male	12
Total		**22**

4. Data Collection Techniques

In this study, the researcher used a test as a measurement tool to assess students' learning outcomes in the cognitive domain. The test consisted of both a pretest and a posttest in the form of multiple-choice questions totaling 30 items.

5. Data Analysis Techniques

The data analysis technique used in this study was descriptive statistics. According to Fitri et al. (2023), descriptive statistics are statistics used to analyze data by describing or illustrating the collected data as it is, without aiming to make general conclusions or generalizations to the wider population. The purpose of descriptive analysis is to identify and explain research

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problems clearly, accurately, and systematically based on field findings.

RESULTS AND DISCUSSION

This research was conducted from December 2025 to May 2026, starting with the preparation of the research proposal and ending with the conclusion. This study aimed to determine the effect of the Kosica Media-Assisted Experimental Method (Light Properties Box) on the Science Learning Outcomes of Fourth-Grade Students at the UPTD of Public Elementary School 122371 Pematangsiantar. The population used in this study was all fourth-grade students at the UPTD of Public Elementary School 122371 Pematangsiantar. The sample used was the entire population, totaling 22 students. In this study, the researcher used quantitative research with a pre-experimental type using a one-group pretest-posttest design. This section will describe the results of the study. These results are conclusions drawn based on the collected data and data analysis. Before conducting the research, the researcher first conducted a trial of the instrument at the same level in a different school, conducted by the UPTD of Public Elementary School 122388, Jl. Rangkutta Sembiring, Pematangsiantar. The trial was conducted on 26 students to determine the validity of the multiple-choice questions. The validity test revealed that out of 50 questions tested, 30 were found to be valid. The reliability test yielded a score of 0.970, which is considered high reliability. The questions found to be valid and reliable were used as pretests and posttests in the research class.

After obtaining valid and reliable test instruments, the researchers administered a pretest on April 21, 2026, in a fourth-grade class at the UPTD of SD Negeri 122371 Pematangsiantar. This was done to determine the students' abilities before the treatment. Based on the pretest results, the average student learning outcome was 53.3, with only 9 students scoring above the minimum competency standard (KKTP) and 13 students scoring below the KKTP. Percentage-wise, of the 22 students who took the pretest, only 40.91% passed the KKTP. Looking at the percentage of the pretest learning results, it can be said that the level of student learning outcomes before using the Light Properties Box Media Assisted Experimental Method (Kosica) was still relatively low. On April 24, 2026, researchers conducted another study using the Light Properties Box (Kosica) Experimental Method in science lessons on the properties of light. After administering the treatment, the average posttest score for students was 78.3, with 4 students failing the GCSE and 18 students scoring above the GCSE. Percentage-wise, 81.81% of the 22 students who took the posttest completed the GCSE. The 25.0 point increase in pretest and posttest scores indicates improved learning outcomes compared to before using the Light Properties Box (Kosica) Experimental Method.

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After processing the data using the N-Gain test, the N-Gain Score was 0.6525, equivalent to 65.25%. An N-Gain Score >0.7 indicates moderate effectiveness. Although in the moderate category, if the Light Properties Box (Kosica) Media-Assisted Experimental Method is revised with a more creative and innovative approach, it is likely to be highly effective. Furthermore, to answer the research hypothesis, a hypothesis test was conducted. Based on the results of the data analysis, the calculated t value was 10.786 and the t table value was 1.720, with a significance level of 0.05 or 5% with df = 21. Thus, it can be concluded that the calculated t value is greater than the t table value, meaning H0 is rejected and Ha is accepted, indicating the influence of the Light Properties Box (Kosica) Media-Assisted Experimental Method on the Science Learning Outcomes of Grade IV Students at the UPTD of SD Negeri 122371 Pematangsiantar.

The application of the Light Properties Box (Kosica) Media-Assisted Experimental Method enables students to be directly involved in the learning process, where they discover and verify the material they are studying for themselves. According to Hamdani (2019) the experimental method is the presentation of learning materials in which students directly conduct experiments, and the experimental method provides every opportunity for students to observe or do it themselves, follow a procedure, observe an object, analyze, prove and draw their own conclusions about something. Therefore, the Experimental Method is very helpful for teachers in creating active and creative learning so that students do not feel bored because the science material has been realized in real terms and this makes students more interested in studying the next science material. This is in line with the constructivism theory developed by Piaget and Vygotsky as quoted by Kumala (2016) which says that students will master the material better if they directly learn from personal experience.

The results of this study add scientific evidence about the influence of the Experimental Method on learning outcomes as has been done by Benu & Maria with the research title The Effect of the Experimental Method on Science Learning Outcomes of Fourth Grade Students of SD Inpres Labat, Kupang City. Based on data analysis, the average learning outcome using the conventional method was 54.55 while the average student learning outcome after applying the experimental method was 82.57. This is reinforced by the results of the hypothesis test which shows that the significance value (sig.2-tailed) is 0.00 and the value is smaller than the probability of 0.05 (0.00 <0.05). So H0 is rejected and Ha is accepted, which means that the research conducted by Benu & Maria shows the influence of the Experimental Method on the science learning outcomes of fourth grade students of SD Inpres Labat, Kupang City. This study also supports previous research by Wilani & Marjo (2025), which found an increase in learning

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outcomes from 68.3 to 84.5 and process skills from 72.85 to 88.35 after implementing the Experimental Method in the learning process. Therefore, it can be concluded that the Experimental Method is effective in improving student learning outcomes.

Based on the research findings, theoretical support, and alignment with previous research, it can be concluded that the Experimental Method Assisted by the Light Properties Box (Kosica) has proven effective in improving science learning outcomes in fourth-grade students at the UPTD of SD Negeri 122371 Pematangsiantar. Therefore, this method is effective as an alternative to create innovative and engaging learning.

CONCLUSION

Based on the research results and discussion presented, the following conclusions can be drawn:

1. The application of the Light Properties Box (Kosica) Media-Assisted Experimental Method significantly improved the science learning outcomes of fourth-grade students at the UPTD of Public Elementary School 122371 Pematangsiantar. This is evidenced by the increase in the average student score from 53.3 in the pretest to 78.3 in the posttest.
2. The N-Gain Test results obtained an N-Gain Score of 0.6525, or an average percentage of 65.25%, indicating that the overall improvement in student learning outcomes is in the moderate category. This indicates that the use of the Light Properties Box (Kosica) Media-Assisted Experimental Method can improve students' science learning outcomes.
3. The results of the Hypothesis Test showed that the sig value (2-tailed) was 0.00, which is less than the significance level of 0.05, resulting in a t-count of 10.786 and a t-table of 1.720. This data states that t count > t table, so H0 is rejected and Ha is accepted, which proves that there is an influence of the experimental method assisted by the light properties box media (Kosica) on the science learning outcomes of students in class IV of UPTD SD Negeri 122371 Pematangsiantar.

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