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Implementation Of The Read Answer Discuss Explain Create Learning Model To Improve The Cognitive Learning Outcomes Of Grade VIII Students On The Material Of Light and Optical Devices

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Abstract- This study aims to describe and analyze the cognitive learning outcomes of students by applying the Read, Answer, Discuss, Explain, and Create (RADEC) learning model on the topic of light and optical devices in grade VIII of SMPN 5 Pekanbaru. The population of this study consisted of all grade VIII students, spread across eight classes. To determine the sample, normality and homogeneity tests were conducted, followed by a simple random sampling technique, resulting in a total of 67 students selected as participants. The research employed a quasi-experimental design with a post-test control group design. The experimental group was taught using the RADEC model, while the control group used conventional learning methods. Data on students' cognitive learning outcomes were obtained through post-test assessments and then analyzed statistically. The results revealed that the cognitive achievement of students in the experimental group reached an average score of 78, categorized as high. In contrast, the control group obtained an average score of 65.31, which was categorized as medium. Furthermore, hypothesis testing showed a significant difference between the two groups, indicating that the application of the RADEC learning model had a positive impact on students' cognitive outcomes. The improvement in the experimental class is strongly attributed to the structured phases of RADEC, which encourage active student engagement. The phases of reading, answering, discussing, explaining, and creating allowed students to not only comprehend the material but also to communicate their understanding and apply it creatively. Such active involvement fostered deeper learning, critical thinking, and collaboration skills, which were less evident in the conventional class. In conclusion, the RADEC learning model is proven to be an effective strategy to enhance students' cognitive learning outcomes in physics, especially on light and optical devices. This model can serve as an alternative instructional approach for teachers seeking to improve student achievement and engagement in science learning.

Keywords: *Constructivism Learning, Cognitive Learning Outcomes, Light and Optical Instruments*

1 Introduction

Education is the main foundation for the development of individuals and society. To ensure measurable and sustainable quality of education, an effective quality assurance system is needed (Rizal et al., 2020). In the challenging 21st century, education serves as a crucial process that equips each individual to achieve independence and mental maturity. Thus, they will be able to compete and develop in various competitive sectors of life (Ikhsan, 2025).

21st century skills require students to have 4C abilities, namely critical thinking, collaboration, communication, and creativity (Permana et al., 2023). These skills will help students work effectively in groups, solve complex problems, and strengthen tolerance among peers. Through critical and creative thinking, students can better face the challenges that arise in everyday life. With low student learning

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outcomes, the national education system faces a difficult challenge to achieve 21st century competencies. This is evidenced by an evaluation conducted by the Organization for Economic Co-operation and Development (OECD).

The OECD assesses Indonesian students in secondary education in three main areas: literacy, mathematics, and science (Fajria et al., 2025). Out of 81 participating countries, Indonesia is ranked 68th, with an average score of 383 in the science category, far below the international average score of 485, indicating that Indonesia is still at the lowest level in the PISA assessment. One of the areas of education that has a central role in developing progressive mindsets and understanding of reality is Natural Science Learning (IPA) (Susanto et al., 2019). Overall, the goal of science learning is to improve all students' abilities. The facts show that changes in the curriculum and regulations made by the government have not fully resolved the various problems that still exist in schools (Amaliyah, 2021).

In the science learning process in grade VIII on the material of light and optical instruments, it did not go well. The teacher's teaching pattern, which tends to be monotonous, still uses the lecture method and one-way assignments, making the class feel stiff and minimal interaction, thus affecting students' cognitive learning outcomes (Susanti, 2016). Improvements are needed in science learning activities, including implementing interesting and innovative learning models or methods, using varied media, and learning activities that can support student learning outcomes (Widyarti et al., 2024). The RADEC learning model is an alternative learning model that is in accordance with current conditions (Pratama et al., 2019). The RADEC model is a learning model that can encourage students to think critically so that it can improve students' cognitive learning outcomes, especially in the material of light and optical instruments.

2 Research Methodology

This study uses a quantitative research method using a quasi-experimental posttest control group design. This activity involves an experimental group that receives special treatment and a control group that does not receive special treatment. To see the effect, the researcher gave a final test (posttest) at the end of the study using a questionnaire (Maryam & Fatmawati, 2024). The research design can be seen in table 1 below.

Table 1 Research Design

Eksperimen	:	X	O_1
Kontrol	:	-	O_2

(Source: Sugiyono, 2013:76)

Based on table 1, this study was conducted with an experimental class and a control class. Where the experimental class is a class that implements the RADEC learning model while the control class is a class that applies conventional methods to the material of light and optical instruments. This research was conducted at SMPN 5 Pekanbaru which is located on Jalan Sultan Syarif Qasim, Rintis, Kec. Lima Puluh, Peanbaru City. The time of implementation of this research is in the even semester of the 2024/2025 academic year. This research was conducted in January - May 2025.

The population used in this study were all students of class VIII of SMPN 5 Pekanbaru consisting of 8 classes. The sample selected using the random sampling technique was class VIII.7 as the experimental class with 35 students and class VIII.1 as the control class with 32 students. The prerequisite tests used in this study are the normality test using the Kolmogorov Smirnov test type and the homogeneity test using the Levene test type.

The data collection technique in the study was through a written test. With the research instrument used, namely by providing a multiple-choice test. The results of students' cognitive learning were analyzed by calculating the average percentage of scores obtained by students. The scores obtained by students were calculated using the following formula:

$$Hasil\ belajar\ kognitif = \frac{jumlah\ soal\ benar}{jumlah\ seluruh\ siswa}\ x\ 100$$

The results of student scores are categorized based on the cognitive learning outcome categories which can be seen in table 2 below.

Table 2 Categories of student cognitive learning outcomes

Interval (%)	Category
$80 < x \leq 100$	Very high
$65 < x \leq 80$	High
$55 < x \leq 65$	Medium
$40 < x \leq 55$	Low
$0 < x \leq 40$	Very Low

(Arikunto, 2009)

3 Results and Discussion

The learning process was carried out in three meetings, then a post-test was conducted using a test instrument that would be tested in the experimental class and the control class. The purpose of the post-test was to see the cognitive learning outcomes of students in each class after being given treatment. This study consisted of two data analyses, namely descriptive analysis and inferential analysis.

1. Descriptive Analysis

The cognitive learning outcome data of students used in this study were learning outcome data obtained from the Post-test results obtained after the application of the RADEC learning model in class VIII.7 as the experimental class and conventional learning in class VIII.1 as the control class at SMPN 5 Pekanbaru.

Based on the Post-test scores of the experimental class and the control class, the learning outcome categories based on the cognitive learning outcome interpretation criteria in seen in Table 2 .

Table 2 Interpretation of Posttest Scores of Experimental and Control Classes

Interval (%)	Category	Experiment		control	
		Number of Student	%	Number of Student	%
80 < x ≤ 100	Very High	8	23	1	3
65 < x ≤ 80	High	15	43	11	34
55 < x ≤ 65	Medium	12	34	14	44
40 < x ≤ 55	Low	-	-	6	19
0 < x ≤ 40	Very Low	-	-	-	-
Average cognitive learning outcomes		78		65,31	
kategori		High		Medium	

Based on Table 2, it is known that the average post-test score of the experimental class that applies the RADEC learning model is higher with an average score of 78 in the high category and the control class that applies the conventional learning model with an average score of 65.31 is in the medium category.

2. Interferential Analysis

Inferential analysis was carried out with the help of IBM SPSS 26 to conduct normality tests, homogeneity tests, and hypothesis tests. Hypothesis testing first requires prerequisite tests, namely normality tests and homogeneity tests using post-test data on cognitive learning outcomes in both class groups. The normality test carried out on this research data is the Kolmogorov-Smirnov test. The detailed results of the normality test can be seen in Table 3.

Table 3 Post-test normality test of students' cognitive learning outcomes in the experimental class and control class

Class	Statistic	df	Sig.
Experiment	.125	35	.183
Control	.139	32	.121

Based on the Output Test of Normality, it can be seen that the significance value of the Kolmogorov-Smirnov normality test on the post-test values of the experimental and control classes is 0.183 and 0.121 greater than 0.05 (0.183> 0.05 and 0.121> 0.05). It can be concluded that the post-test data of the experimental and control classes are normally distributed.

After conducting the prerequisite tests, namely the normality test and the homogeneity test, a hypothesis test was carried out to deter mine whether or not there was a significant difference between students in the experimental class who received treatment in the form of implementing the RADEC learning model and students in the control class who applied conventional learning on the material of light and optical devices. The test used in this hypothesis test is the Independent sample t-test to see the increase in cognitive learning outcomes based on the post-test values between the experimental and control classes.

The hypothesis test was carried out with the help of IBM SPSS 26. The results of the hypothesis test can be seen in detail in table 4.

Table 4 Results of hypothesis testing

		F	Sig.	t	df	Sig. (2-tailed)
Hasil Belajar	Equal variances assumed	.476	.492	5.536	65	.000
	Equal variances not assumed			5.552	64.944	.000

In the Independent Sample T-Test Output in the Sig. column (2-tailed) the Post-test results from both classes obtained a significance value of 0.000. Based on decision making if the significance value (Sig.) <0.05 then Ha is accepted. The table shows that the Sig. value is 0.000 ≤ 0.05 so that Ha is accepted and Ho is rejected. Therefore, it can be concluded that there is a significant difference in students' cognitive learning outcomes between classes that apply the RADEC learning model and classes that apply conventional learning on the material of light and optical instruments.

3. Discussion of Research Results

In this study, the researcher acted as a direct teacher in both classes. The researcher has created a teaching module and ATP as a guideline and learning steps in the experimental class and control class. The experimental class uses the RADEC learning model, and the control class uses conventional learning. After carrying out the learning process, both classes were given cognitive ability test questions in the form of a multiple-choice post-test of 20 questions.

The results of the posttest of both classes were processed by the researcher as research data. Comparison of the average posttest scores in the experimental class and control class for each cognitive domain indicator can be seen in Figure 1.

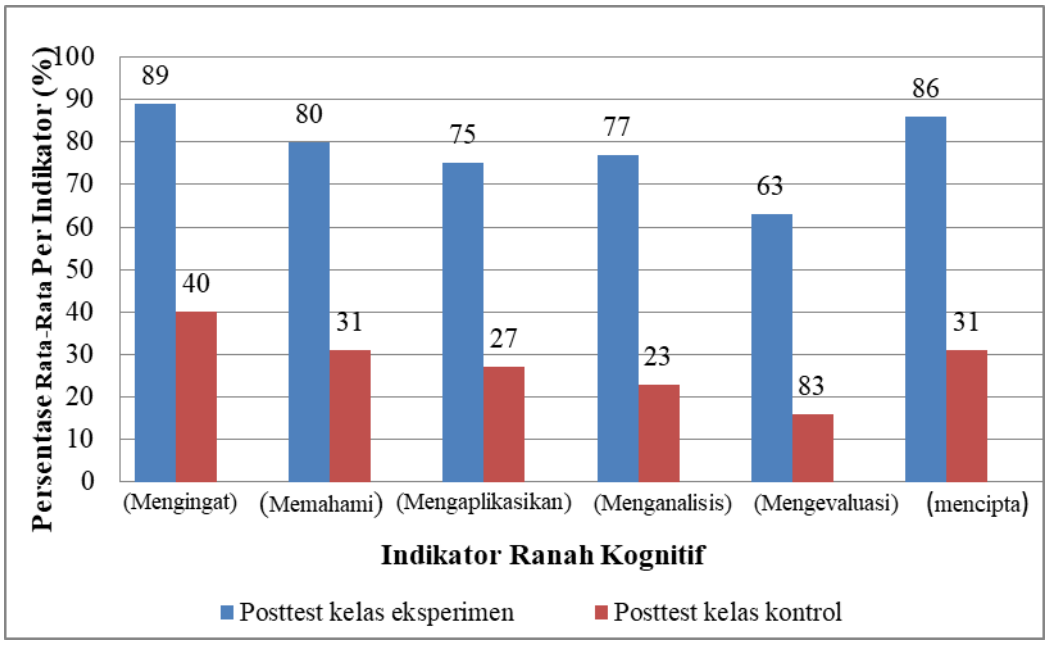

Figure 1. Comparison of the average posttest scores for each aspect of the cognitive domain indicators of the experimental and control classes.

Based on Figure 1, it can be seen that overall the average post-test score of the experimental class is higher than the control class in every aspect of cognitive ability. The experimental class and the control class both experienced a significant increase from the post-test score on the previous material, but the post-test score of the experimental class was higher than the control class. Further explanation of cognitive abilities, namely remembering, understanding, applying, analyzing, and evaluating will be explained as follows:

1. Remembering (C1)

At this level, students are required to be able to recognize, describe and mention materials that have just been studied (Ruwaida, 2019). The experimental class's ability to remember is higher than the control class. This is because in the first phase of the RADEC learning model, namely Read, which provides an opportunity for students to store and remember information related to the material being studied.

2. Understanding (C2)

Understanding is the ability to formulate the meaning of learning messages and be able to communicate them in oral, written or graphic forms. Students understand when they are able to determine the relationship between newly acquired knowledge and their previous knowledge (Ruwaida, 2019). The ability to remember students in the control class is lower than the ability to remember students in the experimental class due to the second phase in the RADEC learning model, namely where students are asked to answer questions with the understanding they have, through the application of this learning model students are able to understand the lesson material that has been implemented.

3. Applying (C3)

Applying is the ability to use or apply procedures in certain circumstances (Ruwaida, 2019). The use of the RADEC learning model can help students apply their knowledge. This is because the experimental class works on LKPD in the learning process which can help students apply what they get while learning. Working on LKPD can help students apply their knowledge and understanding to new problems.

4. Analytical Ability (C4)

Analyzing includes the ability to break down a unit into parts and determine how the parts are connected to each other or the parts to the whole (Ruwaida, 2019). In the experimental class, the ability to

analyze increases, this is supported by the discuss phase which requires students to solve problems found in the learning process.

5. Evaluative Ability (C5)

Evaluation includes the ability to form an opinion about something or several things, along with accountability for that opinion based on certain criteria. This ability is expressed by giving an assessment of something (Ruwaida, 2019). The ability to evaluate the experimental class has increased, this is because the explain phase in the RADEC model requires students to respond to the results of discussions between groups during the presentation. This Explain activity requires interactive and communicative communication.

6. Creating Ability (C6)

Creating is defined as generalizing new ideas, products or new perspectives from an event. Creating is defined as placing several elements in a whole unit so that they are formed in a coherent or functional form (Ruwaida, 2019). Based on the learning outcomes, the experimental class is superior to the control class, this happens because the experimental class applies the radec learning model where in the last phase there is create (creating) according to the cognitive domain indicator C6.

4 Conclusion

Based on the results of descriptive analysis and inferential analysis carried out on the cognitive learning outcomes of class VIII students of SMPN 5 Pekanbaru on the material of light and optical instruments, it can be concluded that:

1. The cognitive learning outcomes of students who apply the RADEC learning model are in the high category on the material of light and optical instruments of class VIII SMPN 5 Pekanbaru. This is evidenced by the results of the posttest after applying the RADEC learning model.
2. There is an increase in cognitive learning outcomes of students who apply the RADEC learning model. Based on the results of the hypothesis test, the experimental class is in the high category with an average score of 78 while the control class is in the medium category with an average score of 65.31.

Thus, it can be concluded that the application of the RADEC learning model can improve the cognitive learning outcomes of class VIII students on the material of light and optical instruments at SMPN 5 Pekanbaru.

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