JoSLEPI 3 (2) (2025)
Journal of Science Learning Process and Instructional Research
https://journal.riau-edutech.com/index.php/joslepi
Publisher :
Andester Riau Edutech
Pusat Inovasi Pendidikan dan Teknologi
ISSN 3031-3252

Implementation of Case Based Learning Model on Vibration And Wave Materials on Students' Cognitive Learning Outcomes of Grade VII SMPN 7 Pekanbaru

Wulan Sri Andayani[1*], M. Nasir[1], M. Sahal[1]

[1] Physics Education, Faculty of Teacher Training and Education, Riau University, Pekanbaru Indomesia

*Corresponding author's email: wulan.sri0459@student.unri.ac.id

Submiited: 01/06/2025
Review: 23/07/2025
Accepted: 26/07/2025
Published: 21/08/2025
Vol. 3
No. 2

Abstract- This research further emphasizes the contribution of the Case Based Learning (CBL) model in improving students' cognitive learning outcomes on vibration and wave materials in grade VIII of SMPN 7 Pekanbaru. The implementation of the CBL model was designed to provide students with real-life cases related to vibrations and waves, encouraging them to analyze, discuss, and solve problems collaboratively. Through this process, students were actively engaged in constructing their knowledge, which led to better conceptual understanding compared to conventional learning that tends to be more teacher-centered. The analysis of the results indicates that the experimental group that received treatment using the CBL model not only achieved a higher average score (73.13) compared to the control group (61.87) but also showed greater improvement in critical thinking and problem-solving abilities. This suggests that CBL creates meaningful learning experiences by linking abstract physical concepts with practical applications, which is essential for enhancing students' long-term retention and comprehension. Furthermore, the significance test confirmed that the difference in learning outcomes between the experimental and control classes was statistically significant, validating the effectiveness of the CBL approach. These findings imply that CBL is not only an effective alternative learning model for improving cognitive outcomes but also a pedagogical strategy that supports the development of higher-order thinking skills (HOTS) among junior high school students. In conclusion, the implementation of the Case Based Learning model on vibration and wave materials has proven to positively influence students' cognitive learning achievements. This model can serve as a recommendation for teachers to foster more student-centered learning environments and to integrate problem-solving strategies that relate scientific concepts to real-world contexts. The study highlights the potential of CBL to be widely applied in science education as a means to cultivate more effective, engaging, and impactful learning processes in the classroom.

Keywords: *Case Based Learning, Cognitive Learning Outcomes, Vibrations and Waves*

1 Introduction

Education is the main and irreplaceable foundation in the process of developing reliable and competent human resources. Education basically aims to equip students to be able to compete globally, especially when education is faced with an era where everyone must compete in various sectors of life in the 21st century.

21st century skills require students to have 4C abilities, namely critical thinking, collaboration, communication, and creativity (Suparya et al., 2022:154). 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, and develop the ability to overcome various problems they may face in the future.

How to Cite :
Andayani, Wulan Sri. *Et Al.* 2025. Implementation of Case Based Learning Model on Vibration And Wave Materials on Students' Cognitive Learning Outcomes of Grade VII SMPN 7 Pekanbaru. *Journal Of Science : Learning Process And Instructional Research* (Joslepi), 3 (2), 13-20

Student Assessment) measurements on Indonesian students in secondary education, especially in three main areas, namely mathematics, science, and literacy. Indonesia is ranked 68th out of 81 participating The national education system faces complex problems in realizing 21st century skills, namely low student learning outcomes (Alfirahmani et al., 2025). This is evidenced by the assessment conducted by the Organisation for Economic Co-operation and Development (OECD) which conducted PISA (Programme for International countries, with an average score in the science category of 383. This value is far different from the international average score of 485. This means that Indonesia is still at the lowest level in the PISA assessment.

Science learning in Indonesia tends to under-optimize students' scientific literacy skills. The underdevelopment of students' scientific literacy skills is one of the factors causing students' difficulty in mastering science concepts optimally (Dwicky Putra Nugraha, 2022:154-155). In addition, the learning process carried out in schools does not actively involve students, science which should be identical to carrying out observations, experiments and proofs, is rarely done in the learning process. This condition causes students to have difficulty in understanding science concepts, especially in complex learning materials(Ikhsan, 2025).

One of the science learning materials studied by students in grade VIII is vibration and wave material. Vibration and wave material is one of the materials that is quite difficult for students to understand. This is evidenced by research conducted by (Mahombar, 2024:78), students are in the moderate category in terms of understanding the concept of vibration and waves with a percentage of 35%. The highest obstacle in understanding the concept of vibration and wave material is due to the lack of supporting resources and the lack of direct practice or experimentation in the learning process at school. As a result of the lack of understanding of the concept, it will affect student learning outcomes. Another study conducted by (Mahardika et al., 2022:62) on vibration and wave material at SMPN 1 Bawang showed that the average learning outcomes of students in the pretest conducted were 47, where the KKM in science learning was 72.

Based on the results of interviews with science teachers at SMPN 7 Pekanbaru, it was obtained that the school had implemented an independent curriculum for grades VII and VIII. In their learning, teachers more often apply teacher-centered learning methods such as lectures and discussions according to the learning material (Maknun et al., 2025). The lack of innovation in these learning models causes learning activities to tend to be passive, and the lack of discussion is one of the factors causing learning activities not to run well and resulting in low student learning outcomes.

The solution to the above problems is improvement in learning activities. Quality learning can be obtained by applying the right learning model and according to the needs in the classroom. According to Wospakrik in (Simbolon, 2022:181) Student Centered Learning (SCL) can encourage and motivate students to develop creativity and independent learning abilities. One of the SCL learning that can be used to develop students' creativity, motivation, and knowledge abilities is the Case Based Learning (CBL) model.

The CBL model is a case-based learning model which is a complex problem based on real conditions to stimulate class discussion and collaborative analysis (Putu & Dharmayanthi, 2022:293). This learning model requires students to actively participate in real or hypothetical problem situations that reflect the types of experiences that are naturally experienced in the field being studied. The advantages of the CBL model according to (Putu & Dharmayanthi, 2022:293) are: 1) can develop analytical skills, 2) can develop the ability to apply theory and reality in the field, 3) increase self-confidence, enthusiasm and cooperation in groups, good presentation skills, 4) independence in finding and solving tasks through problem-solving training. Research conducted by (Simbolon, 2022:183) also shows that the application of the CBL model to the learning outcomes of Quality University Medan students in the Basic Science Concepts course material has better learning outcomes compared to classes taught with conventional learning. This shows that the CBL model has a positive impact on student learning outcomes.

Based on the problems that have been raised, the author is interested in conducting a study entitled "Implementation of the Case Based Learning Model on Vibration and Wave Material on the Cognitive Learning Outcomes of Class VIII Students of SMPN 7 Pekanbaru".

2 Research Methodology

The research design used in this study is quantitative research using experimental research type. The type of experiment conducted is quasi experimental. The design used in this study is Pretest-Posttest Control Group Design, which is a study by looking at the difference in pre-test scores to determine students' initial abilities with their post-test scores after the learning model is applied to the experimental class and control class. This research design can be described in table 1.

Tabel 1. Pre-test post-test control group design

Group	Pre-test	Treatment	Post-test
Eksperiment	O_1	X	O_2
control	O_3	-	O_4

(Sugiyono, 2021:134)

This study aims to determine the effect of the CBL model on student learning outcomes. This research was conducted at SMPN 7 Pekanbaru class VIII in the even semester of the 2024/2025 academic year. The research implementation time started in January-May 2025.

The population in the study was all students of grade VIII in the even semester at SMPN 7 Pekanbaru in the 2025 academic year consisting of 3 classes, namely VIII.1, VIII.2, and VIII.3 with a total of 97 students. From the population mentioned, 2 classes were selected as samples, namely the experimental class and the control class. One class, namely VIII 1 with 32 students, received teaching with the Case Based Learning model and class VIII 3 with 32 students as the control class, namely a class that uses conventional methods in its learning. The instrument used in this study is a test instrument in the form of a written test with multiple choice questions. Pre-test and post-test questions are made based on indicators of learning objective achievement.

Students' cognitive learning outcomes are analyzed through the calculation of the average percentage of scores obtained by students. The scores obtained by students are calculated using the following formula:

Hasil belajar kognitif = $\frac{Jumlah\ soal\ benar}{Jumlah\ seluruh\ soal} \times 100$

The level of students' cognitive abilities is grouped into five criteria. The criteria for students' cognitive learning outcomes can be seen in Table 2.

Table 2 Classification of students' 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 carried out using the same test instrument as the pre-test to be tested on the experimental class and the control class. The purpose of the post-test was to see the extent of the students' abilities in each class after being given treatment. In this study consisted of two data analyses, namely descriptive analysis and inferential analysis.

1. Descriptive Analysis Results

The data obtained through the results of the pre-test and post-test assessments were then presented in a descriptive analysis of the pre-test in the experimental class and control class groups. Descriptive analysis is one of the analysis techniques to describe the cognitive learning outcomes of grade VIII students on vibration and wave material at SMPN 7 Pekanbaru after the learning process was carried out in the experimental class and control class. Students' interpretations for each category in the vibration and wave material can be seen in the Table 3 and Table 4.

Table 3. Interpretation of pre-test and post-test values of the experimental class

Interval (%)	Category	*Pre-test*		*Post-test*	
		Number of student's	%	Number of student's	%
$80 < x \leq 100$	Very High	0	-	6	18,6
$65 < x \leq 80$	High	0	-	16	50,0
$55 < x \leq 65$	Medium	0	-	8	25
$40 < x \leq 55$	Low	1	3,1	2	6,3
$0 < x \leq 40$	Very Low	31	96,9	0	0
Average cognitive learning outcomes		28,75		73,13	
Category		Very Low		High	

Table 4. Interpretation of pre-test and post-test values of the control class

Interval (%)	Category	*Pre-test*		*Post-test*	
		Number of student's	%	Number of student's	%
$80 < x \leq 100$	Very High	0	-	1	3,1
$65 < x \leq 80$	High	0	-	8	25,0
$55 < x \leq 65$	Medium	0	-	14	43,8
$40 < x \leq 55$	Low	2	6,3	8	25,0
$0 < x \leq 40$	Very Low	30	93,8	1	3,1
Average cognitive learning outcomes		28,43		61,87	
Category		Very Low		Medium	

Based on Table 3 and Table 4, it can be seen that the average post-test score of the experimental class is higher than the control class. The average post-test score of the experimental class that applies the case based learning model is 73.13 with a high category, while the control class that applies the conventional learning model is 61.87 with a medium category. In line with the research results (Simbolon, 2022:183) which explain that the application of the case-based learning model can improve student learning outcomes, where classes that apply the case-based learning model have better learning outcomes than classes that apply the conventional learning model.

2. Inferential Analysis

Inferential analysis was obtained with the help of IBM SPSS 22 to conduct normality tests, homogeneity tests, and hypothesis tests. Hypothesis testing requires prerequisite tests first, namely normality tests and homogeneity tests using pretest and posttest data on cognitive learning outcomes in both class groups. The normality test performed on this research data is the Kolmogorov-Smirnov test. The detailed results of the normality test can be seen in Table 5.

Table 5. The results of the pre-test and post-test normality tests in the experimental and control classes

Class Group	**Sig. *Pre-test***	**Sig. *Post-test***
Experiment	0,109	0,163
Control	0,200	0,200

Based on Table 5, it shows that in the experimental class for the pre-test has a significance value of 0.109 and for the post-test has a significance value of 0.163. In the control class, the results of the normality test for both the pre-test and post-test have a significance value of 0.200. Based on these results, the pre-test and post-test data in the experimental class and the control class are normally distributed where the significance value (Sig.) > 0.05.

The next stage in the inferential analysis is the homogeneity test. After it is known that the data is normally distributed, the next step is to conduct a homogeneity test using the Levene Test. The results of the homogeneity test using the Levene Test attached to the t-test table can be seen briefly in Table 6.

Table 6. Results of homogeneity test and t-test of experimental class and control class

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
		F	**Sig.**	**t**	**df**	**Sig.(2-tailed)**
Cognitive abilities	Equal variances assumed	0,023	0,880	4,213	62	0,000
	Equal variances not assumed			4,213	61,988	0,000

After conducting prerequisite tests, namely normality tests and homogeneity tests, a hypothesis test was conducted to determine whether or not there was a significant difference between students in the experimental class who received treatment in the form of implementing a case-based learning model with students in the control class who applied conventional learning on vibration and wave material. The test used in this hypothesis test is the Paired sample t-test which aims to determine the difference in students' cognitive learning outcomes between students in the experimental class and the control class on vibration and wave material. Furthermore, a hypothesis test was conducted using the Independent sample t-test to see the increase in cognitive learning outcomes based on post-test scores between the experimental class and the control class.

The Paired sample t-test was conducted to test both hypotheses with the help of IBM SPSS 22. The detailed results of the Paired sample t-test can be seen in Table 7.

Table 7. Hypothesis test results (t-test)

		N	t	**Sig.(2-tailed)**
Pair 1	*Pre-test experiment class & post-test experiment class*	32	-39,730	0,000
Pair 2	*Pre-test control class & post-test control class*	32	-20,568	0,000

In Table 7, it can be seen that the significance value (Sig.2-tailed) < 0.05 for both the pre-test and post-test results of the experimental class and the control class. Thus, it can be concluded that there is a significant difference in the average cognitive learning outcomes of students between the pre-test and post-test both in the experimental class that applies the case-based learning model and in the control class that applies the conventional learning model on the vibration and wave material.

3. Discussion of Research Results

In this study, the researcher acted as an educator who directly taught both classes. The guidelines and learning steps in the experimental and control classes are stated in the ATP and the teaching module that has been developed by the researcher. In the experimental class, learning uses a case-based learning model and the control class applies conventional learning as implemented by the science teachers at the school. After carrying out the learning process, both classes were given cognitive ability test questions in the form of 20 multiple-choice post-test questions.

Comparison of the average pre-test scores for each aspect of the cognitive ability indicators of the experimental class and the control class can be seen in Figure 1.

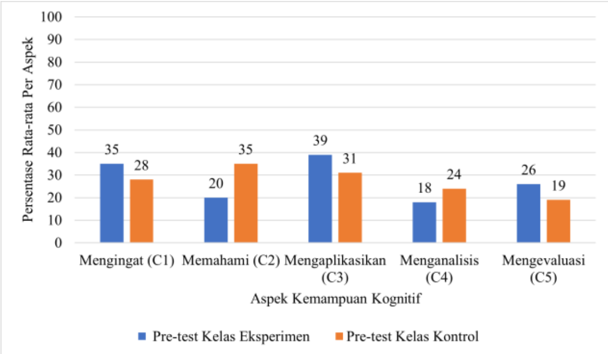

Figure 1 Comparison of the average pre-test scores for each aspect of the cognitive ability indicators of the experimental class and the control class.

Based on Figure 1, it shows that the average pre-test score of the experimental class is superior in the aspects of remembering (C1), applying (C3), and evaluating (C5). Meanwhile, the control class is superior in the aspects of understanding (C2) and analyzing (C4). The comparison of the average post-test scores on each aspect of the cognitive ability indicators of the experimental class and the control class can be seen in Figure 2.

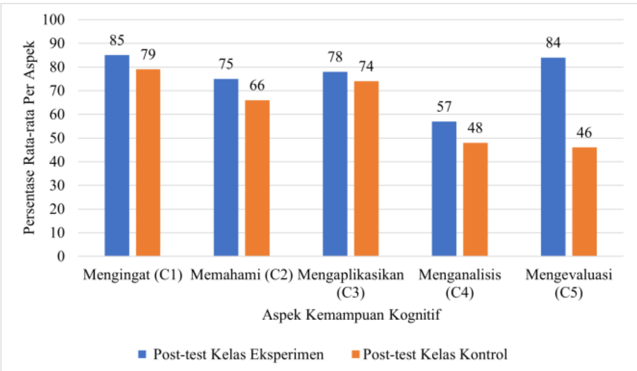

Figure 2 Comparison of the average post-test scores for each aspect of the cognitive ability indicators of the experimental class and the control class.

Based on Figure 4.2, it shows 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 their pre-test scores, but the post-test score of the experimental class was higher than the control class. Further explanation regarding cognitive abilities, namely remembering, understanding, applying, analyzing, and evaluating will be explained as follows:

1. Remembering

The remembering aspect (C1) is the ability of students to remember knowledge from a memory by taking definitions, facts or lists, or reciting previously learned knowledge (Listiani, 2022:399). The ability to remember students in the control class was slightly lower than the ability to remember students in the experimental class. The experimental class had a higher average due to the first phase in the case-based learning model, namely presenting cases. In the case presentation phase, the delivery of cases by students guided by the teacher will encourage students to be able to convey an explanation of the case faced in a simple way as a way out of the problem. Students who are able to explain information simply with their own understanding will find it easier to remember the information.

2. Understanding (C2)

The understanding aspect (C2) is the ability of students to build meaning from various types of functions, both oral and written (Listiani, 2022:399). The experimental class has a higher average compared to the control class in the understanding aspect. The experimental class has a higher average because of the second phase in the case-based learning model, namely analyzing cases. In this phase, students analyze the cases faced with the study group where students can indirectly increase their knowledge through the cases they will face by encouraging students to get used to analyzing the right information. In analyzing cases, students will learn to understand important information so as to encourage students to build their knowledge independently and foster the ability to remember with long-term memory.

1. Applying (C3)

The application aspect (C3) is the student's ability to use procedures that refer to the material studied and used in products such as models, presentations, interviews, or simulations (Listiani, 2022:399). The experimental class has a higher average because of the third phase in the case-based learning model, namely finding information, data, and literature. In the third phase, students look for information, data, and literature to solve the cases they will face by considering the assumptions that lead students to find the right assumptions based on the sources obtained to solve the case. In finding information, students can conduct experiments to help solve the problems faced, as well as read various literature to strengthen the information that has been obtained through the experiments carried out.

4. Analyze (C4)

The analysis aspect (C4) is the student's ability to break down material or concepts into several parts by determining how the parts are interconnected or how the parts relate to the overall structure or purpose (Listiani, 2022:399). The experimental class had a higher average compared to the control class because of the fourth phase in the case-based learning model, namely solving cases. In this phase, students in the process get questions that lead to solving cases by the teacher which has a good impact on students in determining solutions related to the problems being faced. Students will analyze solutions or actions that can be a way out of the problems being faced. The fourth phase which is continuously given during the learning process can hone students' ability to break down material and be able to connect theory with its application in everyday life, thus students will become more skilled in analyzing an event or problem being faced.

5. Evaluating (C5)

The evaluating aspect (C5) is the student's ability to make judgments based on criteria and standards through checking and criticism (Listiani, 2022:399). The experimental class has a higher average compared to the control class because of the fifth and sixth phases in the case-based learning model, namely drawing conclusions and presentations and improvements. Inferring or concluding is the student's ability to draw a logical and acceptable conclusion. In this phase, students will conclude the results of solving the cases they have completed with the help of direction from the teacher.

4 Conclusion

Based on the results of the research that has been conducted at SMPN 7 Pekanbaru by applying the case based learning model to the vibration and wave material, the following conclusions can be drawn:

1. The application of the case based learning model in the experimental class has a higher average cognitive ability than the control class that applies conventional learning. It is proven by the average cognitive ability based on the pre-test post-test, the experimental class is in the high category and the control class is in the medium category.

2. There is a significant difference in students' cognitive abilities between the experimental class that applies the case based learning model and the control class that applies conventional learning to the vibration and wave material.

Thus, it can be concluded that there is a significant influence of the application of the Case Based Learning model on the vibration and wave material on the cognitive learning outcomes of class VIII students of SMPN 7 Pekanbaru.

Reference

Alfirahmani, Irawan, D., & Nasir, M. (2025). Development of Android-Based Physics Learning Media to Improve Computer Thinking Skills for High School Students. *Journal of Sience Learning Process Aand Instructional Research (JOSLEPI)*, *3*, 1–10.

Arikunto. (2009). Psikologi Pendidikan. Bandung: Pt. Remaja Rodaskarya

Dwicky Putra Nugraha, D. M. (2022). Hubungan Kemampuan Literasi Sains Dengan Hasil Belajar Ipa Siswa Sekolah Dasar. *Jurnal Elementary*, *5*(2), 153. https://doi.org/10.31764/elementary.v5i2.8874

Harahap, T. K., Indra, I. M., Issabella, C. M., Yusriani, Hasibuan, S., Hasan, M., Musyaffa, A. ., Surur, M., & Ariawan, S. (2021). Metodologi Penelitian Pendidikan. In *Pustaka Ramadhan*.

Ikhsan, K. Z. Z. P. R. (2025). Implementation of a Simulation-Based Learning Model Using PHET to Improve Learning Outcomes for Class IX MTsN 1 Kuantan Singingi. *Journal of Educational Sciences*, *5*(4), 715–723.

Listiani, W. (2022). *Transformasi Taksonomi Bloom dalam Evaluasi*. *2*(03), 397–402.

Mahardika, H. C., Ismawati, R., & Rahayu, R. (2022). Penerapan LKPD berbantuan simulasi PhET untuk meningkatkan motivasi dan hasil belajar kognitif IPA peserta didik SMP. *Edu Sains: Jurnal Pendidikan Sains & Matematika*, *10*(1), 61–70. https://doi.org/10.23971/eds.v10i1.3170

Mahombar, A. (2024). Analisis Pemahaman Konsep dan Kendala Pemahaman Konsep Materi Getaran dan Gelombang. *Jurnal Fisika Dan Pembelajaran (PHYDAGOGIC)*, *6*(2). https://doi.org/10.31605/phy.v6i2.3683

Maknun, D. L., Irawan, D., & Azhar. (2025). Implementation of the Nearpod-Assisted CORE Learning Model to Improve Students ' Understanding of Class VII SMP Negeri 20 Pekanbaru ' s Concepts on Motion and Force Material. *Journal of Science: Learning Process and Instructional Research (JoSLEPI)*, *3*(1), 42–49.

OCDE. (2024). Pisa 2022. In *Perfiles Educativos* (Vol. 46, Issue 183). https://doi.org/10.22201/iisue.24486167e.2024.183.61714

Putu, N., & Dharmayanthi, I. (2022). *Penerapan Model Case Based Learning (CBL) Mengembangkan Critical Thinking Skills Siswa Pembelajaran Geografi di SMA Negeri 1 Kuta Utara untuk dalam*. *10*(3).

Simbolon, D. H. (2022). *Pengaruh Model Case Based Learning (CBL) Terhadap Hasil Belajar Mahasiswa*. *1*(03), 2020–2023.

Sugiyono. (2021). Metode Penelitian Pendidikan. Bandung: ALFABETA

Suparya, I. K., I Wayan Suastra, & Putu Arnyana, I. B. (2022). Rendahnya Literasi Sains: Faktor Penyebab Dan Alternatif Solusinya. *Jurnal Ilmiah Pendidikan Citra Bakti*, *9*(1), 153–166. https://doi.org/10.38048/jipcb.v9i1.580