
Effect Of Problem-Based Learning Supported By Media Edukatif On Improving Students' Understanding And Solving Matter Problems Of Rotation And Revolution Of The Earth

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ABSTRACT

This study aims to analyze the effect of the application of Problem Based Learning (PBL) assisted by educational media to increase the understanding and ability of students in solving problems on the rotation and revolution of the Earth. This study uses experimental methods with Pre-experimental Design because there are 3 stages, namely Pretest, Treatment and Posttest. Samples were selected using purposive sampling technique, the total number of samples used in this study was 40 students of SD Karang Padak. Data were collected through concept comprehension tests and problem solving ability tests, then analyzed using statistical tests. The results showed that students who studied with PBL approach assisted by Educational media experienced a significant increase in understanding of the concept. In addition, the problem-solving abilities of the students in the experimental group also improved significantly. These findings indicate that PBL aided by educational media is effective in improving students' understanding and skills in learning the concept of rotation and revolution of the Earth. Conclusion the application of PBL assisted by educational media can have a positive impact in improving the understanding of concepts and problem-solving skills of students on the rotation and revolution of the Earth.

Keywords: Problem based learning; educational media; problem solving; rotation revolution of the earth

ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh penerapan *Problem Based Learning* (PBL) berbantuan media edukatif terhadap peningkatan pemahaman dan kemampuan peserta didik dalam memecahkan masalah pada materi rotasi dan revolusi Bumi. Penelitian ini menggunakan metode eksperimen dengan Pre-Eksperimental Design karena terdapat 3 tahap yaitu Pretest, Treatment dan Posttest. Sampel penelitian dipilih menggunakan teknik purposive sampling, Jumlah total sampel yang digunakan dalam penelitian ini adalah 40 siswa SD Karang Padak. Data dikumpulkan melalui tes pemahaman konsep dan tes kemampuan pemecahan masalah, kemudian dianalisis menggunakan uji statistik. Hasil penelitian menunjukkan bahwa siswa yang belajar dengan pendekatan PBL berbantuan media edukatif mengalami peningkatan pemahaman konsep yang signifikan. Selain itu,

kemampuan pemecahan masalah siswa di kelompok eksperimen juga meningkat secara signifikan. Temuan ini menunjukkan bahwa PBL berbantuan media edukatif efektif meningkatkan pemahaman dan keterampilan siswa dalam mempelajari konsep rotasi dan revolusi Bumi. Simpulan penerapan PBL berbantuan media edukatif dapat memberikan dampak positif dalam meningkatkan pemahaman konsep dan kemampuan pemecahan masalah siswa pada materi rotasi dan revolusi Bumi.

Kata Kunci: *problem based learning* ; media edukatif ; pemecahan masalah ; rotasi revolusi bumi

INTRODUCTION

Improved understanding of concepts and problem-solving skills are two important aspects in the learning process (Dayanti et al., 2021; Setiawan & Pasaribu, 2023). The matter of rotation and revolution of the Earth is one of the key topics in science education because it plays a role in improving students' understanding of natural phenomena (Biantara et al., 2022; Maulana et al., 2024). However, this topic is often considered difficult because it requires clear visualization to explain abstract concepts. Weakness in understanding this concept affects not only students' learning outcomes, but also their ability to solve problems related to natural phenomena.

This problem requires the application of more innovative and interactive learning methods to help students understand these concepts. One effective approach is Problem Based Learning (PBL), which is a student-centered learning method by exposing them to real problems to be solved through reasoning and in-depth investigation (T. P. Dewi, 2021; Mohammed et al., 2024). In addition, to increase the effectiveness of PBL, Educational media based on visualization and interactivity are very important to be used as learning aids. Thus, the combination of PBL and educational media can be a relevant solution to overcome students' difficulties in understanding the rotation and revolution of the Earth.

Previous studies have shown that PBL can significantly improve students' critical and analytical thinking skills (Mbewu, 2024; Zhang et al., 2024; Zheng et al., 2023). PBL is able to improve students' understanding of concepts in physical matter (S. A. Sari & Prastowo, 2022). On the other hand, educational media such as graphic visualizations, simulations, and interactive aids have been shown to help students understand abstract concepts more concretely (Adrianus et al., 2023; S & Indihadi, 2021; Zunidar, 2022). However, research that specifically integrates PBL with educational media on learning the rotation and revolution of the Earth is still very limited.

The application of PBL in learning the rotation and revolution of the Earth needs to be focused on the main problem, namely the difficulty of students understanding this concept, which is often caused by the lack of adequate visualization (R. C. Dewi, 2023; Fjørtoft & Larsen, 2022). Educational Media designed specifically for this material can provide concrete and interactive visualization, so that students more easily understand concepts such as rotational motion, revolution, and its impact on natural phenomena (Maulana et al., 2024; Nurnaningsih, 2018).

Various studies highlight the importance of combining innovative methods such as PBL with educational media. These Media can be digital simulations, animated graphics, or contextualized physical aids, which not only support the learning process but also increase students' motivation to understand the material (Malalina & Yenni, 2020; Mukhlisin et al., 2023; Siregar et al., 2024). In addition, it is also important to ensure that the educational media

used are relevant to the needs of students and have a direct impact on their understanding of difficult concepts (Kurino et al., 2023).

Based on this review, this study aims to analyze the effect of the application of PBL with the help of educational media on improving the understanding of concepts and problem-solving abilities of students on the rotation and revolution of the Earth. This study also aims to provide empirical contributions related to the effectiveness of the use of educational media in PBL and develop learning models that can be adopted by teachers to improve science learning, especially on concepts that require deep visualization.

METHODS

Type and Design

This study uses experimental method with pre-experimental design because there are three stages namely pretest, treatment and posttest (Andriani et al., 2017; Darwin et al., 2021). The research design used is one group pretest posttest design. This study was conducted in SD Karang Padak Kec. Labuhan Badas district. Sumbawa, which is studying the rotation and revolution of the earth.

The sample was selected using purposive sampling technique, the total number of samples used in this study was 40 students. The one group pretest-posttest design was chosen because it allows researchers to measure changes in students' understanding of concepts and problem-solving abilities after being given the intervention. The main focus of this study is on the effectiveness of problem-based learning models (PBL) supported by educational media in improving student learning outcomes. Although this design did not involve a control group, several mitigation measures were taken to improve internal validity, including providing consistent treatment throughout the learning session, controlling external variables such as learning environment and implementation time, and using validated and reliability-tested instruments. This is done to ensure that the changes that occur can be directly attributed to the application of the PBL model and educational media.

Data and Data Sources

The data collected in this study consisted of quantitative and qualitative data. Quantitative data was obtained through pre- and post-test scores given to students before and after learning (Syahrizal & Jailani, 2023). The results of these tests measure the students' understanding of the concepts of the Earth's rotation and revolution, as well as their problem solving skills. In addition, quantitative data were obtained from observation sheets that recorded students' activities during the learning process, such as their participation in group discussions, collaboration, and use of educational media.

Qualitative data were collected through direct observation of the learning process. Observation notes contain descriptions of students' behaviours, such as their participation in discussions and use of educational media (Anggito & Setiawan, 2018; Tanzeh, 2018). Documentation in the form of photographs, videos or field notes is also used to support the findings of observations and provide a clearer picture of the learning process. Where appropriate, questionnaires or interviews will be used to collect data on students' perceptions of the effectiveness of problem-based learning (PBL) learning models supported by educational media.

The main source of data in this study are the students involved in the learning process of the experimental group using the PBL model supported by educational media. In addition, teachers or researchers also act as a source of data by filling out observation sheets and documenting the learning process. Learning materials and educational media used are also an additional source of data to support the analysis of the effectiveness of the learning methods used.

Data collection technique

This study used several data collection techniques to obtain comprehensive information about students' understanding, the effectiveness of learning models and activities during the teaching and learning process. Tests (pre-test and post-test) are used as the main technique to measure students' understanding of the concepts of rotation and revolution of the Earth, as well as their problem solving skills. The pretest was administered before the lesson began to obtain baseline data, while the posttest was administered after the lesson to assess the improvement in students' understanding. The instruments used are validated test questions and the results are scored using a rubric or rating scale that assesses the students' level of understanding and problem solving skills.

Table 1. Assessment tests (Pretest and Posttest)

No	Assessment Aspects	Evaluation Criteria	Score
1	Understanding the concept of Earth rotation	Do not understand (0), low understanding (1), Enough (2), Good (3), Very Good (4)	0-4
2	Understanding the concept of Earth rotation	Do not understand (0), low understanding (1), Enough (2), Good (3), Very Good (4)	0-4
3	Problem solving skills	Not able (0), low ability (1), sufficient (2), Good (3), Very Good (4)	0-4

- **Maximum Total Score: 12**

- **Score Categories:**

- 0-3 : very low
- 4-6 : low
- 7-9 : enough
- 10-12 : good

In addition, observation sheets are used to record students' learning activities during the learning process, especially for experimental groups using problem-based learning (PBL) models supported by educational media. This sheet contains indicators of students' participation in discussions, cooperation in groups and use of educational media. Observations are made by trained researchers or observers and focus on aspects of active participation, collaboration and how students solve problems independently or in groups.

Table 2. Assessment Of Observation Sheet

No	Observation Indicators	Evaluation Criteria	Score
1	Active participation in discussions	Inactive (0), rarely active (1), moderately active (2), Active (3), very active (4)	0-4
2	Collaboration in groups	Not cooperating (0), rarely cooperating (1), quite cooperating (2), Good (3), Very Good (4)	0-4

3	Use of Educational media	No use (0), minimal use (1), Good Enough (2), Good (3), Very Good (4)	0-4
4	Ability to solve problems independently or in groups	Not able (0), low ability (1), sufficient (2), Good (3), Very Good (4)	0-4

- **Maximum Total Score: 16**

- **Score Categories:**

0-4 : very low

5-8 : low

9-12 : enough

13-16 : good

Documentation techniques are also used to support observational data. This documentation takes the form of field notes, photographs or videos that record the course of the learning process and thus provide additional evidence of classroom interaction and the use of educational media. In addition, where appropriate, questionnaires were given to students to measure their responses to PBL learning models supported by educational media. This questionnaire included questions about students' perceptions of learning effectiveness, levels of engagement and benefits of educational media. The data from the questionnaire were analysed quantitatively and qualitatively to determine the students' responses in more depth. Through this data collection technique, this study is expected to provide a comprehensive picture of the effectiveness of the learning methods used.

Instrument validation is carried out to ensure that the measuring instruments used can measure aspects that are in accordance with the objectives of the study. Content validation is carried out by involving education experts and teachers in the field of study to assess the suitability of questions, observation sheets, and questionnaires to learning indicators. Instruments deemed less suitable are revised based on the input provided by the expert. After validation of the contents, the reliability of the instrument is tested to ensure the consistency of the measurement results. In the pretest and posttest tests, reliability is tested using the test-retest method to see the consistency of the results at different times. Meanwhile, the reliability of the observation sheet was tested using inter-rater reliability analysis to ensure the similarity of assessment between observers. The reliability of the questionnaire was analyzed using Cronbach's Alpha coefficient to measure internal consistency, with a reliability value of ≥ 0.7 is considered to indicate a good level of reliability.

Table 3. Questionnaire Assessment

No	Assessment Aspects	Evaluation Criteria	Score
1	Student perceptions of learning effectiveness	Ineffective (0), less effective (1), moderately effective (2), effective (3), very effective (4)	0-4
2	Level of involvement in learning	Not involved (0), minimally involved (1), moderately involved (2), involved (3), very involved (4)	0-4
3	Benefits of using educational media	Not useful (0), less useful (1), quite useful (2), useful (3), very useful (4)	0-4

- **Maximum Total Score: 12**

- **Score Categories:**

0-3 : very low

4-6 : low

7-9 : enough

10-12 : good

Data analysis

The data obtained from the pretest and posttest were analysed using inferential statistics. Normality and homogeneity tests are first performed to ensure that the data are normally distributed and homogeneous (Usmadi, 2020). Furthermore, the t-test is used to compare the difference in mean scores between the experimental group and the control group, both on the pretest and posttest scores. This analysis aims to determine whether there are significant differences between the two groups in terms of concept understanding and problem solving skills. In addition, the data from the observation sheet were analysed descriptively to illustrate the students' involvement during the learning process. This is done to see to what extent students are actively involved in the PBL process and how educational media contribute to improving student interaction and understanding.

RESULTS AND DISCUSSION

Based on the analysis of the data from the test evaluation tables (pre-test and post-test), observation sheets and questionnaires, it can be concluded that the application of the learning strategies carried out showed very effective results. In terms of the understanding of the concept of rotation and revolution of the Earth and the ability to solve problems from the pre-test and post-test data, it can be seen that the average score of the post-test has increased significantly compared to the pre-test. This indicates that students are successfully improving their understanding of the concepts taught.

Table 4. Pre-Test and post-test results

Sample	Test	Pretest Value		Test	Posttest Value	
		Observation	Questionnaire		Observation	Questionnaire
1	10	7	8	12	9	10
2	7	9	10	9	11	12
3	5	6	6	7	8	8
4	10	14	11	12	16	12
5	9	10	9	11	12	11
6	6	8	7	8	10	9
7	8	12	10	10	14	12
8	11	15	8	12	16	10
9	6	5	6	8	14	8
10	7	9	9	9	11	11
11	10	11	9	12	13	11
12	8	6	7	10	8	9
13	9	12	10	11	14	12
14	6	5	6	8	9	8
15	9	11	8	11	13	10
16	8	12	9	10	14	11
17	5	7	5	7	11	7
18	7	10	8	9	12	10
19	10	13	11	12	15	12
20	6	6	6	8	11	9
21	9	12	9	11	14	11
22	9	10	9	11	12	11
23	10	12	10	12	14	12
24	7	8	7	9	10	9
25	8	12	9	10	14	11
26	10	9	8	12	11	10
27	5	6	7	7	8	9

28	6	7	5	8	10	7
29	9	11	10	11	13	12
30	8	12	9	10	14	11
31	9	12	9	11	15	11
32	7	8	6	9	10	9
33	10	12	8	12	14	12
34	6	5	6	8	12	10
35	9	10	9	12	14	11
36	6	7	7	8	9	10
37	9	12	10	11	14	11
38	10	12	11	12	14	12
39	7	9	8	11	15	12
40	10	12	9	12	14	11
Minimum	5	5	5	7	8	7
Maximum	11	15	11	12	16	12
Mean	8.025	9.6500	8.2250	10.075	12.300	10.350
Std. Dev.	1.717000	2.71322	1.65618	1.70049	2.30050	1.45972

Furthermore, the evaluation of the observation sheet showed that students were increasingly active in discussions, working in groups and using educational media. With an average post-test observation score of 12,300, this indicates an increase in students' participation and collaboration in learning. The evaluation of the questionnaire showed that the students have a positive perception of the effectiveness of learning. The average score of the post-test questionnaire, which reached 10,350, indicated that the students felt that the learning that had taken place was not only effective but also beneficial to them. Overall, the increase in average scores in all aspects - whether from tests, observations or questionnaires - suggests that the teaching methods used were successful in increasing students' understanding, engagement and positive perceptions of the learning process.

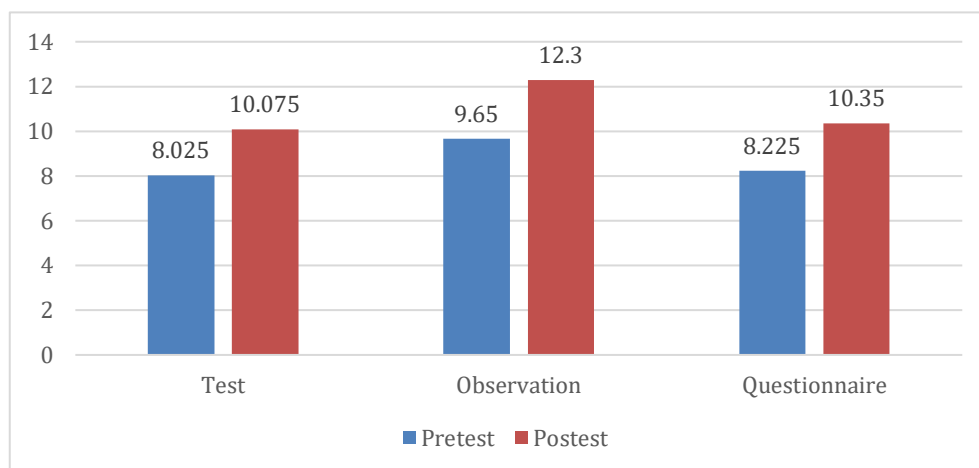


Figure 1. Average Pretest and Posttest

Table 5. Test Results Of Paired Samples

Pair	Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t	df	Sig. (2-tailed)
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Pretest - Posttest	-2.05000	0.38895	0.06150	-2.17439, -1.92561	-33.334	39	0.000
Observasi1- Observasi2	-2.65000	1.57789	0.24949	-3.15463, -2.14537	-10.622	39	0.000
Questionnaire 1- Questionnaire 2	-2.12500	0.68641	0.10853	-2.34452, -1.90548	-19.580	39	0.000

The table presented shows the results of statistical analysis of three value comparisons, namely pretest vs. posttest, observasi1 vs. observasi2, and questionnaire 1 vs. questionnaire 2. In this analysis, the mean difference value for pretest-posttest is -2.05000, which indicates that the mean value of the posttest is lower than the pretest. For the pair observasi1 - observasi2 the mean difference was recorded as -2.65000, while for questionnaire 1-questionnaire 2 the mean difference value was -2.12500. The standard deviation shows how much variation there is in each pair of data, with pretest-posttest having a standard deviation of 0.38895, observasi1-observasi2 at 1.57789, and questionnaire 1 - questionnaire 2 at 0.68641. The standard error estimate of the mean difference was also calculated, where pretest - posttest had a value of 0.06150, observasi1-observasi2 at 0.24949, and questionnaire 1 - questionnaire 2 at 0.10853.

The 95% confidence interval for the mean differences showed that for pretest-posttest the range was from -2.17439 to -1.92561, for observasi1 - observasi2 from -3.15463 to -2.14537, and for questionnaire 1 - questionnaire 2 from -2.34452 to -1.90548. All these intervals do not include zero, which indicates a statistically significant difference. The statistical value of t for each comparison also shows significant results, with pretest-posttest at -33.334, observasi1-observasi2 at -10.622, and angket1 - angket2 at -19.580.

The p-value for all pairs is 0.000, indicating that the difference is statistically significant. In conclusion, this analysis shows that there are significant differences between the values of pretest and posttest, observasi1 and observasi2, and questionnaire 1 and questionnaire 2, indicating the impact of changes or interventions made between these measurements.

The use of educational media not only helps students to understand concepts, but also increases their active involvement in the learning process (Putri & Basir, 2020; Rachmawati et al., 2021). Students can visually observe natural phenomena, such as the difference between day and night due to the earth's rotation, and seasonal changes due to the earth's rotation (Hafizah & Nurhaliza, 2021). In addition, PBL trains students to solve problems related to natural phenomena, such as the influence of the tilt of the Earth's axis on the change of seasons. Students' critical and analytical thinking skills are increasingly developed through collaborative processes in groups.

Challenges in implementing this method are limited resources and infrastructure, as well as the need to train teachers in the optimal use of technology. Nevertheless, these findings confirm that PBL supported by educational media is very effective in improving students' understanding of concepts and problem-solving abilities related to the topic of rotation and revolution of the Earth. The findings of this study suggest that the use of educational media not only improves students' conceptual understanding, but also facilitates collaboration and discussion in the classroom. This is in line with Amalia's research (Amalia, 2021) which emphasises the importance of using media in the teaching and learning process. Educational media can help students to organise information and connect new concepts with existing

knowledge. In this way, educational media serve as a bridge between theory and practice, which improves learning outcomes.

One of the new aspects revealed by this study is the influence of educational media on students' perceptions of learning. With an average score of 10.350 on the post-test questionnaire, students showed that they felt more involved and benefited from the use of media in the learning process. These findings support previous research by (Lasut et al., 2022; P. M. Sari & Yarza, 2022), which shows that learning strategies involving the use of visual aids can increase students' motivation and interest in learning.

It should be noted, however, that although the results of this study show a positive impact, there are some limitations. The data used is quantitative and does not delve deeply into the subjective experiences of students. The research may also not be fully generalisable to other contexts with different student characteristics or different educational media.

This research shows that educational media make a significant contribution to improving students' understanding and problem-solving skills in relation to the subject of the Earth's rotation and revolution. These findings support the argument that the use of media in learning is not only effective in improving academic outcomes, but also in building engagement and positive learning experiences. By understanding how educational media can improve the quality of learning, educators are expected to design and implement a more effective curriculum and create a supportive learning environment.

CONCLUSION

The results showed that the application of PBL assisted by educational media significantly improved students' conceptual understanding, which can be seen from the increase in post-test scores compared to pre-test. Student participation from observation sheet is more active in Group Discussion and collaboration. Students' positive perception of the learning process is also evident from the results of the questionnaire, which indicates that learning has become more interesting and useful. The use of educational media not only enhances students' academic understanding, but also enriches the learning experience through the visualization of complex concepts, such as the rotation and revolution of the Earth. These results have practical implications for teachers, especially in science learning. The integration of educational media into PBL can be an effective strategy to help students understand complex material while honing problem-solving skills. Teachers are advised to continue to explore and use innovative learning media to create a learning environment that is more dynamic, interactive, and relevant to student needs. Further research suggested that PBL method assisted by educational media is applied to other materials, both in science learning and other subjects. Further research may also explore the long-term effects of these methods on student learning outcomes, as well as assess their effectiveness at different levels of Education. It is important to expand the benefits and applications of this learning model across a variety of educational contexts.

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