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The Implementation of PBL Model on Student Learning Outcomes in the Concept of Life Organizational Systems

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Abstract: This research aims to determine the effect of the Problem Based Learning (PBL) model on student learning outcomes in the concept of Life Organization Systems. This research is experimental research, with the research design used being a one group pretest-posttest design. The sampling technique used in this research was the total sampling technique. The population in this study was all class VII of SMP Negeri 3 Biluhu for the 2024/2025 academic year. The sample in this study consisted of 3 classes, namely the experimental class, the replication 1, and the replication 2, The experimental and replication classes were determined randomly. Research data was collected using test techniques, then the data was analyzed using descriptive statistics, which include normality tests, homogeneity tests, hypothesis tests, and n-gain analysis. The results obtained for the concept of Life Organization Systems using the PBL model through hypothesis testing where for the T_{count} in the experimental class was 2.42; replication 1 was 2.32; replication 2 was 2.29, and the T_{table} for experimental class was 2.14; replication 1 was 2.18; replication 2 was 2.16. It can be concluded that the hypothesis testing in each class is that the T_{count} is greater than the $T_{table.}$ Thus, the implementation of PBL model has an effect on student learning outcomes in the concept of Life Organization Systems.

Keywords: Life Organization Systems; PBL model; Student learning outcomes

Introduction

Education is the process of teaching and learning aimed at helping individuals develop their potential for more excellent knowledge. It is a deliberate and planned effort to create an engaging and active learning environment, facilitating the development of a person's potential. This process helps individuals cultivate self-control, personality, intelligence, good character, and skills (Alenezi, 2023; Almazroa & Alotaibi, 2023). Thus, education can be considered a platform for one of the primary tools in knowledge development, which can be implemented in a democratic, fair, and non-discriminatory manner (Fitriah & Mirianda, 2019; Tamwifi & Akbar, 2023; Tuerah et al., 2023). Secondary education aims to enhance knowledge, intelligence, good character, personality, and skills, equipping individuals to keep pace with technological advancements (Mahayukti et al., 2021).

Technological advancements have come a long way over time. Comparing the past to the present, technology has significantly transformed the world, particularly in education. Technology integration in education has simplified various aspects, especially for teachers, enhancing the teaching and learning process for the entire school community (Johnson & Acemoglu, 2023;

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Timotheou et al., 2023; Drigas et al., 2023). This includes creating teaching modules, questions, and instructional materials. The teaching modules must be engaging, especially for subject students find challenging, like science. Science lessons, in particular, should captivate students' interest and make the subject matter more accessible and understandable (Hasanah et al., 2023; Davis et al., 2016).

Science education involves blending the experience of scientific processes with an understanding of scientific products through personal experiences. This type of learning should be designed and focused on problem-solving processes that support preserving human life in a secure cultural environment. In this context, students seek personal experiences that guide them in planning their future lives and becoming individuals who master technology and are conscious of the environment. Therefore, science learning should be able to create these two dimensions. Science is a process for developing scientists' skills and attitudes to achieve science products. Using another term, developing these process skills can foster attitudes like those of scientists (Scientific Behavior) to achieve science products. In line with the opinion that the idea of independent learning aligns with Indonesian education's future vision and mission, aiming to develop high-quality individuals capable of competing in various aspects of life (Santos et al., 2023; Sibagariang & Pandia, 2021; Fang et al., 2023).

An independent curriculum is essential for allowing students to develop according to their potential and abilities. Such a curriculum enables learners to engage in critical, high-quality, expressive, practical, varied, and progressive learning. Implementing this new curriculum requires cooperation, commitment, dedication, and concrete actions from all parties involved to instil the Pancasila student profile in learners (Fitra et al., 2020; Yu, 2023; Ibrahim et al., 2024).

The learning process carried out by teachers still needs to run optimally, especially in Natural Sciences subjects. Natural science is a subject that students consider difficult. Therefore, the key to learning science is a good understanding of concepts. To grasp a new concept, students must first comprehend the previous material. This foundation is essential for them to accept and understand new ideas quickly. With students' lack of understanding of the material presented, learning outcomes are not optimal, and students do not achieve complete learning outcomes (Meliansari et al., 2023).

Student learning outcomes are the percentage of results achieved from the teaching and learning process. These outcomes are inherently tied to the achievements of the learning activities and represent an ongoing process. On the other hand, achievement results from this teaching and learning process. Learning outcomes indicate success in mastering school subjects, reflected in the scores obtained from tests administered by the teacher (Winarso, 2016; Deak & Santoso, 2021).

The teacher can enhance students' critical thinking skills in physics by selecting the appropriate learning model, which should incorporate a student-centered approach. One learning model that embodies this characteristic is the Problem-Based Learning (PBL) model. Amir et al. (2021) notes that PBL encourages students to think critically and analytically. The fundamental principle of the PBL model is to introduce problems as the initial step in the learning process. These problems are typically those encountered in everyday life because the better the influence on improving learning outcomes (Amir et al., 2021). Here, the teacher's job is as a facilitator who directs students in searching for and finding the necessary solutions can enhance lifelong learning skills. PBL promotes an open, reflective, critical, and active learning approach.

Observation results showed that all teachers did not use the PBL model in learning, including in learning at Junior High School in SMP Negeri 3 Biluhu. An interview with a science teacher mentioned that teaching has primarily relied on the lecture and discussion models. The PBL model has yet to be implemented due to the challenges of applying it with students and because students are accustomed to the traditional teaching model.

Research was carried out at this school because the school was still implementing everyday learning and observing in general. This is due to the difficulty of operating and implementing the PBL model in the learning process, which is quite tricky and time-consuming to program, especially for students who are used to an observing learning style. Based on the problems, researchers want to implement the PBL model to change how students learn to be more effective and enjoyable.

Method

The method used in the research uses the experimental procedure. The design used in this research is A group pretest-posttest Design. This design was chosen because there is an initial test before treatment and a final test after treatment. The treatment results can be known accurately with the research design because the effect can be seen, and the research sample consists of an experimental class and two replication classes. This research is experimental, with the research design being a one-group pretest-posttest design. The flowchart of the study from random assignment to pretest and posttest is in Figure 1. The sampling technique used in this research was the total sampling technique. The population in this study was all class VII of SMP Negeri 3 Biluhu for the 2024/2025 academic year. The sample in this study consisted of 3 classes, namely Class VII 1 as the experimental class, Class VII 2 as the replication class 1, and Class VII 3 as the replication class 2, where the experimental and replication classes were determined randomly. Research data were gathered through testing methods. The data were then analyzed using descriptive and inferential statistics, which included normality tests, homogeneity tests, hypothesis tests, and n-gain analysis.

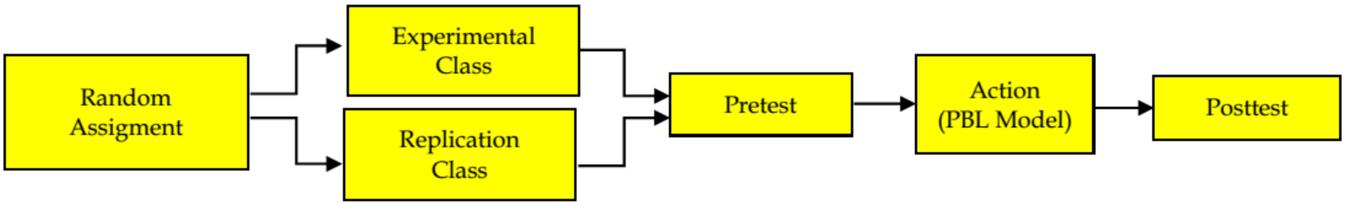

Figure 1. The flowchart of the research

In this research, data collection techniques were used, namely in the form of essay test questions. The test is given twice, namely the first, called the Pretest, which is carried out at the first meeting to determine the initial knowledge or abilities that students have before receiving learning. Then, the second test called the post-test, is carried out at the end of the meeting to determine whether there has been an increase in student learning outcomes after carrying out the learning process using the PBL model on student learning outcomes. This treatment was carried out in all the research sample classes: Experiment Class, Replication 1, and Replication 2.

To determine the value of each student's learning outcomes in each class, both experimental class, replication 1 and replication 2, use the equation (1).

$$\text{Mark} = \frac{\textit{the total score obtained by students}}{\textit{Maximum Score}} x100 \quad (1)$$

To find out the average increase in student learning outcomes in each test carried out in the pretest in the experimental class, replication 1 and replication 2 use equation (2).

$$\text{Average} = \frac{\textit{the total score obtained by all students}}{\textit{The number of students}} \quad (2)$$

The test carried out in this research contained an assessment of understanding of students' learning outcomes which was carried out twice, namely before (Pretest) and after being given treatment (Posttest). The initial test assesses students' prior knowledge, while the final test evaluates their learning outcomes after being treated with the PBL model. In this research instrument, it includes C2 (Understanding), C3 (Implementation), C4 (Analysis), C5 (Evaluate) and C6 (Describe).

The research instrument used in this study is a test. As we know, tests are several questions that are used as trials to measure the knowledge, intelligence, skills, abilities, or talents of individuals or groups (Tanjung, 2016).

Content validity is the suitability of test items to the material, indicators and learning objectives. The test is declared valid if the items are appropriate for measuring the indicator. Material experts check this validity before the test is used. This research's content validity includes teaching modules, teaching materials, Student Worksheets, and learning outcome tests. The validator lecturer checks the suitability of the test items to the learning objectives and cognitive level. Validator suggestions are used to improve learning tools. Validation results were correlated using the formula from Widoyoko (2012) to determine equation (3) validity.

$$PPV = (\Sigma JTV)/(\Sigma JST) \times 100\% \quad (3)$$

Information PPV is Validator Rating Percentage, ΣJTV is Total Number of Validator, and ΣJST is Highest Total Amount.

After the percentage of research instrument validation results is calculated, the feasibility of using the criteria in Table 1.

Table 1. Validity Criteria

Percentage (%)	Category
81 - 100	Very valid
61 - 80	Valid
41 - 60	Enough valid
40 - 21	Less valid
0 – 20	Very invalid

After obtaining a recapitulation of the scores from the two validators through several revision stages with various kinds of suggestions and input from the validators, the validity can then be decided by comparing the PPV percentage prices for each research instrument. The research instrument validity results are found in Table 2.

Table 2. Validity of Research Instruments

Instrument Type	Average	∑JTV	∑JST	PPV (%)	Information
Teaching Module	3.18	380	432	87.96	Very Valid
Student Worksheets	3.44	134	190	88.15	Very Valid
Teaching materials	3.71	129	136	94.85	Very Valid
Learning Results Test	3.69	98	104	94.23	Very Valid

In this research, the validity test calculations used the Microsoft Excel program. The test uses a two-sided test with a significance level of 0.05 which is matched to the R_{table}, with the criterion being that if the calculated $R \geq R_{table}$, then the test item instrument is declared valid. However, if $R_{count} < R_{table}$ then the test item instrument is declared invalid. The R_{table} value in this study was found to be 0.286 because the number of class VII students at SMP Negeri 3 Biluhu in each class was: 16 students for class VII 1, for class VII 2 there were 14 students and for class VII 3 there were 15 students. Therefore, to get student test results, researchers need student respondents to prove the validity of the test. The following are the average results of the construct validity test of the learning outcomes test instruments that have been carried out by students in Table 3.

Table 3. Average Instrument Construct Validity Test

Class	R_{count}		R_{table}	Criteria
	Pretest	Posttest		
Experiment	0.56	0.65	0.42	Valid
Replication 1	0.53	0.51	0.40	Valid
Replication 2	0.59	0.49	0.41	Valid

This research uses descriptive and inferential statistical techniques. Descriptive statistics describe research objects based on sample or population data without further analysis. Inferential statistics, or probability statistics, involves analyzing data with normality tests, hypothesis testing, and n-gain analysis.

Normality Test

The normality test is carried out after the research results are obtained to find out whether the sample data is normally distributed (Ghozali, 2017). This test can be done using Microsoft Excel. The statistics used are the Kolmogorov-Smirnov test in equation (4).

$$F_i = |S(Xi) - F_0(Xi)| \tag{4}$$

Criteria for $Fi \geq k$ (normally distributed data), $Fi \leq k$ (data not normally distributed). Statistical hypothesis for H_a is Normally distributed data and H_1 is data not normally distributed. Normality testing criteria: Accept Ha at the level a = 0.05 if $Fi \geq k$ is obtained from the Kolmogorov Smirnov table.

Homogeneity Test

After the research data is known to be normally distributed, a homogeneity test is carried out to determine whether the two population groups are homogeneous or heterogeneous. The homogeneity test tests the similarity of variations in two or more distributions. This research uses Fisher's test in equation (5).

$$F = \frac{Largest\ Variation}{smallest\ variation} \tag{5}$$

Testing Criteria If $F_{count} \geq F_{table}$ means it is not homogeneous, and If $F_{count} \leq F_{table}$ means homogeneous
Conclusion for Not homogeneous is comparative test analysis cannot be carried out, and Homogeneous is comparative test analysis can be carried out.

Hypothesis Testing

Hypothesis testing was carried out to determine the effect of the PBL model on student learning outcomes. Based on research data, an associative statistical hypothesis test was carried out using the t-test in equation (6).

$$t = \frac{\bar{x} - \mu 0}{\frac{s}{\sqrt{n}}} \tag{6}$$

Information for t is calculated price t, $\bar{x}$ is sample average value, μ_0 is hypothesized value, s is sample standard deviation, and n = number of samples (Sudjana, 2005).

N-gain Analysis

The increase before and after learning is calculated using the n-gain formula. This research uses pretest and posttest instruments, analyzed based on student scores. To determine the increase, analysis of course average normalized gain, single student normalized gain, and n-gain per indicator is used in equation (7) (Hake, 1999).

$$N - Gain = \frac{skor\ Posttest - skor\ prettest}{skor\ ideal - skor\ prettest} \tag{7}$$

After carrying out calculations, the results obtained are then interpreted based on the criteria according to Hake (1999), in Table 4.

Table 4. N-Gain Value Categories

Gain Index	Criteria
g > 0.70	High
0.30 < g < 0.70	Medium
g < 0.30	Low

Based on the N-Gain category Table 4, If the Gain index value (g) is > 0.70, then the n-gain criteria is high. If 0.30 < g < 0.70, then the n-gain criterion is medium. And, if g < 0.30, then the n-gain criterion is low.

Result and Discussion

Results

Student Learning Results and Cognitive Domain Results

The PBL model influences learning outcomes in the concept of life organization systems. This effect can be seen from the difference between the pretest and posttest. Student learning outcomes are obtained from validated essay tests. The classes that received the same treatment were the experimental, replication 1, and replication 2. The process included a pretest, PBL learning for 3 meetings according to the module, and a posttest.

Table 5. Calculation Results

Class		Average
	Pretest	Posttest
Experimental	39.31	82.32
Replication 1	33.04	81.71
Replication 2	34.29	81.82

Table 5 shows the difference in average scores between the experimental class, replication 1 and replication 2. The average pretest score for the experimental class was 39.31, while the posttest was 82.32. Replication 1 has an average pretest score of 33.04 and a posttest of 81.71, while Replication 2 has an average pretest score of 34.29 and a posttest of 81.82. The average student learning outcomes in the experimental class are higher than replication 1 and replication 2. The average increase in student learning outcomes in each class can be seen in Figure 2.

The learning process aims for students to achieve cognitive competence obtained from test results or working on questions based on indicators. Cognitive refers to a person's ability to understand and apply knowledge. This process can involve several aspects, such as using, analyzing, evaluating, and describing. Students' cognitive abilities can be assessed based on aspects C3, C4, C5, and C6. The average results of students' cognitive achievements are represented in Figure 3.

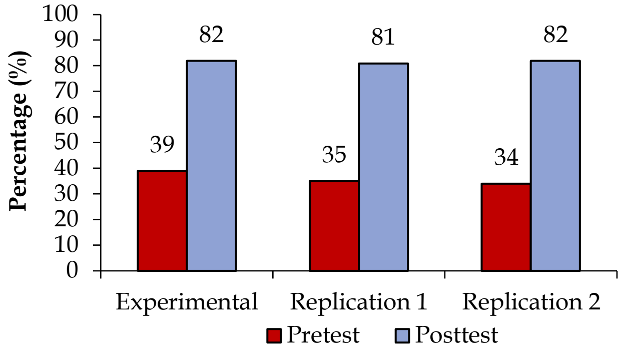

Figure 2. Percentage of cognitive achievements of the Experimental Class

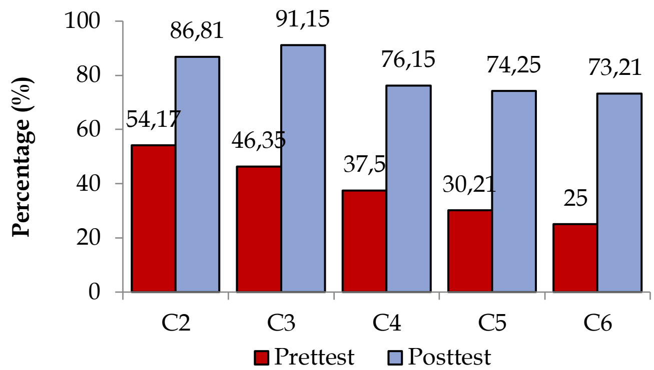

Figure 3. Percentage of cognitive achievements of the Experimental Class

Based on Figure 3, the experimental class shows that the average calculation results for each achievement of cognitive levels C2 to C6 have increased from pre-test to post-test. For the cognitive domain C2 test level, there was an increase of 32.64, while for the cognitive domain C3 test, there was an increase of 44.8. At cognitive levels C4 to C5, the increases were 38.75, 44.04, and 48.21. At cognitive level C3, the increase was more significant than at other cognitive levels.

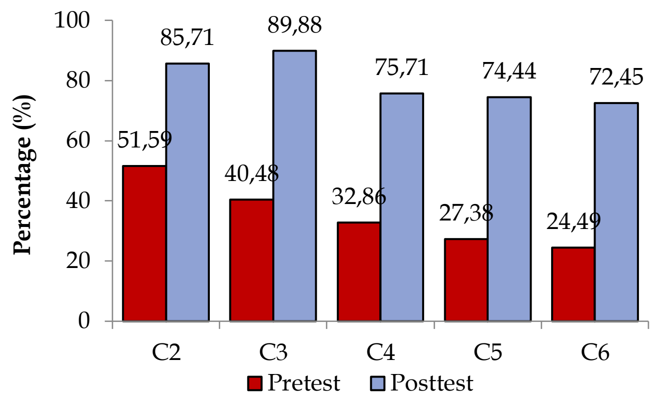

Figure 4. Percentage of cognitive achievements in replication 1

Figure 4 shows the percentage of cognitive domain achievements in replication class 1. For each cognitive domain in the Post-Test, the percentage of replication class 1 experienced an increase before and after (Pretest-Posttest). For cognitive level C2, there was an increase of 34.12, while for cognitive level C3, there was an increase of 49.4. C4 cognitive level increased by 42.85, and cognitive levels C6 to C6 increased by 47.06, 47.95. Of the five cognitive levels above, the one with the most significant increase in value is C3.

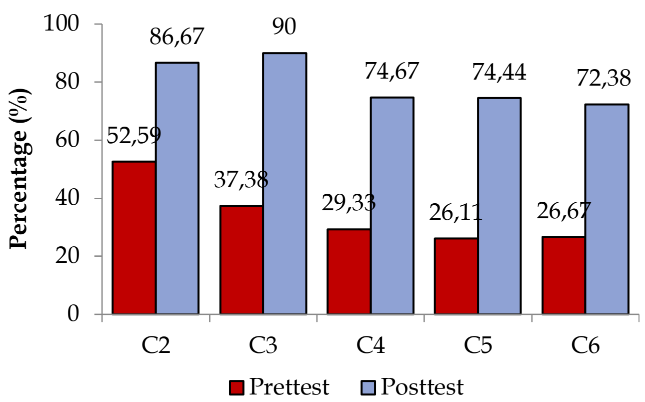

Figure 5. Percentage of cognitive achievements in replication 2

Based on Figure 5, the percentage of cognitive domain achievements from C2 to C6 has increased from pretest to posttest by using range value pretest and posttest. At the cognitive level, C2 experienced an increase of 34.08, and C3 experienced an increase of 52.62. The cognitive levels of C4 and C5 experienced the same growth, namely 45.34, while C6 experienced a rise in test scores of 45.71. If we compare the C2 cognitive level to the C2 and C6 cognitive levels, it can be seen that the C3 cognitive level has experienced a more significant increase.

Data Analysis

Normality test

The data normality test aims to determine whether the data is normally distributed. In this research, the Smirnov colmogrof normality test formula contained in Chapter III was used using Microsoft Excel. The normality test of data in the three classes, namely experiment, replication 1, and replication 2, and the results obtained from statistical tests in Table 6.

Table 6. Results of Data Normality Test

Class	F_i	K	Status
Experiment	0.46	0.33	Normally distributed
Replication 1	0.45	0.35	Normally distributed
Replication 2	0.45	0.34	Normally distributed

Based on the data normality test results in Table 6, it is known that $Fi \geq K$ for the real F level a = 0.05. So, it can be concluded that the research data for the experimental class, replication 1 and replication 2, are normally distributed.

Homogeneity Test

Based on the Table 7 for the three experimental classes, replication 1 and replication 2, for the experimental class the variance is 88.34 with the highest number of variants, replication 1 with the number of variants is 83.02 and replication class 2 with the number of variants 82.27 is the smallest variant. Based on the homogeneity test, it can be obtained that F_{count} is ≤ (smaller) than F_{table}, so the data is said to be homogeneous, so it can be concluded that comparative test analysis can be carried out.

Table 7. Homogeneity Test Results

Class	Variation	F_{count}	F_{table}	Status
Experiment	88.34			
Replication 1	83.02	1.07	2.46	Homogeneous
Replication 2	82.27			

Hypothesis Test

From the Table 8, it can be seen that each normality test has an accepted status. For the experimental class, if the value of 2.42 T_{count} is greater than the value of 2.14 T_{table}, then Ha is accepted, while for replication class 1, it has a T_{count} value of 2.32 and a T_{table} value of 2.18, so Ha is accepted. For replication class 2, it has a T_{count} value of 2.29 and a T_{table} value of 2.16, so Ha is accepted.

Tabel 8. Results of Hypothesis Testing

Class	T_{count}	T_{table}	Status
Experiment	2.42	2.14	H_a Accepted
Replication 1	2.32	2.18	H_a Accepted
Replication 2	2.29	2.16	H_a Accepted

N-Gain Analysis

Table 9 shows that the n-gain category in the experimental class is different from replication classes 1 and 2. In the experimental class, there is an n-gain value of 0.77 with high criteria, and for replication classes 1 and 2, there is an n-gain value of 0.69 with a medium category. The results of n-gain testing in the experimental and replicative classes can be seen in Figure 6.

Table 9. Results of N-Gain Test

Class	N-gain	Criteria
Experiment	0.77	High
Replication 1	0.69	Medium
Replication 2	0.69	Medium

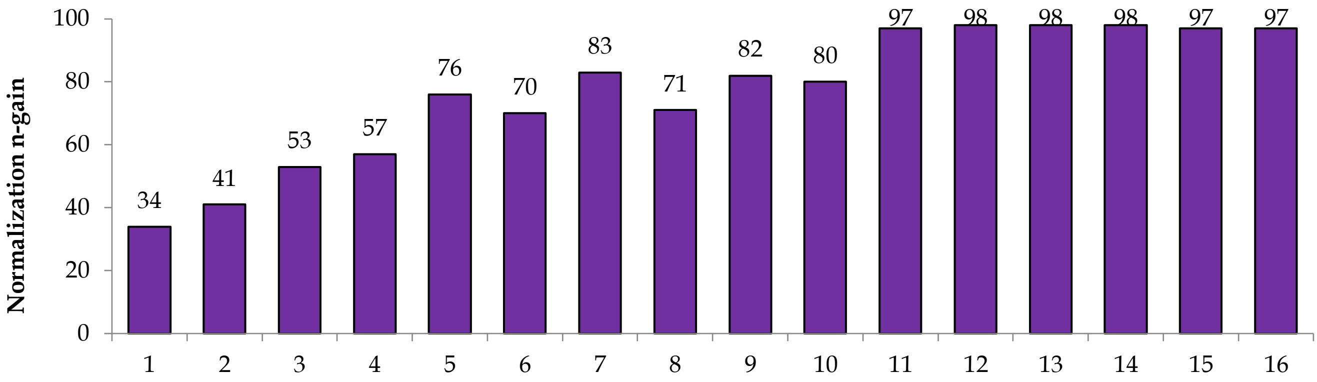

Figure 6. Normalization graph of experimental class n-gain students

Figure 6 shows the increased understanding of each student in the experimental class. This means that the PBL model improves the learning outcomes of each student in the experimental class. Furthermore, looking at the single student normalized gain in replication 1 in Figure 7 shows that replication 1 also obtained higher categories than medium categories.

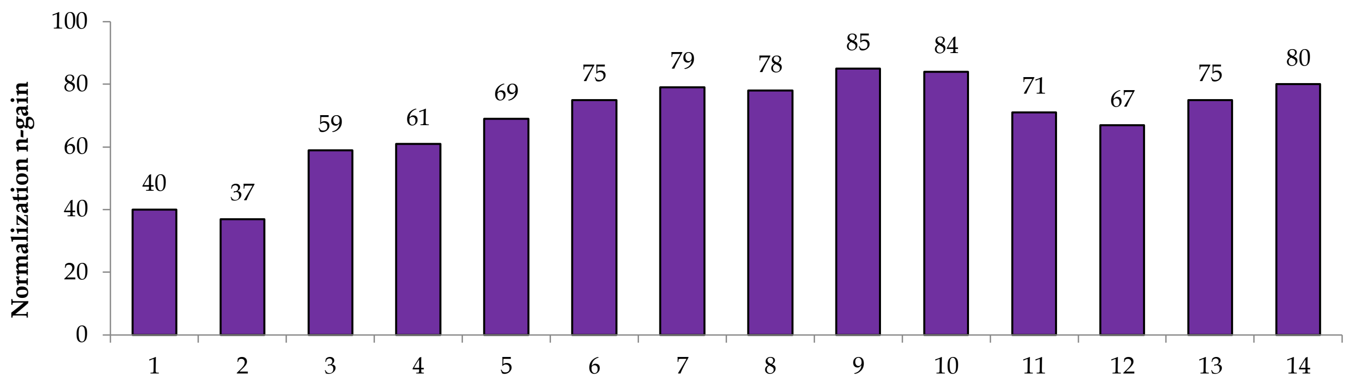

Figure 7. Normalized student n-gain for replication 1

Based on Figure 7, there is an increase in the understanding of each student for replication 1. After being given treatment, there is an increase in the learning outcomes of each student. Thus, the PBL model has a quantitative effect in increasing the understanding of each student in replication 1. Analysis of the single student normalized gain in replication 1. Then, the single student normalized gain in replication 2 is looked at in Figure 8.

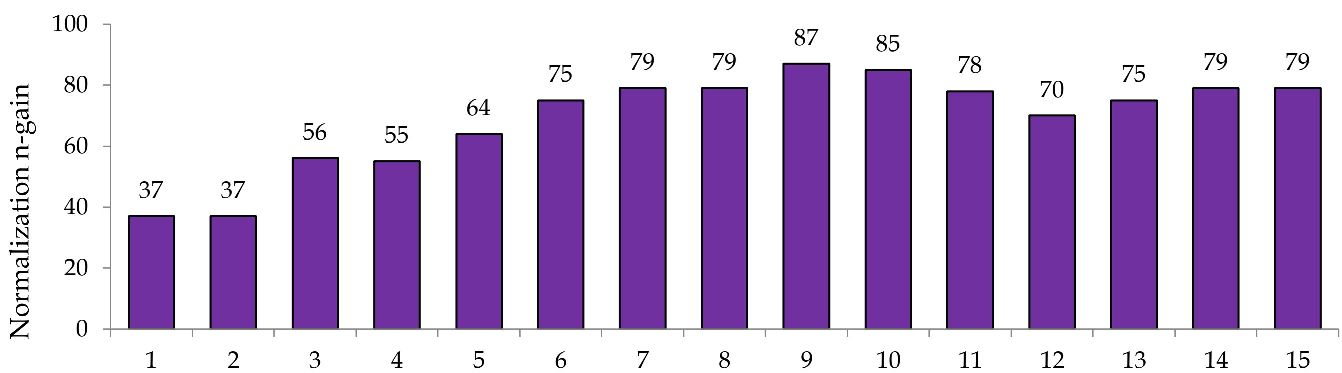

Figure 8. Normalized student-gain graph for replication 2

Figure 8 shows that each student in replication 2's understanding increases after treatment. Therefore, the PBL model affects each student's knowledge in replication 2's knowledge.

Figures 6 to 8 show that there are no students in the low category for all sample classes. This shows that the PBL model increases each student's understanding.

Then, proceed with analyzing n-gain per indicator. The n-gain analysis per indicator was conducted to determine the increase in student's conceptual understanding of each indicator in simple plane material. The results of the n-gain analysis per indicator can be seen in Figure 9.

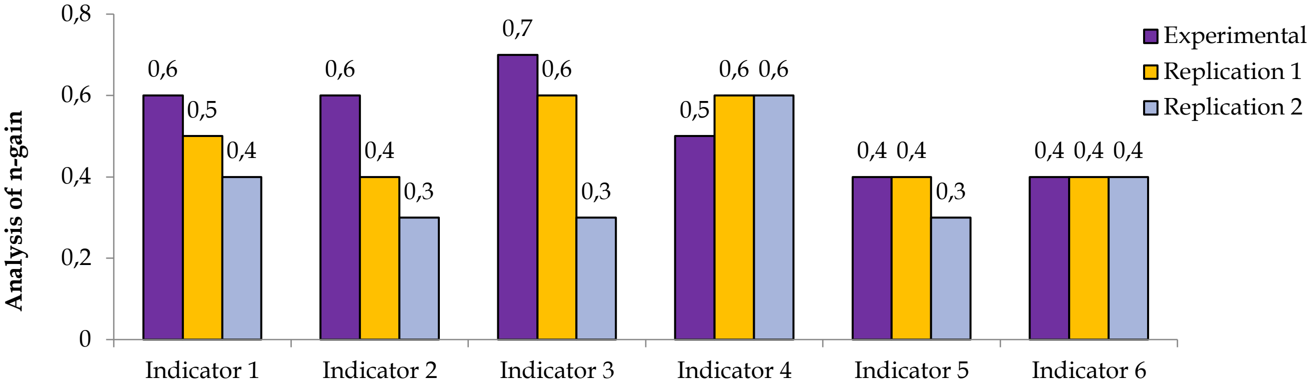

Figure 9. Analysis of n-gain per indicator

Figure 9 shows an increase in understanding per indicator. Where students have gained new understanding or strengthened previous experience, this means that the PBL model significantly affects the learning outcomes of class VII students. The magnitude of the influence is shown in the n-gain value per indicator.

Discussion

The research was carried out using the PBL model on the concept of Life Organization Systems in class VII, which was carried out at SMP Negeri 3 Biluhu. This research took class VII as the subject population, and the sample consisted of 3 classes, namely class VII 1 as the experimental class, class VII 2 as the replication 1, and class VII 3 as the replication 2. For the use of the replication class in experimental research where the replication itself is the repetition of the experiment, to produce better estimates and see the consistency of the results obtained (Sudjana & Dahlan, 1980), this research aims to know the influence of the PBL model on student learning outcomes.

This research significantly contributes to various learning systems because it helps in teaching and enables teaching and learning activities. This learning model creates an atmosphere that is not monotonous, and students appear active in the learning process. It is also a learning model that requires students to think critically in solving a problem given by the teacher.

The learning process lasted for 4 meetings; the first meeting provided a pre-test, and after that, they offered the concept of Life Organization Systems and divided into groups to hold discussions up to meeting 3. From the first meeting to the third meeting, each discussion was different depending on the Student Worksheets given. After discussion, the results were presented to each group. And other groups improve or add to the results of other group discussions. Apart from that, if there are groups who want to ask questions directly, they are welcome, and the group presenting is allowed to answer as well as other groups who want to reply; after that, the teacher answers and concludes with the correct answer. After the discussion, the teacher briefly explains the learning material at the end of each meeting, which begins with a conclusion for the students. In the fourth meeting, the teacher gives a posttest for 100 minutes, which is completed.

The PBL model is used to increase students' interest in learning, which can be seen from students' attention being focused on the ongoing learning process, which influences student learning outcomes. Apart from that, with this model, the learning process will feel more meaningful but can give a deep impression to students because learning feels more fun and not monotonous, so students are more active in learning. With the PBL model, students can always apply local cultural values in learning and everyday life. The PBL model emphasizes student-centred teaching by providing problems that refer students to higher-level thinking (Critical Thinking). Teachers can divide students into several groups so that problem-solving can be done together and students can work together in discussions.

The PBL model is a learning model that is oriented towards the process of solving problems through the concepts or knowledge they learn so that it can improve students' critical thinking abilities. In its implementation, they work in groups and hold discussions so that students are directly and actively involved in understanding the learning material. They can develop intelligent and critical thinking skills by understanding a problem and analyzing how to solve it (Paradina et al., 2019). The PBL model can also improve students' abilities to solve real-life issues built by everyday life (Siburian et al., 2023).

In this research, 3 meetings were held, each with a time of 2 x 40 minutes. Before the lesson begins, the teacher can provide motivation and ask questions that enable students to think critically before entering the study material. Student learning outcomes scores are obtained from the instrument as a written test in an Essay with 10 questions. The written test is research data in the form of a pre-test carried out in both experimental classes, replication 1 and replication 2. This learning outcomes test aims to determine the success of learning in each class and the success of PBL in the life organization system on student learning outcomes.

Average data on student learning outcomes is obtained through tests in the form of pretests, which are carried out before providing treatment. The experimental class got an average score of 39.31 after treatment or treatment using the PBL model. Posttest scores were obtained with an average score of 82.32. The pretest score in replication 1 was 33.04, and the posttest score obtained after undergoing treatment was the same as 81.71. Replication 2 obtained an average Pretest result score of 34.29 and an average Posttest result score of 81.82 after receiving the same treatment as the two previous classes. The experimental class had a higher average Posttest score than the replication class because the experimental class students' enthusiasm for learning was very good as long as the researchers taught using the PBL model. So, it can be concluded that from the average score of the learning test results for the three classes, both the experimental class, replication 1 and replication 2, had higher posttest scores than pretest scores. The results of this research are in line with the results of research from (Bharudin et al., 2022), which showed that the average posttest score for the experimental class was 91.62, replication 1 was 91.80, and replication 2 was 87.65.

Calculating the average student cognitive learning outcomes proves that learning using the PBL model influences student learning outcomes in the concept of life organization systems. This is the opinion of Putri et al. (2023) that learning using the PBL model affects students' cognitive abilities because they are encouraged to be actively involved in solving a problem presented. The PBL model also has several advantages, including improving students' ability to solve real-life problems, building new knowledge through learning activities in everyday life, and triggering thinking skills and scientific communication through discussion, collaboration or presentation activities. The results of their work can thus influence the validity of student learning (Siburian et al., 2023).

The results of the analysis of cognitive level achievements C2 to C6 in the experimental class show that the C2 cognitive level has increased by 32.64. In contrast, for the cognitive domain of the C3 test, there was an increase of 44.8. At cognitive levels C4 to C5, the increases were 38.75, 44.04 and 48.21. At cognitive level C3, the increase was more significant than at other cognitive levels. This aligns with research Ayunda et al. (2022) that students can solve questions at a higher C3 cognitive level than C4 and C6 cognitive domains because C5 level questions require students to express an opinion through examining and criticizing.

In replication 1 where each cognitive domain in the Pre-Test and Post-Test students experienced very significant differences in scores. The percentage of replication class 1 experienced an increase before and after (Pretest-Posttest) in each cognitive domain from C2 to C6. For cognitive level C2, there was an increase of 34.12, while for cognitive level C3, there was an increase of 49.4. C4 cognitive level increased by 42.85, and cognitive levels C6 to C6 increased by 47.06 to 47.95. Of the five cognitive levels above, the one with the most significant increase in value is C3.

Replication class 2 increased the percentage of cognitive domain achievements from C2 to C6 from the pretest to the posttest. At the cognitive level, C2 experienced an increase of 34.08, and C3 experienced an increase of 52.62. The cognitive levels of C4 and C5 experienced the same increase, namely 45.34, while C6 experienced a rise in test scores of 45.71. If we compare the C2 cognitive level to the C2 and C6 cognitive levels, it can be seen that the C3 cognitive level has experienced a more significant increase.

In each class, both experiments and replications significantly increased cognitive level C3 more than C4, C5, and C6. This is because the questions included in the C2 level cognitive domain are in the low category. In answering these questions, students only remember and memorize definitions and state the steps for an activity (Yulianis & Susanti, 2019).

Analysis of the data from this research was carried out through several tests, namely normality test, hypothesis test and N-gain test in the experimental class, replication 1 and replication 2. Where the data normality test aims to determine whether the data obtained is normally distributed, this research uses the Kolmogrof-Smirnov normality test formula with the help of Microsoft Excel, which can be seen in Chapter III. Based on data normality testing, the data obtained for all samples in the three classes, experimental class, replication 1 and replication 2, were normally distributed. Thus, statistical testing is continued using the t-test because the data is normally distributed.

Hypothesis testing aims to find out whether there is an influence from treatment in the form of learning using the PBL model in the experimental class, replication 1 and replication 2 on student learning outcomes. Based on the results of hypothesis testing in Table 8, the T_{count} in the experimental class was 2.42; replication 1 was 2.32; replication 2 was 2.29, and the T_{table} for experimental class was 2.14; replication 1 was 2.18; replication 2 was 2.16. Ho is rejected, and Ha is accepted because the T_{count} is greater than the T_{table}. This shows the influence of the PBL model on the concept of the Life Organization system in class VII on student learning outcomes. This is because using the PBL model can be one of the efforts to improve science learning outcomes because the beginning of learning begins by presenting a problem, identifying the problem, continuing with discussions, and designing a solution which will be achieved at the end learning by collecting various sources of knowledge obtained from the internet, books, even though observation (Kristiana & Radia, 2021).

A final test, namely the n-gain test, is used to see improvements in student learning outcomes through pretest-posttest. The n-gain analysis in Table 9 shows that in the experimental class, replication 1 and replication 2, the n-gain test results fall into the medium criteria. Based on the single student normalized gain, it shows that in each class, both experimental, replication 1 and replication 2, no students were in the low category or, on average, were in the medium category. This shows that after being given treatment, there was an increase in understanding for each student. Analysis of n-gain indicators to determine the increase in student's conceptual understanding of each indicator question in the concept of life organization system. Based on Figure 8, the n-gain analysis shows increased understanding per indicator. Students gain new knowledge or strengthen previous understanding. The implementation of PBL model on the concept of life organization systems influences student learning outcomes.

Conclusion

Based on the research results carried out in the previous chapter, the PBL model on the concept of Life Organization Systems using the Experimental Class, replication 1 and replication 2 show that the PBL model significantly affects student learning outcomes in class VII. Where the learning outcomes of class VII students on the concept of Life Organization Systems using the PBL model through hypothesis testing where for the T_{count} in the experimental class was 2.42; replication 1 was 2.32; replication 2 was 2.29, and the T_{table} for experimental class was 2.14; replication 1 was 2.18; replication 2 was 2.16. It can be concluded that the hypothesis testing in each class is that the T_{count} is greater than the T_{table}, this can mean that the implementation of PBL model has an effect on student learning outcomes.

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The authors declare no conflict of interest.

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