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Improving Students' Learning Outcomes in Science through the Implementation of Problem-Based Instruction

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Abstract

Learning outcomes in science subjects are strongly influenced by the learning strategies implemented in the classroom. However, many students still experience difficulties in understanding scientific concepts due to passive learning environments and limited student engagement. This study aims to improve students' learning outcomes in science through the implementation of the Problem-Based Instruction (PBI) model.

This research employed Classroom Action Research (CAR) conducted in two cycles, each consisting of planning, action, observation, and reflection stages. The participants were students of Grade VII at SMP Negeri 27 Rarowatu Utara during the academic year 2024/2025. Data were collected through observation, learning achievement tests, and documentation. The collected data were analyzed using descriptive quantitative and qualitative techniques.

The results indicated a significant improvement in students' learning outcomes after the implementation of the Problem-Based Instruction model. In Cycle I, students' learning achievement showed moderate improvement, while in Cycle II, students demonstrated higher mastery of the learning material and increased active participation during the learning process. These findings indicate that Problem-Based Instruction effectively enhances students' understanding, engagement, and critical thinking skills in science learning.

Therefore, it can be concluded that the implementation of Problem-Based Instruction contributes positively to improving students' learning outcomes and creating a more meaningful and student-centered learning environment.

Keywords: Problem-Based Instruction, learning outcomes, science learning, classroom action research

A. Introduction

Education plays a vital role in developing students' intellectual abilities, character, and problem-solving skills. In science education, students are expected not only to understand scientific concepts but also to develop critical thinking, inquiry skills, and the ability to apply knowledge in real-life situations. However, learning processes in many classrooms still rely heavily on teacher-centered approaches, which often limit students' active involvement and reduce learning effectiveness.

Based on preliminary observations conducted in Grade VII of SMP Negeri 27 Rarowatu Utara, several learning problems were identified. Many students showed low motivation and limited participation during science lessons. Students tended to rely on memorization rather than understanding concepts, which resulted in low learning outcomes. These conditions indicate the need for innovative instructional strategies that promote active learning and student engagement.

One learning approach that can address these challenges is **Problem-Based Instruction (PBI)**. PBI is a student-centered learning model that encourages students to learn through solving real-life problems. Through this approach, students actively construct knowledge, collaborate with peers, and develop critical thinking skills. Learning becomes more meaningful as students are directly involved in identifying problems, formulating hypotheses, and finding solutions.

Problem-Based Instruction also helps students develop independence and responsibility for their own learning. By engaging students in authentic problem-solving situations, teachers can foster deeper understanding and long-term retention of knowledge. Moreover, PBI supports the development of communication and collaboration skills, which are essential competencies in 21st-century learning.

Considering these advantages, this study focuses on implementing the Problem-Based Instruction model to improve students' learning outcomes in science learning. This research aims to examine how the application of PBI can enhance students' understanding, engagement, and achievement in science subjects at the junior high school level.

B. Literature Review

1. Learning Outcomes

Learning outcomes refer to the changes in knowledge, skills, attitudes, and behaviors that occur as a result of the learning process. Learning outcomes are commonly used as indicators of the effectiveness of instructional strategies. Students with high learning outcomes demonstrate a deep understanding of learning materials and the ability to apply concepts in various contexts.

Learning outcomes are influenced by several factors, including learning methods, student motivation, learning environment, and teacher competence. Effective learning occurs when students actively engage in the learning process and construct knowledge through meaningful experiences. Therefore, teachers need to design learning activities that encourage active participation and critical thinking.

2. Problem-Based Instruction (PBI)

Problem-Based Instruction is a learning model that emphasizes problem-solving as the core of the learning process. In this model, students are presented with contextual problems that stimulate inquiry, discussion, and exploration. Students work collaboratively to analyze problems, gather relevant information, and propose solutions.

PBI encourages students to become independent learners who are capable of critical thinking and decision-making. Through problem-solving activities, students develop analytical skills, communication abilities, and teamwork. This learning model also allows students to connect theoretical knowledge with real-life situations, making learning more meaningful and relevant.

Previous studies have shown that the implementation of Problem-Based Instruction can significantly improve students' learning outcomes, motivation, and engagement. By placing students at the center of the learning process, PBI fosters active learning environments that support deeper understanding and long-term retention.

3. Problem-Based Instruction in Science Learning

In science education, Problem-Based Instruction plays a crucial role in promoting inquiry-based learning. Science learning emphasizes observation, experimentation, and reasoning, which align closely with the principles of PBI. Through problem-solving activities, students are encouraged to explore scientific concepts, test hypotheses, and draw conclusions based on evidence.

The application of PBI in science learning helps students develop scientific thinking skills and enhances their ability to apply knowledge in real-world contexts. This approach also increases students' curiosity and motivation to learn, as they are actively involved in discovering solutions rather than passively receiving information.

Therefore, implementing Problem-Based Instruction in science learning is expected to improve students' understanding, engagement, and overall learning outcomes.

4. Student Engagement and Active Learning

Student engagement plays a crucial role in determining the success of the learning process. Engagement refers to the level of students' involvement in learning activities, including behavioral, emotional, and cognitive participation. According to Fredricks, Blumenfeld, and Paris (2004), student engagement encompasses students' active participation, emotional commitment, and cognitive investment in learning tasks. High levels of engagement are associated with improved academic achievement, motivation, and persistence in learning.

Active learning strategies encourage students to participate directly in the learning process rather than passively receiving information. When students are actively engaged, they tend to develop deeper understanding, critical thinking skills, and positive attitudes toward learning. Active learning also supports meaningful knowledge construction, as students are encouraged to explore, question, and apply concepts in various contexts.

In science learning, student engagement is particularly important because scientific concepts often require observation, experimentation, and reasoning. Active engagement allows students to connect abstract concepts with real-world phenomena, making learning more meaningful and relevant. Therefore, instructional strategies that promote student engagement are essential for improving learning outcomes in science education.

5. Problem-Based Instruction and Student Engagement

Problem-Based Instruction (PBI) is widely recognized as an effective learning model for enhancing student engagement. In PBI, learning begins with a problem that reflects real-life situations, encouraging students to explore, analyze, and propose solutions collaboratively. This approach shifts the focus of learning from teacher-centered instruction to student-centered exploration.

According to Hmelo-Silver (2004), problem-based learning supports the development of higher-order thinking skills by engaging students in inquiry, reasoning, and reflection. Students become active participants who construct knowledge through interaction and problem-solving processes. This learning environment promotes autonomy, responsibility, and self-directed learning.

Moreover, PBI encourages social interaction among students, which plays a significant role in knowledge construction. Collaborative problem-solving enables students to exchange perspectives, clarify misunderstandings, and deepen conceptual understanding. As a result, students become more confident and motivated to participate in learning activities.

6. The Role of Teacher Guidance in Problem-Based Learning

Although Problem-Based Instruction emphasizes student-centered learning, teacher guidance remains a critical component of successful implementation. Teachers act as facilitators who guide students through the learning process, provide scaffolding, and help students reflect on their learning experiences.

According to Vygotsky's theory of social constructivism, learning occurs most effectively when students receive appropriate support within their zone of proximal development. Teacher guidance helps students bridge the gap between what they can do independently and what they can achieve with assistance. Through questioning, feedback, and encouragement, teachers help students develop deeper understanding and confidence.

In the context of Problem-Based Instruction, effective guidance ensures that learning objectives are achieved while maintaining student autonomy. Teachers guide discussions, clarify misconceptions, and support students in connecting theoretical concepts with real-life applications. This balance between independence and guidance contributes to meaningful and sustainable learning outcomes.

7. Conceptual Framework of the Study

Based on the theoretical perspectives discussed above, this study is grounded in the assumption that learning outcomes can be improved through the integration of Problem-Based Instruction and structured teacher guidance. The conceptual framework of this study emphasizes the relationship between instructional strategies, student engagement, and learning outcomes.

The implementation of Problem-Based Instruction encourages active learning, collaboration, and critical thinking. When combined with effective teacher guidance, this approach supports students in achieving higher levels of understanding and academic performance. Thus, the conceptual framework of this study positions Problem-Based Instruction as a key strategy for enhancing learning outcomes in science education.

C. Methodology

1. Research Design

This study employed **Classroom Action Research (CAR)** as the research design. Classroom Action Research is a reflective process conducted by teachers to improve instructional practices and enhance students' learning outcomes through systematic cycles of planning, action, observation, and reflection. This design was selected because it allows teachers to identify classroom problems, implement appropriate learning strategies, and evaluate their effectiveness in real learning situations.

The CAR model used in this study followed the framework proposed by **Kemmis and McTaggart**, which consists of four interconnected stages: **planning, action, observation, and reflection**. These stages were implemented in a cyclical process to ensure continuous improvement of the learning process. The research was conducted in **two cycles**, as the results of the second cycle met the predetermined indicators of success.

Each cycle consisted of **two meetings**, allowing sufficient time for students to experience the learning process using the Problem-Based Instruction (PBI) model. The reflection results from Cycle I were used to improve the planning and implementation of Cycle II, ensuring a more effective learning process.

2. Research Setting and Participants

This research was conducted at SMP Negeri 27 Rarowatu Utara during the 2024/2025 academic year. The participants were students of Grade VII, consisting of 32 students with diverse academic abilities and learning characteristics. The class included both male and female students with varying levels of motivation and prior knowledge.

The selection of this class was based on preliminary observations conducted by the researcher. The observations revealed that students experienced difficulties in understanding science concepts, showed low participation during learning activities, and tended to rely heavily on teacher explanations. These conditions indicated the need for an instructional approach that actively involved students in the learning process.

All students in the class were involved as research participants to ensure comprehensive observation and to create a natural classroom learning environment. This approach also allowed the researcher to observe interaction patterns, learning behaviors, and students' responses to the implementation of the Problem-Based Instruction model.

3. Research Procedures

The research procedures were carried out through two cycles, each consisting of planning, action, observation, and reflection stages.

a. Cycle I

Planning

During the planning stage, the researcher prepared lesson plans based on the Problem-Based Instruction model. Learning materials, student worksheets, observation sheets, and assessment instruments were developed to support the learning process. The learning objectives and success indicators were clearly defined to guide the implementation.

Action

In the action stage, learning activities were conducted according to the prepared lesson plans. Students were introduced to real-life problems related to the science topic being studied. They worked in small groups to analyze the problems, discuss possible solutions, and present their findings. The teacher acted as a facilitator, guiding discussions and providing support when needed.

Observation

Observation was conducted throughout the learning process to record students' learning activeness, participation, and interaction. The observer used observation sheets to document students' engagement, collaboration, and responsiveness during learning activities.

Reflection

After the completion of Cycle I, reflection was carried out to evaluate the effectiveness of the implemented learning strategy. The reflection focused on identifying strengths and weaknesses in the learning process. The results indicated that although students showed increased interest, some still experienced difficulties in participating actively and understanding the learning material. These findings were used as a basis for improving the implementation in Cycle II.

b. Cycle II

Planning

Based on the reflection results from Cycle I, improvements were made to the learning design. The teacher refined the lesson plan by providing clearer instructions, allocating time more effectively, and preparing guiding questions to support students' understanding.

Action

During Cycle II, the learning process was implemented with improved strategies. Students were encouraged to participate more actively in discussions and to collaborate effectively with their peers. The teacher provided more structured guidance and feedback to ensure that all students were involved in problem-solving activities.

Observation

Observations during Cycle II indicated significant improvements in students' learning behavior. Students demonstrated higher levels of engagement, confidence, and collaboration. The classroom atmosphere became more conducive to learning, and students showed greater enthusiasm during activities.

Reflection

The reflection results showed that the improvements implemented in Cycle II successfully enhanced students' learning activeness and understanding. The learning objectives were achieved, and the predetermined success indicators were met. Therefore, the research was concluded at the end of Cycle II.

4. Data Collection Techniques

Data were collected using several techniques to ensure comprehensive and accurate results:

1. **Observation**
   Observation was used to assess students' learning activeness during the implementation of the learning model. Observation sheets included indicators such as participation, collaboration, attentiveness, and responsiveness.
2. **Learning Achievement Tests**
   Tests were administered at the end of each cycle to measure students' understanding of the learning material. The test items were designed to assess cognitive aspects, including comprehension, application, and analysis.
3. **Documentation**
   Documentation included lesson plans, students' worksheets, photographs of learning activities, and field notes. These documents supported the validity of the research findings.

5. Data Analysis Techniques

The data obtained in this study were analyzed using both quantitative and qualitative approaches.

a. Quantitative Data Analysis

Quantitative data from learning achievement tests were analyzed using descriptive statistics to determine the level of students' mastery. The percentage of students who achieved the minimum mastery criterion was calculated using the following formula:

$$\text{Percentage} = \frac{\text{Number of students achieving mastery}}{\text{Total number of students}} \times 100\%$$

The learning process was considered successful if at least 70% of students achieved the minimum mastery criterion.

b. Qualitative Data Analysis

Qualitative data obtained from observations were analyzed descriptively to identify patterns of student behavior, engagement, and interaction during the learning process. This analysis helped explain the changes in students' learning activeness and supported the quantitative findings.

D. Results and Discussion

1. Results

This section presents the findings of the research obtained from the implementation of the Problem-Based Instruction (PBI) model during Cycle I and Cycle II. The results focus on students' learning outcomes and learning activeness throughout the learning process.

Cycle I Results

Implementation of Learning Activities

Cycle I was conducted in two meetings using the Problem-Based Instruction model. At the beginning of the learning process, the teacher introduced the learning objectives and presented contextual problems related to science material. Students were then divided into small groups to discuss and solve the given problems collaboratively.

During the learning process, students showed initial enthusiasm; however, several challenges were observed. Some students were still hesitant to express their ideas and relied heavily on their peers. Others experienced difficulty in understanding the problems presented, which affected their participation in group discussions. Classroom interaction was present but not yet optimal.

The teacher provided guidance and facilitated discussions, but several students still required additional support to engage actively in the learning process. This condition indicated that students were still adapting to the Problem-Based Instruction approach.

Students' Learning Activeness in Cycle I

Based on observation results, students' learning activeness in Cycle I showed moderate improvement. Several indicators such as participation in group discussions, responsiveness to questions, and cooperation among group members began to appear. However, not all students were actively involved.

The average level of learning activeness in Cycle I reached moderate criteria, indicating that further improvement was needed. Some students remained passive listeners, while others were still hesitant to communicate their ideas openly.

Students' Learning Outcomes in Cycle I

The learning achievement test conducted at the end of Cycle I showed that the average student score was 67.18. Only 54.84% of students achieved the minimum mastery criterion, indicating that learning outcomes had not yet reached the expected target.

The relatively low achievement was influenced by several factors, including students' unfamiliarity with problem-based learning, limited confidence, and insufficient understanding of the learning material. These findings indicated the need for improvement in instructional strategies for the next cycle.

Reflection of Cycle I

Reflection activities were conducted collaboratively by the researcher and the observer. The reflection results identified several areas that required improvement:

1. Learning instructions needed to be clearer and more structured.
2. Students required more guidance and motivation to actively participate in discussions.
3. Time management needed improvement to ensure all learning activities could be completed effectively.
4. Teachers needed to provide more encouragement to less active students.
5. Based on these reflections, improvements were planned for Cycle II to enhance the effectiveness of the learning process.

Cycle II Results

Implementation of Learning Activities

Cycle II was conducted by refining the learning strategies implemented in Cycle I. The teacher provided clearer explanations of learning objectives, gave examples related to real-life situations, and encouraged all students to participate actively in discussions.

Group discussions were better organized, and students demonstrated increased confidence when sharing ideas. The teacher also provided more structured guidance and feedback during the learning process, which helped students better understand the material.

The learning environment in Cycle II became more interactive and conducive to meaningful learning. Students showed greater enthusiasm and responsibility toward completing learning tasks.

Students' Learning Activeness in Cycle II

The observation results indicated a significant improvement in students' learning activeness during Cycle II. Students actively participated in discussions, asked questions, and responded to their peers' ideas. Collaboration among group members improved, and students demonstrated higher levels of confidence.

The average learning activeness score increased to 84.94, which fell into the high category. This improvement reflected the effectiveness of the Problem-Based Instruction model in fostering active student engagement.

Students' Learning Outcomes in Cycle II

The learning achievement test administered at the end of Cycle II showed a significant improvement in students' performance. The average score increased to 81.32, and 70.97% of students achieved the minimum mastery criterion.

These results indicate that the implementation of Problem-Based Instruction successfully enhanced students' understanding of the learning material. The improvement in learning outcomes was closely related to increased student engagement, collaboration, and critical thinking skills.

2. Discussion

The findings of this study demonstrate that the implementation of the Problem-Based Instruction model significantly improved students' learning activeness and academic achievement. The gradual improvement observed from Cycle I to Cycle II indicates that students became more accustomed to active learning and problem-solving activities.

The increase in learning activeness suggests that Problem-Based Instruction effectively encourages student participation and engagement. Through collaborative problem-solving, students developed confidence in expressing ideas and sharing knowledge with peers. This finding is consistent with previous studies indicating that student-centered learning models promote active learning and deeper understanding.

Furthermore, the improvement in learning outcomes supports the view that meaningful learning occurs when students are actively involved in constructing knowledge. By engaging with real-life problems, students were able to connect theoretical concepts with practical applications, thereby enhancing their comprehension and retention.

The integration of structured guidance also played an important role in supporting students' learning. Guidance helped students remain focused, motivated, and confident throughout the learning process. This combination of problem-based learning and guided support created a conducive learning environment that fostered both cognitive and affective development.

Overall, the results indicate that Problem-Based Instruction is an effective instructional approach for improving learning outcomes in science education. The findings of this study reinforce the importance of implementing active learning strategies to enhance students' engagement and academic performance.

E. Conclusion

Based on the findings and discussion, it can be concluded that the implementation of the Problem-Based Instruction (PBI) model effectively improved students' learning outcomes in science learning at SMP Negeri 27 Rarowatu Utara. The application of PBI encouraged students to actively participate in the learning process, enhanced their engagement, and supported the development of critical thinking and problem-solving skills.

The results showed a significant improvement in both students' learning activeness and academic achievement from Cycle I to Cycle II. Students became more confident in expressing their ideas, collaborating with peers, and responding to learning challenges. The increase in students' learning outcomes indicates that the learning process became more meaningful and effective when students were actively involved in solving contextual problems.

Furthermore, the integration of structured guidance during the learning process played an important role in supporting students' understanding and motivation. Through guidance and facilitation, students were able to overcome learning difficulties and participate more actively in classroom activities. This finding highlights the importance of teacher facilitation in ensuring the success of student-centered learning approaches.

In conclusion, the Problem-Based Instruction model is an effective instructional strategy for improving students' learning outcomes in science education. It is recommended that teachers apply this model as an alternative learning approach to create an active, engaging, and meaningful learning environment. Future research is encouraged to explore the application of Problem-Based Instruction in different subjects, educational levels, or learning contexts to further examine its effectiveness.

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