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Implementation of a Practicum-Based Problem-Based Learning (PBL) Model to Improve Students' Learning Activities

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Abstract – This study aims to determine whether using the problem-based learning model accompanied by experimental methods can increase students' physics learning activity. The type of this research is class action research, with the research subjects being students of class XI Science MAS Al-Khairaat Luwuk, totaling 16 students. This research was conducted on fluid material in the odd semester of the 2023/2024 academic year. Data collection was carried out using observation techniques during learning activities. The data was analyzed using descriptive analysis and obtained a classical score of the percentage of students' physics learning activities in cycle I of 57.36% with moderate criteria, cycle II of 67.79% with active criteria, and cycle III of 73.57% with active criteria. From this study's results, using a problem-based learning model accompanied by an experimental method can increase students' physics learning activity.

Keywords: PBL model, laboratory, activities

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Introduction

Science is knowledge obtained through learning and verification. Mastery of science can be pursued through improving the quality of education. Education is the learning of knowledge, skills, and habits of a group of people that are passed down from one generation to the next through teaching, training, or research. Contemporary education continuously innovates in learning across various aspects, ranging from vision, mission, goals, programs, services, methods, technology, processes, to evaluation. Educational reform is one form of effort to improve educational quality. Improving educational quality involves curriculum reform, enhancement of learning quality, and the effectiveness of learning methods (Rostiyana, 2022).

Science is essentially a collection of knowledge (a body of knowledge), a way of thinking, and a way of investigating. There are several terms used to describe the nature of physics as part of science. First, physics as a product refers to a collection of knowledge (a body of knowledge). Second, physics as an attitude is related to a way of thinking. Third, physics as a process is defined as a way of investigating (Gustini & Wulandari, 2020).

Physics is a branch of Natural Science (IPA) or science that explains natural phenomena (Saprudin et al., 2021). Physics is an empirical science, meaning that everything studied in physics is based on observations of nature and its phenomena (Sears & Zemansky, 1993). In the learning process, students should be emphasized on the formation of knowledge processes and the mastery of concepts. Students are required to construct knowledge within themselves through active participation during the learning process. In physics learning, students are not only actively

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receiving knowledge delivered by the teacher but are also required to possess skills in managing knowledge and to think critically in solving problems related to the material being studied (Ali et al., 2024; Susanti & Munir, 2022). Therefore, students are required to be active in learning activities, especially in terms of collaboration, both among students and between students and teachers.

Studying physics means solving problems and discovering why and how phenomena occur. Physics learning is a process of teaching and learning activities between students and teachers concerning theories that explain natural phenomena in order to achieve desired objectives. These objectives include improving cognitive, affective, and psychomotor abilities developed through learning experiences. When learning physics, students are introduced to physics products in the form of topics, concepts, principles, theories, and laws of physics. Students are also taught to conduct experiments in the laboratory or outside the laboratory as a scientific process to understand various topics in physics.

There are many obstacles in the physics learning process that can lead to low student activity and learning outcomes. Physics is often perceived by students as a difficult subject. Students may have low thinking skills and be unable to think critically, even though thinking is a fundamental ability for learners. Learning physics becomes easier when students are able to use their thinking skills to understand concepts in solving problems (Hanafi & Manan, 1988:14). The abstract nature of some physics concepts and the large number of formulas are common complaints that make it difficult for students to understand physics material properly. Students sometimes focus solely on formulas without understanding the underlying concepts, which ultimately contributes to low learning outcomes. Other obstacles in physics learning include inappropriate learning models or methods, unsuitable approaches, improper use of learning media, and classroom conditions that remain passive (Pinasthika & Kaltsum, 2022).

Facts in the field indicate that the physics learning activities of Grade XI Science students at MAS Al-Khairaat Luwuk are still relatively low. Based on interviews with students, it was found that physics is considered one of the difficult and less interesting subjects, resulting in low student interest in learning it, and many students feel unmotivated when attending physics classes. Observations show that students' learning activities during the learning process tend to be passive and that they pay little attention to the teacher's explanations. Students' activities in the physics learning process, such as conducting experiments, engaging in science processes, asking questions, answering questions, and collaborating are still limited. Learning in physics should emphasize approaches that require high levels of student activity, such as the use of experimental methods incorporating science process skills. This approach is necessary to provide concrete

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learning experiences that can increase student activity and help students understand physics concepts, thereby making their knowledge more meaningful.

An initial step to address the problem of low student activity and learning outcomes can be taken by fostering students' interest in physics. In addition, students need to be provided with learning motivation and appropriate learning strategies. This will encourage students to be more active during the learning process. The learning model used by the teacher plays an important role in achieving learning objectives and cultivating students' interest in learning. The selection of appropriate learning strategies, along with the use of varied learning models and methods, can stimulate learning motivation and increase student activity in the learning process. A strategy is a general pattern of a sequence of activities that must be carried out to achieve certain objectives. Essentially, a strategy is a plan or an overall description of learning activities (Sanjaya, 2011).

According to Hendrawijaya (1999), learning activity includes both physical and mental activities. In the learning process, these two types of activities must always be interconnected. A student thinks while acting; without action, a student does not think. Therefore, to encourage students to think actively, they must be given opportunities to act. Thus, students' learning activities are a series of interrelated physical and mental activities carried out during the learning process, resulting in optimal learning (Kulsum, 2022).

To improve students' understanding of physics concepts, a learning model oriented toward thinking process activities is required. In addition, considering the diversity of students' characteristics and learning styles, innovative learning activities that align with technological developments in the 21st century are needed. Innovative learning has become a demand in every teaching and learning process. Learning that utilizes technology and the selection of appropriate learning strategies will increase students' learning activities and help achieve learning outcomes (Sari, 2016). Therefore, a learning model and method that can be used to enhance students' physics learning activities are needed. One such model is Problem-Based Learning (PBL), which is a learning model that involves presenting authentic and meaningful problem situations to students, enabling them to conduct investigation and inquiry. According to Dewey (as cited in Trianto, 2010), problem-based learning is an interaction between stimulus and response, representing a two-way relationship between learning and the environment.

Problem-based learning employs an approach that engages students with real-life problems. This learning model aims to help students develop thinking skills, problem-solving abilities, and intellectual skills, as well as to learn various roles through real-life learning experiences. Problem-based learning has several advantages, such as being realistic to students' lives, aligning concepts with students' needs, fostering students' inquiry skills, strengthening retention, and enhancing problem-solving abilities. However, its weaknesses include the need for

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complex preparation, difficulty in finding relevant problems, and the requirement of considerable time for investigation (Trianto, 2010:96–97). Considering these conditions, there is a need for a method that can activate students' psychomotor skills and assist in the investigation process. One method that can encourage students to be active and support inquiry, thereby preventing passive learning, is the experimental method. The experimental method is one way of presenting lessons in which students conduct experiments by directly experiencing what is being learned (Djamarah & Zain, 2006:84).

Based on the background described above, it is necessary to conduct a classroom action research (Classroom Action Research). The research problem is formulated as follows: how does the implementation of the Problem-Based Learning (PBL) model accompanied by the experimental method improve the physics learning activities of Grade XI Science students at MAS Al-Khairaat Luwuk.

The purpose of this study is to examine the improvement of students' physics learning activities through the implementation of the Problem-Based Learning (PBL) model accompanied by the experimental method among Grade XI Science students at MAS Al-Khairaat Luwuk. The results of this study are expected to support the development of students' thinking abilities and increase their physics learning activities, thereby improving learning outcomes. In addition, the findings may serve as information and considerations for creating learning processes that can enhance students' learning activities, as well as a reference for conducting further research

Research Methods

This study is a classroom action research conducted at MAS Al-Khairaat Luwuk Palengaan, Pamekasan. The research involved Grade XI Science students, who were selected due to the problem of low physics learning activity in the class. The study was carried out over three weeks during the odd semester of the 2023/2024 academic year. The research design employed the Hopkins cycle model; according to Aqib (2006) and Susilo et al. (2022), classroom action research follows a spiral cycle consisting of four phases: planning, action, observation, and reflection.

The data collection technique for students' physics learning activities in this study was observation, and the data were analyzed descriptively in terms of the percentage of students' learning activities. The percentage of students' learning activities was calculated using the following formula.

$$P_a = \frac{A}{N}(100\%)$$

Explanation : P_a = Percentage of students' learning activities
A = Total score obtained by the student
N = Maximum possible score

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The calculation results are adjusted to the categories of student activeness, which are presented in Table 1 below.

Table 1. Student Activity Categories

Activity Percentage	Criteria
$Pa \geq 80\%$	Very Active
$60\% \leq Pa < 80\ \%$	Active
$40\% \leq Pa < 60\ \%$	Moderately Active
$20\% \leq Pa < 40\ \%$	Less Active
$Pa < 20\%$	Very Less Active

(Basir, 1988)

Result and Discussion

A. Results

This study was conducted at MAS Al-Khairaat Luwuk Palengaan Pamekasan involving students of class XI Science in the odd semester of the 2023/2024 academic year. Before the study was carried out, interviews were conducted with several students and observations were made of students' physics learning activities. The interview results showed that most students in class XI Science were less interested in the physics subject. They stated that physics is a subject that is difficult to understand and involves too many formulas. In addition, they had difficulty understanding the physics material explained by the teacher in class. The example problems and the practice questions given were sometimes very different, so the solution methods were also different even though they were based on the same concept.

The results of the observations prior to the study indicated that students' physics learning activities were low. However, after the study was conducted over three cycles within approximately one month, there was an increase in students' physics learning activities. In the first cycle, the students' physics learning activities were as follows: experimental activities 71.12%; science process activities 53.17%; questioning activities 39.32%; cooperation activities 69.78%; and answering or expressing opinions 47.11%. The students' activities in Cycle I can be seen in Table 2 below.

Table 2. Student Activities of Class XI Science at MAS Al-Khairaat Luwuk in Cycle I

Student Activities	Percentage (%)
Conducting experiments	71,12
Carrying out science process skills	53,17

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Asking questions	39,32
Cooperation	69,78
Answering or expressing opinions	47,11

In the second cycle, the students' physics learning activities were as follows: experimental activities 69.34%; science process activities 73.77%; questioning activities 58.53%; cooperation activities 78.47%; and answering or expressing opinions 51.37%. The activities of Class XI Science students at MAS Al-Khairaat Luwuk in Cycle II can be seen in Table 3.

Table 3. Student Activities of Class XI Science at MAS Al-Khairaat Luwuk in Cycle II

Student Activities	Percentage (%)
Conducting experiments	69,34
Carrying out science process skills	73,77
Asking questions	58,53
Cooperation	78,47
Answering or expressing opinions	51,37

The average students' physics learning activity in Cycle II was 66.76% with the active criterion. In the third cycle, the students' physics learning activities were as follows: experimental activities 84.11%; science process activities 82.37%; questioning activities 61.15%; cooperation activities 87.93%; and answering or expressing opinions 50.77%. The students' activities in Cycle III can be seen in Table 4 below.

Table 4. Student Activities of Class XI Science at MAS Al-Khairaat Luwuk in Cycle III

Student Activities	Percentage (%)
Conducting experiments	84,11
Carrying out science process skills	82,37
Asking questions	61,15
Cooperation	87,93
Answering or expressing opinions	50,77

The average students' physics learning activity in Cycle III was 73.57% with the active criterion.

B. Discussion

Here is a **more concise and focused version** of the text while preserving the key findings and academic clarity: Physics learning requires careful selection of learning models and supporting elements to improve students' activity and learning outcomes. This study focused on five learning activities: conducting experiments, applying science process skills, questioning,

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collaboration, and expressing opinions, which were initially in low to moderate categories and therefore required classroom action research. After implementing the problem-based learning model with experimental methods, students' learning activities showed continuous improvement. In Cycle I, experimental and collaboration activities reached the active criterion, while science process skills, questioning, and expressing opinions were still moderate. The increase in activity was driven by hands-on experiments and group-based problem solving. Improvements were made in Cycle II based on Cycle I evaluations, resulting in higher activity levels across all indicators. Experimental, science process, questioning, and collaboration activities reached the active criterion, while expressing opinions remained moderate. Overall, the results indicate that reflection and follow-up actions between cycles effectively increased students' learning activities.

The evaluation of Cycle I was related to several technical aspects in the stages of the learning process and students' ability to conduct investigations during the experimental stage. In Cycle I, there were still several students who were less active in collaborating within their groups. They experienced difficulties in carrying out several experimental steps, so they tended to remain passive and were not optimal in analyzing the experimental data. As a follow-up plan, the teacher conducted interviews with some of these students regarding their difficulties in carrying out the experiments and provided solutions. In terms of data analysis, some students had difficulty performing calculations and constructing graphs, resulting in less optimal answers. The teacher eventually provided special guidance to address the students' difficulties as an improvement for the learning process in Cycle II. An increase in activity from Cycle I to Cycle II was observed.

In Cycle III, an increase in average activity was also observed. Evaluation was continuously carried out from Cycle II to Cycle III, followed by the preparation of follow-up action plans. As a result, in Cycle III all types of activities showed an increase in percentage except for answering or expressing opinions; however, overall there was still an increase in students' learning activities on average. Differences in the subject matter caused a decrease in the percentage value for answering or expressing opinions, although it was not very significant and remained higher than in Cycle I. In Cycle III, students' activity in conducting experiments reached 84.11%, categorized as very active. Science process activities reached 82.37%, also categorized as very active. Questioning and cooperation activities reached percentages of 61.15% and 87.93%, categorized as active and very active, respectively. A decrease to 50.77% occurred in answering or expressing opinions, but it remained in the moderate criterion. On average, the activity percentage in Cycle III reached 73.57% (active criterion), which was higher than Cycle II at 66.76% (active criterion) and Cycle I at 57.36% (moderate criterion).

The processing of scores based on observations of learning activities shows that in each cycle there was an average increase in learning activity. This occurred because an innovative learning

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process was implemented that incorporated elements of 21st century competencies. The application of the Problem Based Learning (PBL) model was very effective in the physics learning process and was able to increase students' learning activities because it was accompanied by experimental methods. This learning model is able to foster students' creativity in solving problems (Ansya & Salsabilla, 2024).

The implementation of the PBL model in learning is closely related to problem-solving techniques. Problem solving is a way of learning in which students are no longer viewed as merely receiving information; instead, they learn to approach each problem using their existing knowledge and to construct their own understanding. Problem solving was applied in this study because it is very important for physics content, as understanding physics concepts is not easy. Solving physics problems requires systematic analytical thinking based on an understanding of related concepts. This encourages students to use all of their thinking abilities in solving problems or in understanding the material being studied. In this context, students are required to think critically about the material or in solving problems (Sari & Ahmad, 2024).

Here is a **shorter, more concise version** while keeping the key ideas and academic tone: Students demonstrated creativity and innovation through conducting experiments, analyzing data, constructing graphs, and presenting practicum results. Collaboration and communication skills were evident during group investigations within the PBL model, where students actively discussed experimental findings under teacher guidance. These activities also helped build students' self-confidence. The study implemented 21st-century competencies through a STEAM approach integrated with TPACK. This approach was suitable for physics learning, as physics involves abstract and contextual concepts that require technological support. The use of technology, such as LCD projectors to display videos and images of physical phenomena, increased students' enthusiasm, curiosity, and learning effectiveness. The integration of technology, pedagogy, and content through TPACK shifted learning from teacher-centered to student-centered practices. Through PBL and experimental activities, students became more active, engaged in discussion, developed science process skills, and improved collaboration and learning outcomes.

Innovation in science learning made students interested in learning and encouraged curiosity about phenomena related to the material being studied. Improvements in the presentation of problems in each cycle led to increased student activity in conducting experiments and in science process skills. Student activity in conducting experiments in Cycle I with a percentage of 71.12% increased to 69.34% in Cycle II and then rose to 84.11% in Cycle III. A similar trend was observed in students' science process skills, as these skills are embedded in the experimental activities. The percentage of science process skills increased from 53.17% in Cycle I to 73.77% in Cycle II and further increased to 82.37% in Cycle III. These activities were categorized as active in Cycles I and

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II and very active in Cycle III. This is consistent with the findings of Naimah (2022), which state that innovation in science learning through the use of learning media can enhance students' creativity.

Students' questioning activity was categorized as moderate in Cycle I with a percentage of 39.32%, but it increased to the active category in Cycles II and III. The percentage of questioning activity reached 58.53% in Cycle II and 61.15% in Cycle III. During the learning process, students' curiosity was stimulated, resulting in an increased desire to ask questions. This was also due to the engaging presentation of material and the orientation of students toward contextual problems through the display of learning videos. Students' cooperation activity in Cycle I was categorized as active at 69.78% and increased in Cycle II and Cycle III to 78.47% and 87.93%, respectively. This increase occurred because of guidance and support from the teacher during the investigation stage, where students collaborated in discussion groups to conduct experiments and analyze data. At this stage, interaction among students within groups also occurred through exchanging ideas and asking questions as part of the problem-solving process. Students were very active in seeking solutions to problems with guidance from the teacher. In this process, the teacher provided direction to ensure that discussions remained within the scope of the studied material. This stage strongly emphasized students' cognitive abilities, allowing them to construct their own knowledge based on their experiences.

The final student activity examined in this study relates to students' ability to answer questions or express opinions on a particular topic. There was an increase in this activity from Cycle I to Cycle II, with the percentage rising from 47.11% to 51.37%. In Cycle III, however, it decreased to 50.77%. These increases and decreases were not very significant. The increase in Cycles I and II occurred because the main material studied was the same, namely static fluids, with subtopics of hydrostatic pressure and Archimedes' principle. In Cycle III, the main material studied was dynamic fluids, focusing on flow rate and continuity. The experimental technique in Cycle III differed from the previous cycles because it used virtual experiments, whereas in the first two cycles students conducted experiments directly in the laboratory. This difference caused a slight decrease in activity in Cycle III, although it was not significant. Nevertheless, overall, the average students' physics learning activity increased from 57.36% in Cycle I to 66.76% in Cycle II and further increased to 73.57% in Cycle III.

There are obstacles in the physics learning process, one of which is students' perception that physics subject matter is difficult. This perception can lead to low physics learning activity among students, as occurred in the environment of Madrasah Aliyah Mambaul Ulum Bata-Bata. Considering the low level of students' physics learning activity, a learning strategy that emphasizes student activity is needed. The selection of the Problem Based Learning (PBL) model accompanied by experimental methods is very appropriate for the characteristics of physics

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content and is supported by experimental activities in learning. PBL is an innovative learning model that presents authentic and meaningful problem situations to students, enabling them to more easily carry out investigation and inquiry. The experimental method in the learning process can encourage students to be active and support investigation, so students do not appear passive. Through experimentation, students experience directly what they are learning, making the learning process more meaningful.

These results lead to the conclusion that the use of a problem-based learning model accompanied by experimental methods can increase students' physics learning activities. This occurs because the PBL model applied in this study is an innovative learning model that incorporates 21st century competencies through a STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) based on TPACK (Technological, Pedagogical, Content Knowledge) and HOTS (Higher Order Thinking Skills).

Conclusion

Based on the results and discussion of the study, it can be concluded that the use of a problem-based learning model accompanied by experimental methods can increase students' physics learning activities. This can be seen in the first cycle, in which the activity score of 57.36% increased to 66.76% in the second cycle and further increased to 73.57% in the third cycle. These results support the conclusion that the applied learning model was effective in improving students' learning activities.

The writing of this research article is not free from various limitations, including those encountered during the learning process. To obtain optimal results, several aspects should be considered, as follows:

1. The stages of the learning process must follow the PBL syntax correctly and sequentially, especially in the core learning activities.
2. Learning should apply 21st century elements appropriately, including the STEAM approach used in this study.
3. All elements within the STEAM approach must be included in the learning process without exception.
4. TPACK elements can be further developed with a wider variety of facilities and media that are attractive to students.
5. HOTS elements, especially in the investigation stage, should encourage students to think critically or at a higher level by utilizing all of their abilities in solving problems.

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