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Implementation of the Probelm Based Learning (PBL) to Improve Problem-Solving Skills on Static Fluid Material in Grade XI SMA Negeri 4 Jambi City

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Abstrak

Penelitian ini bertujuan untuk mengetahui peningkatan kemampuan pemecahan masalah peserta didik melalui penerapan model *Problem Based Learning* (PBL) pada materi fluida statis di kelas XI SMA Negeri 4 Kota Jambi. Metode yang digunakan adalah Penelitian Tindakan Kelas (PTK) dengan dua siklus, masing-masing terdiri dari tiga pertemuan yaitu dua pertemuan kegiatan belajar dan satu pertemuan tes kemampuan pemecahan masalah siswa setiap siklus. Data dikumpulkan melalui observasi aktivitas guru dan siswa serta tes kemampuan pemecahan masalah. Hasil penelitian menunjukkan adanya peningkatan aktivitas guru dan siswa serta kemampuan pemecahan masalah siswa. Pada siklus I, ketuntasan klasikal siswa sebesar 55,56%, meningkat menjadi 83,33% pada siklus II. Model *Problem Based Learning* (PBL) efektif dalam meningkatkan kemampuan pemecahan masalah siswa.

Kata Kunci: *Problem Based Learning (PBL), Kemampuan Pemecahan Masalah, Fluida Statis, Penelitian Tindakan Kelas (PTK)*

Abstract

This study aims to determine the improvement of students' problem-solving skills through the implementation of the Problem Based Learning (PBL) model on static fluid material in grade XI at SMA Negeri 4 Kota Jambi. The method used is Classroom Action Research (CAR) with two cycles, each consisting of two meetings. Data were collected through observations of teacher and student activities and problem-solving ability tests. The results showed an increase in teacher and student activities as well as students' problem-solving skills. In cycle I, students' classical mastery was 55.56%, which increased to 83.33% in cycle II. The Problem Based Learning (PBL) *model is effective in improving students' problem-solving skills.*

***Keywords**: Problem Based Learning (PBL), Problem-Solving Abilities, Static Fluid, Classroom Action Research*

Introduction

Physics education plays a crucial role in fostering students' awareness of the importance of scientific principles and their applications in daily life. The ultimate goal is to enhance students' understanding of concepts and principles deeply, which can be observed through their active participation in learning activities and satisfactory academic achievements (BSNP, 2020). However, initial observations in grade XI F-4 at SMA Negeri 4 Kota Jambi revealed a significant gap in students' engagement and comprehension. Students exhibited minimal interest in exploring learning materials independently, struggled with conceptual understanding, and faced difficulties in problem-solving processes.

Previous research indicates that the lack of student engagement in physics classes is a common issue, often resulting from traditional teaching methods that do not encourage active participation (Ulfah & Arifudin, 2021). Despite the teacher's efforts to implement various instructional models and approaches, group learning sessions were less effective, and the use of student worksheets (LKPD) was minimal. This scenario necessitates the adoption of more interactive and student-centered learning models.

Problem Based Learning (PBL) is recognized as an effective pedagogical approach to enhance students' critical thinking and problem-solving abilities. PBL encourages students to engage actively in the learning process by presenting real-world problems that require analytical and reflective thinking. Studies have shown that *Problem Based Learning* (PBL) not only improves students' academic performance but also fosters essential skills such as collaboration, communication, and self-directed learning (Junika Purnama et al., 2021; Erayani & Jampel, 2022). The urgency of this research lies in addressing the identified gaps in student engagement and problem-solving skills through the implementation of the *Problem Based Learning* (PBL) model.

Method

This research employed a Classroom Action Research (CAR) design, conducted in two cycles to observe and improve the learning outcomes progressively. The study was carried out at SMA Negeri 4 Kota Jambi with students from grade XI F-4 as the research subjects. Each cycle consisted of two meetings, followed by assessments to evaluate the effectiveness of the implemented strategies.

The data collection methods included observations of both teacher and student activities, using structured observation sheets to ensure consistency and accuracy. Additionally, problem-solving ability tests were administered at the end of each cycle to quantitatively measure the students' progress. The instruments used in this study were validated by experts to ensure their reliability and relevance to the research objectives.

Data analysis was conducted using descriptive quantitative methods, focusing on the comparison of student performance across the two cycles. The analysis aimed to identify trends, improvements, and areas requiring further intervention. The success indicators for this research were defined as achieving a classical mastery level of at least 75% and an observable increase in student engagement during learning activities.

Result and Discussion

The implementation of the *Problem Based Learning* (PBL) model resulted in notable improvements in both teacher and student activities, as well as in students' problem-solving abilities.

Table 1. Graph showing the progression of teacher and student activities from Cycle I to Cycle III.

	Teacher (%)		**Student (%)**	
Cycle	**I**	**II**	**I**	**II**
Cycle I	93%	91%	57%	68%
Category	Good	Good	Fair	Fair
Cycle II	94%	93%	74%	70%
Category	Good	Good	Fair	Fair
Cycle III	97%	99%	86%	87%
Category	Good	Good	Fair	Fair

Based on table 1, it is evident that in Cycle I, teacher activities were relatively low compared to subsequent cycles. In Meeting I, the result was 92%, and in Meeting II, it was 90%. Several challenges contributed to the suboptimal teacher activities in this cycle: difficulties in managing group discussions led to uneven student interactions, the presentation of learning objectives and stimulating questions did not fully capture students' attention, and the guidance provided to students in defining problems and formulating hypotheses lacked systematic direction, causing some students to struggle with their tasks. During presentations, only a few groups were active in providing feedback, while others remained passive. Additionally, the teacher was not fully effective in asking students to explain the material learned to reinforce their understanding. Reflections from Cycle I were conducted to address these challenges for more optimal implementation in Cycle II.

The use of videos in *Problem Based Learning* (PBL) proved effective in enhancing the learning process due to several key advantages. Firstly, videos can present problems in an engaging visual format, helping students understand the context more concretely and realistically. This aligns with cognitive theory, which suggests that concept comprehension is easier when information is presented multimodally, combining visual and auditory elements (Rahmananda et al., 2024). Secondly, videos allow students to observe phenomena that are difficult to demonstrate directly in class, such as scientific simulations or hazardous experiments, thus broadening their perspectives in problem-solving. Moreover, video use can boost learning motivation as students are more engaged with media-based learning compared to conventional lecture methods.

However, despite the advantages of videos, their use needs to be supported by appropriate learning strategies. If videos are used merely as passive media without further interaction, students tend to watch without critically engaging with the problems presented. Therefore, incorporating other media, such as live demonstrations, can further enhance the effectiveness of *Problem Based Learning* (PBL). Live demonstrations offer the advantage of providing real experiences to students, allowing them to interact directly with the objects or phenomena studied. Through demonstrations, students can observe, ask questions, and test their hypotheses firsthand, ultimately improving their problem-solving skills and deepening concept comprehension.

By combining videos and live demonstrations, problem-based learning becomes richer and more profound. Videos can be used as introductions to visualize problems, while live demonstrations help students understand scientific principles more concretely. Thus, integrating various learning media in *Problem Based Learning* (PBL) not only increases student engagement but also strengthens conceptual understanding and problem-solving skills.

In Cycle II, there was an improvement in teacher activities compared to Cycle I. According to data in table 1, Meeting I achieved 94%, and Meeting II achieved 93%. Several improvements observed in Cycle II include: more effective group divisions ensuring all group members actively participated in discussions, clearer and more engaging presentation of learning objectives and stimulating questions through real-life demonstrations. According to Duch, *Problem Based Learning* (PBL) challenges students to "learn how to learn" and work collaboratively to find solutions to real-world problems. Using live demonstrations, students not only gain theoretical insights into concepts but also see how these concepts are applied in real life, increasing their curiosity and engagement in learning.

Additionally, as Arends cited in Trianto (2009) states, *Problem Based Learning* (PBL) emphasizes authentic problems, enabling students to construct their own knowledge and develop higher-order thinking and inquiry skills. Live demonstrations support this principle by presenting real problems, allowing students to hypothesize, observe results, and analyze directly. This fosters greater student independence in finding solutions and builds their confidence in organizing and communicating their findings.

Based on findings in Cycle II, teachers who were more active in providing systematic guidance and assisting students in formulating hypotheses and drawing conclusions enhanced student interaction in discussions. Adding live demonstrations further increased this interaction as students had concrete experiences to discuss. Moreover, demonstrations allowed teachers to provide more direct and specific feedback on students' thinking processes, supporting deeper understanding.

In Cycle III, teacher activities showed significant improvement compared to the previous two cycles. Based on data in Figure 1, Meeting I achieved 97%, and Meeting II achieved 99%. The enhancements observed in Cycle III include: excellent management of group divisions, ensuring all students actively participated in discussions, no passive groups, more engaging presentation of learning objectives and stimulating questions, increasing student enthusiasm in understanding the material provided, more systematic guidance from teachers in helping students define problems, develop hypotheses, and conduct investigations. Students appeared more confident in developing solutions, and during discussion presentations, there was increased interaction between groups. Students not only presented their work but also actively provided feedback and critiques to other groups, and teachers were more effective in providing evaluations and reflections on learning.

Teachers also began implementing random student selection to explain previously learned concepts, further increasing student engagement. Additionally, videos were played directly via a projector to prevent student boredom during lessons. Visualizations through projectors were clearer and more interactive, allowing students to observe concepts in detail without spatial and visual limitations. Projectors also provided flexibility in presenting various learning scenarios, making it easier to illustrate phenomena that are difficult to demonstrate directly in class. Furthermore, digital media overcame resource limitations and risks of errors in direct experiments, making learning safer and more accurate. The use of projectors also helped improve student focus and concentration due to more engaging and easily followed visual displays.

According to Budiyono (2020), selecting learning media should not lead educators to neglect their responsibility to teach properly. Some educators assign tasks for students to find learning materials via the internet during lessons. While this method is not entirely wrong if based on strategies encouraging independent learning or problem-solving, known as Problem Based Learning (PBL), in some cases, this method becomes an opportunity for educators to relax and leave the classroom while students work on tasks, returning only as the lesson ends.

In Cycle III, teacher activities reached the highest level compared to the previous two cycles. This indicates that the implementation of the *Problem Based Learning* (PBL) model became increasingly effective after improvements from the previous cycles. The most significant improvements were observed in guiding students in investigations, fostering student interactions, and providing deeper evaluations of student learning outcomes.

Although there were significant improvements, some aspects still need further enhancement, such as ensuring all students are actively involved in learning and increasing the effectiveness of guiding students in drawing conclusions from investigations. By continuously reflecting and improving, it is hoped that the quality of learning can continue to increase.

Based on table 4.1, it is evident that in Cycle I, student learning activities were relatively low compared to subsequent cycles. In Cycle I, student engagement was limited, with results showing 57% in Meeting I and 68% in Meeting II. Several factors contributed to the low activity levels in this cycle: students struggled to understand the problem concepts provided, leading to longer task completion times; there was a lack of confidence in asking questions and sharing opinions, particularly during group presentations; teachers were still focused on explaining basic concepts, limiting student exploration activities; and students were not yet familiar with the Problem Based Learning (PBL) model, requiring extensive guidance to comprehend their tasks.

Trianto (2010) emphasized that "*Problem Based Learning* (PBL) is a learning model that engages students with real-world problems aligned with their interests, empowering their thinking, creativity, and participation, thereby enhancing motivation and curiosity." Hence, students are expected to develop higher-order thinking skills and problem-solving abilities. The application of the PBL model confronts students with challenges that motivate them to repeatedly attempt solutions, ultimately boosting their confidence in their abilities.

Additionally, there was a lack of active participation in group discussions, with some students remaining passive and relying heavily on their peers. According to Novianingsih (2016), teachers should form heterogeneous groups to promote balanced academic capabilities and foster better peer learning dynamics. Although group formation based on academic performance was moderately effective in Cycle I, it still lacked in fostering social interactions and diverse peer learning influences. Therefore, reflections were made to improve these aspects in Cycle II to enhance student engagement.

In Cycle II, there was a noticeable improvement in student learning activities compared to Cycle I. Based on data from table 4.1, Meeting I and Meeting II both recorded 74%. The following improvements were observed: students became more active in group discussions, although some remained passive; understanding of concepts improved due to clearer guidance from the teacher during the problem exploration phase; students' confidence in asking and answering questions increased, driven by stimulating questions from the teacher that encouraged critical thinking; and group presentations became more interactive, with more active Q&A sessions compared to Cycle I. This aligns with research by Setyaningsih & Abadi (2018), which states that group learning fosters the emergence of more ideas, making it easier to find solutions to given problems. Shared responsibilities within groups also helped all members achieve a uniform understanding, benefiting students with lower comprehension levels.

Active participation in group discussions positively impacted students' critical thinking skills, shifting their roles from passive group members to active problem-solvers. While students began to adapt to the PBL model, some still required further guidance in formulating conclusions. Continuous reflections were made to optimize student engagement in Cycle III.

In Cycle III, student learning activities significantly improved compared to the previous two cycles. According to data in table 4.1, Meeting I achieved 86% and Meeting II achieved 87%. The following enhancements were noted: all students actively participated in learning processes, both in group discussions and presentations; students' understanding of the material improved, with fewer struggling to complete tasks; peer interactions increased, including sharing opinions, answering questions, and providing constructive feedback; students' confidence in asking and answering questions grew, indicating better comprehension of the concepts; and students became more independent in solving problems, collaborating effectively to formulate conclusions from group discussions.

In Cycle III, student learning activities reached their highest levels compared to the previous cycles, demonstrating the increasing effectiveness of the *Problem Based Learning* (PBL) model following previous improvements. The most significant progress was observed in student participation in discussions, confidence in asking and answering questions, and independence in completing tasks. These findings align with studies by Odell et al. (2019), Pratiwi & Wuryandani (2020), and Wati (2018), which state that *Problem Based Learning* (PBL) is designed to present problems that challenge students to expand their knowledge and acquire new insights through self-discovery. Consequently, students become accustomed to working independently and creatively in solving problems encountered in both academic and real-life contexts.

Ariyani & Kristin (2021) also highlighted that PBL enhances student learning interactions through engaging contextual problems. This aligns with findings from Cycle III, where students were more active in discussions and more interested in the learning process. Furthermore, Wijnen et al. (2018) noted that PBL increases students' learning motivation due to the challenging nature of the problems presented. Observational data from this cycle indicated that students were more motivated to complete tasks, as evidenced by their increased participation in discussions and willingness to ask questions and share opinions.

Despite these improvements, there are still areas that require further enhancement, such as ensuring equal student participation and improving their ability to formulate independent conclusions. Continuous improvement is essential to elevate the quality of learning. This is consistent with Rosane's (2013) findings, which suggest that applying the PBL model in physics education not only increases student learning activities but also fosters critical thinking in processing and presenting information systematically. In this study, increased student engagement was evident in the presentation of group reports and in the analysis and evaluation stages of problem-solving processes. Therefore, implementing the *Problem Based Learning* (PBL) model not only enhances student learning activities but also cultivates critical thinking skills in organizing and presenting information.

Table 2. Students' Problem-Solving Ability Test Results

	Classical Mastery (%)
Cycle I	55,56%
Category	Not Achieved
Cycle II	72,22%
Category	Not Achieved
Cycle III	88,89%
Category	Achieved

Based on Table 2, it is evident that there was a progressive increase in students' classical mastery of problem-solving skills across each cycle. In the first cycle, the classical mastery percentage was only 55.56%. This indicates that while more than half of the students achieved mastery, many still did not meet the expected standards. This could be attributed to students adapting to the newly implemented teaching method or a lack of initial understanding of the concepts taught.

In the second cycle, there was a significant improvement, with mastery reaching 72.22%. This increase suggests that the refinement of teaching strategies, such as the more effective application of the *Problem Based Learning* (PBL) approach, began to positively impact students' abilities. It is likely that students became more accustomed to the active and exploratory nature of this learning model, leading to better conceptual understanding.

The third cycle showed an even more substantial improvement, with mastery reaching 88.89%. This indicates that the majority of students had achieved problem-solving mastery. This improvement can be attributed to students' enhanced understanding following various problem-based learning activities and experiences. Additionally, the teacher's role in providing guidance and feedback significantly contributed to better learning outcomes. This aligns with Yazdani's (2002, in Nur, 2011) assertion that one of the benefits of *Problem Based Learning* (PBL) is enhancing self-direction in problem-solving. Similarly, research by I.M Dwi (2013) indicates that using the PBL model can improve students' problem-solving skills, as students become more motivated to engage actively in learning.

These findings demonstrate that the implementation of the *Problem Based Learning* (PBL) model had a positive impact on improving students' problem-solving abilities. The gradual increase from Cycle I to Cycle III illustrates the effectiveness of the *Problem Based Learning* (PBL) model in helping students gain a deeper understanding of the material and sharpen their problem-solving skills. Therefore, the *Problem Based Learning* (PBL) model can be considered an effective strategy for teaching physics in grade XI.

Conclusion

The implementation of the *Problem Based Learning* (PBL) model significantly improved the problem-solving skills of students in static fluid material at SMA Negeri 4 Kota Jambi. The research demonstrated a marked increase in both student engagement and academic performance from cycle I to cycle III. These findings underscore the effectiveness of PBL in fostering critical thinking, active learning, and conceptual understanding in physics education.

1. The increase in student activity in each cycle indicates that PBL is effective in capturing students' attention and enhancing their engagement in the learning process. In Cycle I, activity levels were still low (65%), possibly due to students being unfamiliar with problem-based learning. However, after deeper implementation in Cycle II (72%) and Cycle III (80%), students began to feel more confident in actively participating as they became more engaged in relevant and contextual learning. The *Problem Based Learning* (PBL) method focuses students on solving real-world problems, motivating them to actively seek information, collaborate, and discuss in groups. Problem-based learning provides direct experiences that make students feel more involved in the learning process, unlike more theoretical or passive learning approaches.
2. The increase in total scores on each indicator reflects that *Problem Based Learning* (PBL) not only enhances student engagement but also their understanding and skills. In Cycle I, a score of 74% indicated that although there was progress, some students still struggled to understand the material or apply it effectively. However, in Cycle II and Cycle III, there were significant improvements (79% and 83%), indicating that problem-based learning became increasingly effective in developing students' skills over time. The *Problem Based Learning* (PBL) model allows students to learn actively through direct experience. As the cycles progressed, students became more skilled in identifying problems, finding solutions, and applying the concepts they had learned, as reflected in the increased indicator scores. *Problem Based Learning* (PBL) also facilitates deeper understanding as students learn to connect concepts with real-life situations.
3. The increase in the number of students achieving scores $\geq$ 78 in problem-solving abilities (70% in Cycle I, 76% in Cycle II, and 82% in Cycle III) demonstrates that the *Problem Based Learning* (PBL) model is highly effective in training students to identify problems, formulate solutions, and solve problems in a structured manner. In Cycle I, some students may have been unfamiliar with this approach, resulting in scores below the target. However, as students' understanding of

how PBL works increased, their results improved in Cycle II and Cycle III. The PBL model requires students to work in groups to solve real-world problems, which directly enhances their critical thinking and problem-solving skills. Over time, students became more adept at organizing information, analyzing situations, and finding effective solutions. By focusing on real-world problem-solving, students not only learn concepts but also how to apply them in real life.

Based on the available data, it can be concluded that the implementation of *Problem Based Learning* (PBL) is effective in increasing student engagement and their problem-solving abilities. Each indicator showed significant improvement as the cycles progressed, indicating that students increasingly understood how to learn actively, collaboratively, and through problem-based approaches. The *Problem Based Learning* (PBL) model not only enhances students' theoretical knowledge but also trains them to become better problem-solvers, which is highly relevant to real-world demands.

Future research should explore the long-term impacts of *Problem Based Learning* (PBL) on student learning and its applicability across different subjects and educational contexts. Additionally, further studies could investigate the integration of technology-enhanced PBL to leverage digital tools in facilitating problem-solving and collaborative learning.

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Curriculum Vitae

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