

Implementing the Problem-Based Learning (PBL) Approach to Enhance Student Engagement and Learning Outcomes in Informatics for Grade X Mechanical Engineering Students at SMK Negeri 2 Karanganyar

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Abstract:

Enhancing student participation and learning outcomes largely depends on the instructional strategies employed. This study was conducted to explore the implementation of a teaching method. In Grade 10 of the Mechanical Engineering Department at SMK Negeri 2 Karanganyar, the use of Problem-Based Learning (PBL) has proven effective in increasing student participation and academic achievement in the Informatics subject. The aim of this research is to evaluate students' responses to the teaching of Programming Language in Grade 10 Mechanical Engineering at SMK Negeri 2 Karanganyar using the PBL approach, as well as to improve student participation and learning outcomes through the application of PBL. This study employed a classroom action research method with a quantitative approach. Data were collected through tests and observations, with instruction used as the research instrument. Data were analyzed both descriptively and quantitatively. In Cycle I, student participation in learning activities reached 79.17%, which increased to 85.83% in Cycle II. The participation rate in Meeting 1 was 80.0%, and 79.0% in Meeting 2, reflecting efforts to enhance student learning outcomes during Cycle I. In Cycle II, participation increased to 80.0% in Meeting 1 and 90.6% in Meeting 2. A participation rate of 90.6% indicates a positive response to the learning activities using the PBL approach, showing a significant improvement in this aspect.

Keywords: *Informatics, Learning Outcomes, Mechanical Engineering, Problem Based Learning (PBL), SMK Negeri 2 Karanganyar, Student Activity*

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Introduction

Creating a learning environment that inspires students to be active, creative, and deeply engaged with the subject matter is just as crucial as the effective transmission of knowledge from teacher to learner. One of the major challenges in vocational education, particularly in the teaching of Informatics, lies in conveying abstract and complex concepts in ways that enable students to understand and apply them practically. This challenge is particularly prominent in vocational schools, where students are expected to not only grasp theoretical knowledge but also apply it in practical and industry-relevant contexts. In such scenarios, traditional didactic teaching methods may not suffice, and more interactive and contextual pedagogical models become necessary. Problem-Based Learning (PBL) emerges as one of the most effective strategies to address these instructional issues. According to Duffy (1996), PBL challenges students by presenting them with real-world problems, thereby strengthening their learning process. Unlike conventional methods, where knowledge is often delivered in a linear and segmented manner, PBL encourages students to explore, inquire, and discover concepts through contextualized problem-solving. This model not only aids students in mastering Informatics content but also enhances their critical thinking, problem-solving, collaboration, and communication skills—competencies that are vital in the modern workplace.

This study aims to investigate the impact of PBL on student engagement and learning outcomes in the Informatics subject at SMK Negeri 2 Karanganyar, a vocational high school in Indonesia. In light of the ongoing paradigm shift in education, which places greater emphasis on skills-based and contextual learning, PBL is seen as a powerful pedagogical tool to address the existing instructional challenges. Vocational education institutions, in particular, are under pressure to produce graduates who are not only knowledgeable but also competent and industry-ready. Therefore, exploring the implementation of PBL in this setting can offer new insights into innovative teaching practices. As noted by Sanjaya (2012), PBL promotes active student participation by involving them in authentic and complex problem-solving scenarios. Beyond helping learners comprehend Informatics topics, it fosters the development of higher-order thinking and teamwork abilities. Students are encouraged to construct knowledge collaboratively, reflect on their experiences, and continuously evaluate their learning strategies. These processes are essential in equipping them with lifelong learning skills. The core objective of this study is to examine the influence of PBL on student engagement and academic achievement in Informatics. With its emphasis on solving real-life problems, PBL encourages learners to actively participate in their own learning process, thus making the learning experience more meaningful and relevant.

Previous studies have shown that the implementation of PBL in subjects such as Informatics results in increased motivation, improved problem-solving skills, and a deeper understanding of content. Hence, adopting PBL becomes a strategic step toward creating learning environments that empower students to reach their fullest potential (Wena, 2009). Moreover, in the context of vocational education, the application of PBL can help bridge the gap between school-based learning and the requirements of the professional world. When students are engaged in projects that mirror real-life tasks, they are better prepared to transition into the workforce with confidence and competence. In addition, this research seeks to analyze the correlation between PBL, student engagement during the learning process, and their performance in grasping subject matter. The study is expected to not only provide fresh insights into the effectiveness of this instructional method but also contribute to the development of innovative teaching practices that align with both the needs of students and the demands of the modern workforce (Sudjana, 2009). It also serves as a valuable resource for educators and policymakers aiming to reform instructional methods in vocational schools to enhance the quality of learning.

Education remains a vital key to unlocking individual potential and preparing future generations to meet global challenges. In an era where information and communication technologies are rapidly evolving, the teaching of Informatics has gained even more importance. However, educators face increasing pressure to deliver abstract and technical content in a manner that is both relevant and engaging (Hmelo-Silver, 2004). Among the strategies receiving significant attention is Problem-Based Learning (PBL). As an alternative to traditional instruction, PBL enables students to acquire knowledge by working through realistic scenarios. It offers a rich and immersive learning environment that can greatly benefit Informatics education, particularly by cultivating critical thinking, problem-solving, and collaborative skills among learners (Girsang & Saragih, 2019).

The significance of research on the application of PBL in Informatics instruction continues to grow, especially as it relates to enhancing student participation and achievement. This study incorporates a review of relevant literature to support the conceptual framework for implementing PBL in Informatics learning. It is hoped that the findings will lead to a deeper understanding of both the advantages and the challenges of adopting PBL in vocational education settings (Yudianto & Sukarsono, 2018). Ultimately, this research endeavors to support the transformation of teaching and learning approaches in vocational schools by leveraging PBL to foster deeper engagement, improved learning outcomes, and the development of key skills needed in the 21st-century workforce.

Methodology

This study employed a classroom action research (CAR) design involving two implementation cycles, which were conducted in the Grade X Mechanical Engineering class at SMK Negeri 2 Karanganyar. The primary objective was to examine the impact of the Problem-Based Learning (PBL) model on improving student activity and learning outcomes in the Informatics subject, particularly focusing on Pascal Programming. The action research methodology was chosen because it allows for a systematic approach to planning, acting, observing, and reflecting, thereby enabling continuous improvement based on real-time classroom observations. A total of 36 students participated in the study. They were selected from the Grade X Mechanical Engineering class because they were actively engaged in the Informatics curriculum, which required them to understand and apply abstract programming concepts. The complexity of topics like Pascal Programming made it ideal for testing the effectiveness of PBL in fostering meaningful engagement and enhancing learning outcomes.

In the first cycle of the research, the PBL model was introduced as a structured learning approach. Students were grouped into small teams and presented with real-world problems that were relevant to their course content. These problems were designed to encourage critical thinking and collaboration. During the learning sessions, the students were guided through the problem-solving process, culminating in group presentations where they shared their solutions. Observations were made to track student activity, and tests were administered to assess their academic progress. Additionally, students were given questionnaires to capture their feedback on the PBL approach.

After analyzing the results of Cycle I, the research team reflected on areas for improvement. Some students demonstrated difficulty in expressing their ideas during group presentations, and group dynamics were occasionally unbalanced. Based on these reflections, adjustments were made in Cycle II. Greater emphasis was placed on encouraging all group members to participate equally, and more time was allocated for preparation and discussion. Peer evaluations were also introduced to foster accountability within groups.

Data collection was carried out using three main tools. First, observation sheets were used to monitor student engagement during each session. These sheets assessed indicators such as attentiveness, participation in discussions, problem-solving initiatives, and communication within groups. Second, achievement tests were administered at the end of each cycle to evaluate students' understanding and ability to apply Pascal programming concepts. Finally, response questionnaires were used to gauge students' attitudes toward the PBL process, providing qualitative insights into their experiences. Data analysis was performed through descriptive statistics. Student activity and learning outcomes were calculated as percentages, allowing researchers to categorize the results into qualitative labels such as "Excellent," "Good," and "Satisfactory." The comparative analysis between Cycle I and Cycle II revealed improvements not only in participation rates but also in test scores. Student responses further supported the effectiveness of the PBL model, as many reported increased motivation and a better grasp of the subject matter.

The success of the PBL implementation was measured against two main criteria. Firstly, there needed to be a significant increase in active participation, with a benchmark of at least 85% of students engaging actively in class activities. Secondly, academic improvement was expected, with more than 80% of students achieving scores that met or exceeded the minimum competency threshold. These criteria were met by the end of Cycle II, affirming the positive impact of the PBL model on both engagement and academic performance. Through this methodical and reflective research approach, the study was able to provide concrete evidence of how PBL can transform the learning experience in vocational education settings. The findings support the integration of student-centered, problem-based strategies in technical subjects like Informatics to promote deeper learning and skill development.

This study consisted of two cycles of classroom action research conducted in the Mechanical Engineering class at SMK Negeri 2 Karanganyar. A total of 36 students from Grade X Mechanical Engineering served as the subjects of the research. The instructional model implemented was Problem-Based Learning (PBL). Several instruments were used to collect data. Tests were administered to evaluate students' learning outcomes and measure the extent of their understanding. Observations were conducted to assess the effectiveness of the learning process and how well the PBL model was implemented. In addition, a survey was used to gauge students' responses and engagement with learning activities within the Problem-Based Learning framework.

$$NP = \frac{R}{SM} \times 100 \dots \dots \dots (1)$$

Keterangan :

NP (Expected Percentage) : The desired or anticipated percentage score.

R (Raw Score) : The unweighted score obtained by the student.

SM (Maximum Score) : The highest possible score achievable for a given task or assessment.

100 (Standardized Total) : The fixed total score used as a normalization reference

There are five criteria used to categorize the percentage of student learning activity observation scores. These five criteria are described in the following table (Arikunto, 2009)

Table 1. Indicator Criteria Based on Percentage

Percentage (%)	Category
81–100	Very Good
61–80	Good
41–60	Fair
21–40	Poor
0–20	Very Poor

The percentage score of student learning activities serves as an indicator of the success of each cycle. If more than 85% of the students fall into the "Good" category, it can be concluded that there has been an improvement in their learning activities.

Result and Discussion

The author conducted this study with the aim of exploring students' responses to the teaching of programming languages in Grade X Mechanical Engineering at SMK Negeri 2 Karanganyar, utilizing the Problem-Based Learning (PBL) model. Additionally, the study aimed to improve student engagement and learning outcomes through the implementation of PBL. A classroom action research design was employed, adopting a quantitative approach to data collection and analysis. Tests and observations were used as data collection methods. Teaching modules, assessment tools, and observation sheets were utilized as research instruments. For data analysis, both quantitative and descriptive analysis techniques were applied to evaluate the effectiveness of the intervention.

Result

The implementation of the Problem-Based Learning (PBL) model led to a notable improvement in student learning activity levels. In Cycle I, student participation reached 79.1%, classified as "Good." This positive trend continued in Cycle II, where the percentage increased to 85.83%, qualifying as "Very Good," thereby indicating a significant enhancement in student engagement throughout the learning process.

Table 2. Student Learning Activities in Cycle I

No	Group	Percentage	Category
1	Group 1	81.25%	Very Good
2	Group 2	100%	Very Good
3	Group 3	81.25%	Very Good
4	Group 4	83.33%	Very Good
5	Group 5	50%	Poor
Average		79.17%	Good

Table 3. Student Learning Activities in Cycle II

No	Group	Percentage	Category
1	Group 1	100%	Very Good
2	Group 2	75.00%	Good
3	Group 3	87.50%	Very Good
4	Group 4	83.33%	Very Good
5	Group 5	83.33%	Very Good
Average		85.83%	Very Good

The first cycle of implementation focused on improving student learning outcomes. During this cycle, the recorded learning achievement reached 80.0%, indicating a positive response to the initial application of the Problem-Based Learning (PBL) model. In the subsequent cycle, student performance showed further improvement. In one of the observed sessions, the percentage increased to 90.6%, reflecting a significant enhancement in understanding and participation.

Table 4 presents the detailed student learning outcomes during Cycle I, which serve as the baseline for measuring progress in subsequent cycles.

Cycle 1	Meeting 1	Type of Test	Percentage 9.0%
Post-test 1 Post-test Cycle	50.0%	Pre-test	80.0%
	79.0%	Type of Test	Percentage
	Meeting		

From the table above, it can be seen that there was a significant improvement in student performance after the first meeting. The post-test result increased from 9.0% to 50.0%, indicating that students began to grasp the concepts after PBL was introduced. In the second meeting, although the pre-test score was relatively high at 80.0%, the post-test score slightly declined to 79.0%. This slight decrease suggests a need for further reinforcement or variation in instructional strategies to sustain consistent learning gains across sessions.

Table 5. Student Learning Outcomes in Cycle II

Cycle 2	Meeting 1	Type of Test Pre-test	Percentage 19.0%
Post-test 2	80.0% 2	Pre-test	15.0%
Post-test Cycle	90.6% Meeting	Type of Test	Percentage

The results in Table 5 show a substantial improvement in students' learning outcomes between the pre-test and post-test sessions. In the first meeting of Cycle II, the pre-test score was relatively low at 19.0%, but the post-test showed a significant increase to 80.0%. Similarly, in the second meeting, the pre-test result was 15.0%, which rose sharply to 90.6% in the post-test. These findings indicate that the application of the PBL model had a notable positive impact on students' understanding and mastery of the subject material. This significant gain in test scores demonstrates the effectiveness of PBL in promoting active learning, especially when dealing with abstract or technically complex subjects like Informatics in vocational education. It also confirms that repeated exposure and continuous implementation of PBL strategies can result in greater retention and deeper conceptual understanding among students. To evaluate the level of student satisfaction with the implementation of Problem-Based Learning (PBL), a simple response survey was conducted using two answer choices: "Yes" and "No". The summary of student responses is presented in Table 6.

Table 6. Student Responses to the Learning Process

Response	Frequency	Percentage
Yes	29	90.6%
No	7	45.6%
Response	Frequency	Percentage

The data in Table 6 shows that out of 36 students, 29 (90.6%) gave a positive response to the learning process, categorizing the learning experience as "Very Good". This indicates strong approval and engagement with the PBL model. However, 7 students (45.6%) responded negatively, placing their experience in the "Poor" category. Although the majority were satisfied, this finding highlights the importance of addressing individual differences and potential barriers some students may face in adapting to active, problem-based learning approaches. This feedback supports the overall effectiveness of the PBL model in enhancing students' motivation and active participation, while also suggesting that continued refinement of instructional strategies may be necessary to reach all learners more equitably.

Discussion

The graph below illustrates the progressive increase in both student learning activity and achievement as a result of implementing the Problem-Based Learning (PBL) model in teaching the topic of Pascal Programming Language.

This visual representation provides a clear overview of how PBL positively influenced student engagement and academic performance across both research cycles. The steady upward trend indicates that not only did students become more actively involved in the learning process, but their mastery of the subject matter also improved significantly. The data confirms that the integration of real-world problem-solving into the classroom environment helps enhance critical thinking, motivation, and knowledge retention. Consequently, PBL emerges as an effective instructional strategy, particularly in vocational education settings where the ability to apply knowledge in practical contexts is essential.

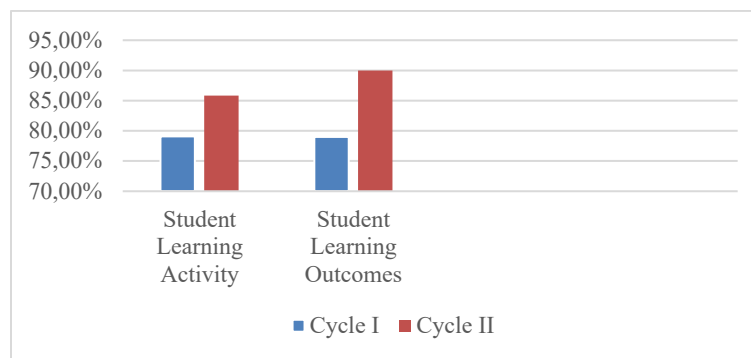


Figure 1. Diagram of Improved Learning Activities and Learning Outcomes

Figure 1 illustrates the comparative increase in both student learning activity and learning outcomes between Cycle I and Cycle II following the application of the Problem-Based Learning (PBL) model. The diagram provides visual confirmation of the effectiveness of PBL in fostering student engagement and academic achievement in the subject of Informatics, specifically within the context of Pascal programming.

The graph presented illustrates the comparative data from Cycle I and Cycle II concerning the application of the Problem-Based Learning (PBL) model in the Informatics subject at SMK Negeri 2 Karanganyar, specifically for the Vocational High School students in the Mechanical Engineering department. The graph distinctly showcases an upward trend in both student learning activity and learning outcomes, highlighting the positive impact of implementing the PBL model in a vocational classroom setting. In Cycle I, student learning activity was recorded at 79.17%, which, according to educational effectiveness categories, falls under the "Good" criterion. However, this figure also signals that some students were not yet fully engaged in the learning process. Observations revealed that several students faced challenges in presenting the results of group discussions effectively during the evaluation stage of the PBL process. This finding aligns with the theory proposed by Hmelo-Silver (2004), who emphasized that while PBL encourages student engagement, successful implementation requires careful facilitation to support students in developing communication and collaborative problem-solving skills.

In response to these observations, improvements were made in Cycle II, which led to a substantial increase in student learning activity, reaching 85.83%, categorized as "Very Good." This increase aligns with Sanjaya's (2012) statement that a well-structured PBL approach enhances student interaction and active participation. Notably, students in Cycle II demonstrated more enthusiasm and confidence when forming groups, participating in group discussions, and presenting their findings to the class. This suggests that the collaborative nature of PBL, as highlighted by Duffy and Cunningham (1996), fosters a learning environment where students become more responsible for their own learning. The graph also reflects an increase in student learning outcomes, from 80.0% in Cycle I to 90.6% in Cycle II. This significant improvement can be explained through constructivist learning theories, particularly the works of Vygotsky, which suggest that knowledge is best constructed through social interaction and contextual experiences. In the PBL model, students learn by solving real-world problems, which enhances knowledge retention and the ability to apply concepts practically. Moreover, Girsang and Saragih (2019) found that PBL implementation in vocational contexts, such as Informatics education, positively affects student motivation and learning depth. The findings of this study support their argument. In Cycle II, students appeared more involved not only in understanding the theoretical content but also in applying it to real-life problem-solving scenarios, particularly in the topic of Pascal Programming Language. Another theoretical underpinning supporting these results is the experiential learning theory of Kolb (1984), which suggests that learning is most effective when students are actively involved in a cyclical process of experiencing, reflecting, thinking, and acting. The PBL model facilitates this process by presenting students with open-ended problems, encouraging them to hypothesize, explore solutions, and reflect on their learning.

This study's graph reinforces the notion that student-centered approaches such as PBL are more effective in cultivating higher-order thinking skills, as opposed to traditional teacher-centered methods. According to Bloom's Taxonomy, active learning strategies like PBL push students beyond basic knowledge acquisition into the realms of analysis, synthesis, and evaluation—levels necessary for success in both academic and professional settings. The improvement in learning outcomes also underscores the role of formative assessment within the PBL model. Throughout the learning cycles, students received continuous feedback from peers and teachers, which is critical for self-regulation and academic growth (Black & Wiliam, 1998). The cycle of feedback and reflection allows students to identify gaps in understanding and develop strategies to improve their learning outcomes.

Furthermore, the increased percentages in Cycle II suggest that students developed a sense of ownership over their learning process. According to Deci and Ryan's Self-Determination Theory, students are more motivated and perform better when they experience autonomy, competence, and relatedness. PBL provides opportunities for autonomy through self-directed learning, competence through problem-solving tasks, and relatedness through group collaboration. The role of the teacher as a facilitator also significantly contributed to this growth. In the second cycle, teachers adjusted their instructional strategies to be more supportive, providing scaffolding to help students navigate complex problems. Vygotsky's concept of the Zone of Proximal Development (ZPD) is particularly relevant here, as it suggests that learners can achieve higher levels of understanding with appropriate guidance and support.

The graph further illustrates that not only did the learning process become more effective, but the learning environment became more inclusive. Students who were initially passive became more engaged in Cycle II, and this inclusive environment promotes equity in learning, which is critical in vocational education settings. The success of the PBL model in this context also suggests its potential scalability. Given the structured implementation and measurable outcomes observed, it is reasonable to propose that PBL could be expanded to other subjects and departments within the school. This supports the findings of Yudianto & Sukarsono (2018), who argued that PBL's flexibility and focus on student engagement make it adaptable to a variety of educational contexts. In summary, the graph serves as compelling evidence of the effectiveness of PBL in improving both student learning activities and outcomes. The implementation of the PBL model not only increased participation and motivation but also enhanced students' ability to apply knowledge practically. These findings reinforce the idea that incorporating real-world problems into classroom instruction, along with structured support and reflection, significantly enhances student learning. Therefore, PBL emerges not just as a method, but as a transformative educational strategy capable of meeting the dynamic demands of modern vocational education.

Conclusion

In this study, the implementation of the Problem-Based Learning (PBL) model in the Grade X Mechanical Engineering class at SMK Negeri 2 Karanganyar demonstrated a significant improvement in student activity from Cycle I to Cycle II. The percentage of student learning activity in Cycle I was 79.17%, which increased to 85.83% in Cycle II, based on the analysis and results obtained. During the first meeting of Cycle I, student activity reached 80.0%, while in the second meeting, it slightly decreased to 79.0%. This decrease became a reflection point and part of the effort to enhance student learning outcomes during the cycle. However, in Cycle II, there was a noticeable improvement. Student activity reached 80.0% in the first meeting and rose significantly to 90.6% in the second meeting. The level of response, which reached 90.6%, indicates that the PBL approach had a positive impact on student engagement and learning behaviors in the Mechanical Engineering class at SMK Negeri 2 Karanganyar. This trend of improvement also correlates with enhancements in learning outcomes, suggesting that PBL not only supports student participation but also contributes meaningfully to academic success.

References

- Afcarino, M. (2023). The Implementation of Problem-Based Learning to Improve Students' Thinking Ability in Biology Subject. March 15, 2023. Retrieved from <http://jurnaljpi.wordpress.com/2009/01/01/muchamad-afcariono/>
- Ahmad, G., Nafisah, D., & Eryadini, D. (2016). Learning Styles and Their Implications for Students' Critical Thinking Ability. *Journal of Educational Innovation*, 1(2), 173.
- Arikunto, S. (2009). *Research Procedures: A Practical Approach*. Jakarta: Rineka Cipta.
- Savery, J. R., & Duffy, T. M. (1996). Problem-Based Learning: An Instructional Model and Its Constructivist Framework. *Educational Technology*, 36(1), 31–38.
- Girsang, A. S., & Saragih, S. (2019). Application of Problem-Based Learning to Improve Student Learning Outcomes in Informatics Subjects at Senior High School. *Journal of Computer Science Education*, 7(1), 20–28.
- Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Journal of Educational Psychology*, 16(3), 235–266.
- Sanjaya, W. (2012). *Learning in the Implementation of the 2013 Curriculum*. Kencana Prenada Media Group.
- Sitorus, K., & Alwardah, N. (2021). Implementation of the Problem-Based Learning (PBL) Model Using Interactive PowerPoint Media on Student Learning Outcomes. *Integrated Science Journal*, 4(2), 53–62.
- Sudjana, N., & Rivai, A. (2009). *Educational Evaluation: Principles, Techniques, and Procedures*. Sinar Baru Algensindo.

- Sudjana, N. (2010). Foundations of Teaching and Learning Process. Bandung: Sinar Baru Algensindo.
- Tyas, K. C., Sulisyono, R., & Widyaastuti, N. S. (2020). Efforts to Improve Learning Activities and Outcomes in Thematic Learning Through the Application of Problem-Based Learning for Grade 5 Students of SD Negeri Kertirejo.
- Yusuf, N. R., Bektiarso, S., & Sudarti. (2020). The Influence of the PBL Model with Google Classroom Media on Students' Activities and Learning Outcomes. ORBITA: Journal of Research, Innovation, and Application in Physics Education, 6(2), November 2020.
- Yudianto, E., & Sukarsono, S. (2018). Implementation of the Problem-Based Learning (PBL) Method to Improve Student Activities and Learning Outcomes in Basic Programming Subject for Grade XI. Journal of Informatics and Information Systems, 4(2), 154–163.
- Wena, M. (2009). Innovative Contemporary Learning Strategies: A Conceptual and Operational Review. Bumi Aksara.