E-ISSN: 3046-7632
International Journal of Administration and Education (IJAE)
https://journal.ashapublishing.co.id/index.php/ijae/hm

The Effectiveness of the Problem-Based Learning Model in the Subject of Facilities and Infrastructure for Students

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ABSTRACT

21st-century learning heavily emphasizes critical thinking, collaboration, and problem-solving skills. Therefore, teachers must implement appropriate steps to meet these criteria. One alternative that can be implemented is through the application of a problem-based learning model. This study is intended to determine the effectiveness of the problem-based learning model, especially in the subject of facilities and infrastructure in class XI MPLB I. The study employs a qualitative approach that utilizes descriptive research methods. The data collection techniques used include observation, interviews, and documentation. The results of the study show that problem-based learning is effective in four main indicators, namely: 1) student involvement in learning is good, shown by active attention, participation in asking questions, and the ability to answer teacher evaluations; 2) inquiry and investigation are effective even though students still face several obstacles; 3) student performance in doing assignments shows a good understanding of the material; and 4) reflection on problem solving goes well through teacher evaluation and guidance in correcting students' mistakes. In addition, this study identifies supporting factors such as adequate learning facilities, learning motivation, teacher competence, and a conducive classroom atmosphere. As for the inhibiting factors, there are limitations in study time and differences in academic ability between students. The application of the problem-based learning model can increase students' activeness, understanding, and critical thinking skills if implemented optimally with the support of adequate internal and external factors.

Keywords: Problem-based learning, Effectiveness of Learning Models, Learning Models

INTRODUCTION

Education has a very crucial role in improving the quality of human resources (HR). Quality education is influenced by several factors, including learning resources, learning facilities, curriculum, and educators. In the context of 21st-century learning, critical thinking, collaboration, and problem-solving skills are highly emphasized. SMKN 1 Gowa, as a vocational education institution, has important facilities and infrastructure subjects for students majoring in Office Management and Business Services (MPLB). Therefore, the subject of facilities and infrastructure requires special attention so that students can actively participate and contribute to the learning process so that its implementation can achieve maximum results.

Government Regulation No. 4 of 2022 in Indonesia outlines the graduate competency standards for vocational secondary education, emphasizing the importance of skills that enable students to live independently and pursue further education aligned with their chosen vocation. Innovation in the classroom's selection of learning models is the key to achieving the competency standards of graduates. One learning model that remains relevant and effective for application is the PBL learning model, as it aligns with current needs.

The problem-based learning model can help students apply the concepts they have mastered and gather relevant information effectively. PBL also requires close collaboration between students. (Jabarullah & Iqbal Hussain, 2019; Supriadi & Mesnan, 2022; Suprianto et al., 2020) . Furthermore, the problem-based learning model encourages students to engage in cases with group members to solve problems and discover concepts independently."

(Houghton, 2023; Malmia et al., 2019; Tadjer et al., 2022) " Problem-based learning is a learning model that focuses on the active involvement of students in dealing with factual issues relevant to the context of the subject matter. The PBL model emphasizes the problem-solving process as the core of learning activities, so that students are encouraged to follow learning carefully, discuss existing problems, and formulate solutions through cooperation and critical reasoning.

The characteristics of problem-based learning include (1) the problem becomes the basis or beginning of the learning process; (2) the problems raised are relevant issues in life; (3) the use of diverse knowledge sources; and (4) learning that focuses on self-direction as the main component in the learning process. Learning with the PBL model begins with problems that need to be solved to deepen the knowledge that students have of the learning objectives of problem-based learning in more detail, namely: "(1) helping students develop thinking skills and solving problems; (2) learning the various roles of adults through their involvement in real-life experiences; (3) to be autonomous students." (Bodagh et al., 2017; Dita et al., 2021; Phungsuk et al., 2017). The main goal of the application of the problem-based learning model is to provide space for students to develop critical thinking skills in solving the problems they face, as well as encourage the creation of an active and independent learning process.

The use of the PBL learning model in the learning process puts students in situations that require them to solve problems related to the context of the learning topic being studied. The PBL learning model directly provides a means for students to participate in contributing to the implementation of problem-solving through investigation activities and the formulation of logical and measurable solutions. Through problem-based learning, it is hoped that students will be able to develop a collaborative attitude and be actively involved in learning, considering that the problem-solving process is often carried out in groups. In facilities and infrastructure subjects, a problem-based learning model is applied to present a contextual learning experience that refers to real situations.

Through initial observation during teaching and learning activities on facilities and infrastructure subjects, it is known that several students show a relatively low level of attention to the delivery of material by teachers. The relatively low attention of students is reflected in the tendency of students to have conversations with friends during learning activities, play on mobile phones, and the low level of intensive student participation in discussions and question and answer sessions. The lack of active involvement of students in learning indicates the existence of student barriers in learning and students' emotional connection to the material being taught. If not handled appropriately, it can hurt the effectiveness of learning, including achieving learning objectives and improving student competence. For this reason, innovative and participatory strategies are needed in the learning process to optimize the active participation of students who show activeness in the dynamics of the learning process, creativity, and meaningful.

Despite the proven effectiveness of the Problem-Based Learning (PBL) model in science and technical disciplines, its application in non-exact subjects such as facilities and infrastructure remains underexplored. Most existing studies on PBL focus on cognitive outcomes in science, mathematics, or engineering, whereas vocational subjects often involve procedural and contextual competencies that require different learning dynamics. The lack of empirical evidence regarding how PBL supports conceptual and practical understanding in non-exact vocational courses represents a significant research gap. This study, therefore, aims to bridge that gap by evaluating how PBL functions in the context of facilities and infrastructure education, emphasizing both its effectiveness and the contextual limitations that influence its implementation.

Seeing these conditions, this study was carried out with the aim of examining the effectiveness of the problem-based learning model in the facilities and infrastructure learning

subjects in class XI MPLB I. In addition, this study was conducted to determine the factors that affect the success or failure in the teaching and learning process. The implications of this study are anticipated to make a significant contribution to efforts to improve the quality of learning, both internally in the learning environment of SMKN 1 Gowa and as a source of reference that is useful for other educational institutions to create a more productive and contextual learning system.

METHODS

This study uses a qualitative method with a descriptive type, which is intended to gain an in-depth understanding of the effectiveness of the problem-based learning model. This study, using a descriptive qualitative approach, considers not only the final learning outcomes but also the processes that occur during the application of the PBL model. The research conducted can answer the possibility of capturing the dynamics of interaction between teachers and students, as well as describing how student involvement is formed through participatory and contextual learning activities.

In this study, data were collected through observation, in-depth interviews with related parties, and documentation to ensure the validity of the data. This study examines the efficacy of the problem-based learning model in the facilities and infrastructure curriculum for class XI MPLB I at SMKN 1 Gowa, specifically engaging teachers of this subject and grade XI students specializing in office management and business services. The number of informants involved was five; they were selected purposefully based on the direct involvement of students in the learning process. This research was conducted to identify and comprehensively evaluate the learning potential of PBL in increasing student involvement in learning.

Indicators that can be used to measure the problem-based learning model include several aspects, namely engagement, inquiry and investigation, performance, and reflection on problem solving. In addition, in examining the effectiveness of the problem-based learning model, it is also necessary to analyze the factors that act as drivers and inhibitors of it.

This research went through several systematic stages, namely the pre-field stage, the work stage, and the data analysis stage. The implementation stage includes direct observation activities, structured interviews, and documentation to obtain primary data as the main source of information. This research instrument includes various supporting devices, including interview guidelines, stationery, and mobile phones as a medium for recording conversations and visual documentation. To ensure the validity of the data, several techniques were applied, including extension of observation, diligence, triangulation, peer discussion, and member examination. The final stage in this study is the data analysis process that refers to the Miles and Huberman model, which includes data reduction, data presentation, and conclusions drawn.

RESULT AND DISCUSSION

The Effectiveness of the Problem-Based Learning Model in Facilities and Infrastructure Subjects

1. Involvement

Engagement reflects the level of attention and commitment students have in the learning process. Cognitive engagement can be realized through direct interaction with teaching materials, educators, and peers. A deeper understanding of the presented material demonstrates the high involvement of students in contributing effectively. Through interviews

that have been carried out with the resource persons, the results indicated that the level of student involvement in learning facilities and infrastructure is quite satisfactory.

Cognitive involvement is demonstrated by students' ability to listen carefully to learning materials, their courage in asking relevant questions, and their responsiveness to questions posed by teachers. Additionally, students' active participation in group learning activities is a crucial indicator of their involvement in learning. Involvement activities show the students' attention and enthusiasm for the material studied, which indirectly contributes to the improvement of conceptual understanding. This finding is strengthened by observation data collected directly in the field; student learning behavior shows consistency with the results of interviews that have been obtained previously. In conclusion, the PBL learning model has been proven to be able to facilitate students' active participation in teaching and learning activities.

Based on the results of the data analysis carried out, the level of involvement of grade XI MPLB I students in learning facilities and infrastructure is classified as an effective category. The active participation of students during learning demonstrates their involvement. Students not only show high attention to the content presented by the teacher but also show active involvement in learning activities through submitting and responding to questions, whether asked only by teachers or fellow students. In addition, the timeliness of students in completing the assigned tasks also reflects the students' commitment to learning. The findings illustrate efficient student involvement in learning activities. There are three aspects to student involvement, namely behavioral, emotional, and cognitive involvement. Behavioral engagement includes students' active participation in classroom activities, such as answering questions and doing assignments; emotional involvement relates to students' feelings towards the learning process, while cognitive engagement includes the attention and effort that students make in understanding the material (D'Errico et al., 2016; D'errico et al., 2018; Meschko et al., 2021).

Students' high curiosity is evident in their courage to ask questions during the learning process. Thus, the active involvement of students in the learning process is considered one of the key contributions to the achievement of goals and the success of the learning process as a whole. In addition, it was found that students of grade XI MPLB I showed a high attitude of academic responsibility by completing all tasks from teachers on time. Completing tasks reflects students' intensive participation in the learning process, as well as commitment to achieving learning objectives that have been set in a disciplined manner. However, there are still some students who need further guidance to maintain consistency in their learning activity.

In a learning context that emphasizes group collaboration, students display active participation by contributing ideas and responding to the opinions of their peers. This exchange of perspectives enables them to collectively build a shared understanding that aligns with the topic under study. Such interactions indicate that students do not engage passively in the learning process; rather, they demonstrate a high level of activity through consistent participation in discussions, posing questions, and submitting assignments on time or even earlier than required.

These patterns of engagement suggest that students recognize the value of teamwork and intellectual exchange as part of the learning experience. However, group dynamics are not always evenly distributed. In some instances, a few students show lower levels of involvement, which may affect the overall balance of collaboration within the group. This variation highlights the importance of fostering equitable participation through strategies that encourage all members to contribute actively. Strengthening group cohesion and accountability can ensure that each student benefits fully from the collaborative learning process and that collective goals are achieved more effectively.

2. Inquiry and Investigation

"Inquiry" refers to a systematic process of digging up information about a specific topic or problem, while "investigation" focuses on searching for facts or evidence in depth. The findings from the conducted field observations indicate that the learning process demonstrated active participation from the students. One of the important stages is a form of student response to assignments or problems given by teachers. The teacher implements this by providing themes or topics for students to study independently or in groups. In addition, the results of observations also indicate that the learning process takes place repeatedly in several learning cycles. Each cycle reflects an improvement in the quality of student engagement, cognitively, affectively, and psychomotorly. *Student inquiry* and investigation in the learning process can be seen by students' increased ability to express opinions, formulate arguments, and solve problems independently and collaboratively.

The results of the interviews indicated that several students showed activity in asking questions about material that they did not understand, both to educators and to peers, during the learning process. In addition, it was found that students were able to explore and search for learning materials independently quite well, although there were still several obstacles in its implementation. These findings are consistent with interview data and field observation results. The interview results indicate that students are beginning to adapt to independent learning and active critical thinking. The habit of active participation of students in the learning process contributes to strengthening students' competence, communication, and confidence in learning.

The data interpretation classifies the students' implementation of inquiry and investigation as effective. Students actively search for and collect information that aligns with the learning theme set by the teacher. The *inquiry* and investigation process is carried out independently by utilizing a variety of learning resources, including the use of digital technology and internet access as a medium for knowledge exploration. The students' activeness in asking questions also shows an intrinsic drive to understand the material in depth. Students often use the internet to expand their knowledge related to the material studied. Students' ability to search for information from various relevant sites reflects a high level of independence in learning, while demonstrating the effectiveness of problem-based learning indicators in encouraging active exploration and better conceptual understanding. The opinion related to inquiry learning is put forward by (Andrini, 2016; Lazonder & Harmsen, 2016; Zuo et al., 2022) that "inquiry learning strategies are a series of learning activities that emphasise the activeness of students to have a learning experience in finding material concepts based on the problems asked."

Furthermore, the interaction between students and teachers is reflected in the frequency and quality of students' participation during classroom discussions, particularly through their tendency to ask questions. Several students show that they are actively involved by asking questions not only of the teacher but also of their classmates. They want to understand concepts or materials that are still unclear. This inquisitive behavior highlights students' awareness of the value of inquiry and dialogue as tools for expanding knowledge and reinforcing comprehension.

Active participation in questioning and discussion-based learning also fosters the development of critical and analytical thinking skills. Through these interactions, students learn to evaluate information, consider multiple perspectives, and construct logical arguments, all of which contribute to a richer and more reflective learning experience. Consequently, such engagement transforms the classroom into a collaborative learning environment where knowledge is not merely transmitted but co-constructed through meaningful intellectual exchange.

In addition to showing activeness in finding and analyzing learning materials, students also face several challenges in understanding the content of learning. The challenges faced by students are caused by differences in their cognitive abilities and knowledge backgrounds, which results in not all students being able to understand the material equally. Some students experience obstacles in interpreting certain concepts conveyed by the teacher. However, teachers' active role in providing support during the learning process minimizes these difficulties. Teachers constantly try to establish effective communication with students, as well as provide explanations through contextual indicators by linking the subject matter to relevant personal experiences. The strategies carried out by teachers are significant in supporting students to internalize concepts in a more applicable and significant way, since the subject matter is presented in a way that is easier to understand when adapted to the real context that students experience in their daily lives. Thus, a communicative and contextual approach from teachers plays an important role in supporting an inclusive and adaptive learning process to the needs of students.

3. Performance

Performance refers to the evaluation of the final results of the presentation of findings or the application of knowledge and abilities that have been obtained by students, usually through assignments or practices designed by educators. Based on the results of interviews with several resource persons, we conclude that assignments and practices in the learning process significantly influence learning by improving students' understanding of the material, encouraging active involvement and direct application of concepts, and strengthening their thinking and analysis skills. Thus, assignments and practices not only have an impact on improving cognitive understanding but also support the development of students' attitudes and skills.

Assignments cannot be fully used as an assessment indicator but still provide an overview of the level of understanding of students in applying the concepts that have been taught. Practice and assignments motivate students to dig for information through various sources, select the information obtained, and increase their capacity for critical thinking and analytical skills. Thus, both assignments and practice are an important part of ideal learning because they can balance the assessment of learning outcomes with the development of students' independence and thinking competence in depth.

Student performance in learning activities is an important indicator in identifying the level of student mastery of the material presented. The optimal performance of students can describe the level of success of teachers in managing the learning process. Based on the analysis of data related to performance, it was concluded that the level of student performance was relatively effective. The teacher explained that assignments should not be used as the only assessment instrument in evaluating student understanding, although the task of providing an overview can present an initial idea of students' understanding of the concepts that have been taught. Alternative assessments are also needed, such as practice, to achieve a more comprehensive understanding of student learning outcomes. Performance indicators allow teachers to assess not only the cognitive aspects but also the applicative skills that students have in a real-world context.

The teacher's assignments and practical activities provide students with opportunities to enhance their understanding of the learned material. The assignments given encourage students to search for information from various sources, then choose the most relevant and appropriate answers based on the information that has been obtained. Thus, performance indicators not only enrich students' insights but also train students' ability to process and analyze information critically. The assignment has a purpose, namely, exercises and skills, as well as to increase the speed of learning and accuracy of learning, reading, absorbing, and

summarizing what has been learned, encouraging students to take responsibility for the lessons and develop independent learning (Dita et al., 2021; Gálvez Suarez & Milla Toro, 2018; Salendab & Dapitanb, 2021).

Overall, students' and teachers' views on assignments show that assignments do not just serve as an evaluation tool but rather serve as a significant medium in helping students develop critical thinking, actively dig for information, and develop students' analytical skills. Through the assignments given, students are expected to develop and remember information, as well as explore various sources of knowledge, conduct in-depth analysis, and formulate answers based on more complex understandings. Therefore, assignments can be considered an important component in the development of students' cognitive and metacognitive skills, which support the improvement of the overall quality of learning.

4. Reflections on Problem Solving

In the reflection stage of learning problem solvers, teachers carry out evaluations to identify mistakes made by students during the learning process. Furthermore, teachers continuously provide guidance to enhance students' understanding and knowledge. Based on the results of interviews and observations that have been conducted, it was found that the process of reflection on solving problems faced by students in the subject of facilities and infrastructure has been carried out optimally.

Reflection on problem-solving not only includes evaluation of students' work but is also followed by the provision of guidance by teachers to assist students in identifying and correcting conceptual errors that arise during the learning process. Through this indicator, students have the opportunity to improve their understanding in more depth and correct previous misconceptions. Reflection on problem solving shows that teachers have an active role in guiding the learning process, which is continuous cognitive development for students.

Based on the results of data analysis, it was found that reflection on problem solving was said to be good; reflection was carried out after completing the assignment submitted by the teacher. The teacher carries out a comprehensive evaluation related to the results of the assignments that have been completed by the students with the aim of identifying and correcting errors that may arise during the task completion process. Teachers refer to the systematically arranged steps in the Learning Implementation Plan (RPP) for evaluation and follow-up improvements. This makes it easier for teachers to provide re-explanations of material that students do not understand, especially when mistakes are found in the learning process. The evaluation process carried out by teachers is not only shown to measure student understanding but also to be a form of reflection to correct misconceptions that occur.

Reflection activities conducted by teachers serve as an effective mechanism to help students identify and understand their mistakes while guiding them toward correcting misconceptions. In this process, teachers do more than simply point out errors; they provide step-by-step guidance on how students can revise and improve their understanding. This reflective approach fosters deeper cognitive engagement, allowing students to internalize concepts rather than merely memorizing corrective feedback.

Indicators of reflection in problem-solving show a positive influence on the overall learning process. Through targeted and constructive feedback, students receive clearer explanations that directly address their learning difficulties. Such teacher support enhances students' comprehension of challenging material and encourages the development of reflective thinking skills—enabling them to independently analyze, evaluate, and refine their reasoning in future learning situations. Integrating evaluation with reflection-based instruction thus contributes meaningfully to improving the quality of student understanding. It transforms assessment from a purely summative process into a formative learning

opportunity, where students are guided to learn from their mistakes and build a stronger conceptual foundation for continued academic growth.

These inhibiting factors have a direct and substantial impact on the overall success of PBL implementation. Limited instructional time constrains the iterative cycles of problem identification, discussion, and reflection that are central to the model's success. When students have insufficient time to complete inquiry and collaborative stages, they tend to rely on surface-level understanding rather than engaging in deeper critical reasoning. Likewise, differences in students' abilities influence group dynamics: highly capable learners may dominate discussions, while others become passive observers. This imbalance can reduce the intended benefits of PBL, where equal participation and shared problem-solving are vital to supporting independent and collaborative learning. Addressing these issues requires differentiated instruction and adaptive time management so that each student can meaningfully contribute and learn through the process.

Reflection will help teachers in developing students' understanding in learning through mistakes that students experience. Reflection will also help students develop their metacognitive awareness. Reflection is one of the important pillars of constructivist learning, because reflection can help learners develop metacognitive awareness (Ali, 2019; DeMonte, 2013; Tadjer et al., 2022; Vermunt, 2014). Reflection in the context of learning is not solely intended as a means of providing constructive feedback, but also serves as a pedagogical mechanism to assist students in identifying and understanding misinterpretations or inaccuracies experienced in the teaching and learning process. In addition, reflection aims to provide structured guidance so that students can make improvements to understanding and skills that are still not optimal.

Supporting Factors and Inhibiting Factors

The results of the interviews show that there are several factors that support the effectiveness of the problem-based learning model in the subject of facilities and infrastructure, including the availability of adequate learning facilities, the readiness and learning methods of students, effective learning skills, conducive classroom conditions, the ability of teachers as professionals in managing learning, and high motivation of students in learning. Inhibiting factors that affect the effectiveness of the problem-based learning model include limited learning media, insufficient allocation of learning time, and differences in students' ability to understand the material. Based on the results of observations, it indicates that the duration of the available learning time, which is only 2x 45 minutes per meeting, is one of the main obstacles that hinder the optimal learning process. The limited time does not provide enough space for students to explore the material thoroughly, especially in the context of problem-based learning that demands exploration and active discussion. Therefore, more flexible timings and the provision of adequate learning media are important to increase the effectiveness of the PBL model implementation.

Various supporting factors influence the effectiveness of the problem-based learning model, playing a crucial role in achieving learning objectives. Supporting factors serve as a foundation that strengthens the learning process, accelerates the achievement of student competencies, and improves the quality of learning. Supporting factors for the effectiveness of the problem-based learning model include adequate learning facilities, relevant teaching materials, and teacher competence in managing the learning process (Amirova, 2020; DeMonte, 2013; Han & Yin, 2016; Rigg & Wal-Maris, 2020).

The interview findings also emphasize that teacher competence plays a vital role in the learning process. Teachers who deliver material clearly, coherently, and systematically can significantly enhance students' understanding and information retention. In addition, students' intrinsic motivation contributes greatly to the overall success of the learning process.

When students possess a genuine internal drive to learn, they are more likely to engage actively and persist in overcoming academic challenges. Several other factors also support the effectiveness of Problem-Based Learning (PBL), including a conducive classroom environment, students' physical and psychological readiness, and the availability of adequate learning facilities. A comfortable classroom atmosphere fosters engagement and concentration, while student readiness determines how well they receive and process new material.

Students' motivation and learning abilities serve as essential indicators of PBL success, alongside the teacher's competence. For optimal implementation, teachers must possess professional, pedagogical, and personal competencies that enable them to guide, facilitate, and inspire students effectively. The synergy between competent teachers, motivated learners, and supportive learning environments ultimately determines the quality and sustainability of PBL outcomes.

Conversely, a number of inhibiting factors can also reduce the effectiveness of PBL. These barriers include limited learning time and differences in learning abilities between students. Based on the results of the research through interviews with informants from class XI MPLB I, it was found that the time available in each learning session was considered insufficient to explore the material thoroughly. This makes it difficult for students to understand concepts in depth and limits the teacher's space to provide individual attention to students who need more help.

Differences in students' learning abilities present a significant challenge in the implementation of the Problem-Based Learning (PBL) approach. PBL emphasizes active student participation in the process of identifying and solving real-world problems, requiring analytical thinking, collaboration, and reflection. Nevertheless, not all students are able to engage effectively in reflective activities, particularly those who struggle with conceptual understanding, critical thinking, or teamwork. Students with higher learning abilities often complete tasks more quickly, while those with lower abilities may feel left behind, discouraged, or less motivated, especially in the absence of adequate guidance and support.

Overall, the success of PBL depends largely on several key factors: the readiness of the learning environment, the teacher's pedagogical competence, the level of student motivation, and the availability of learning resources and facilities. One of the major challenges in applying this approach is effective time management and accommodating the diverse learning needs and abilities of students. Therefore, it is essential to design adaptive instructional strategies and provide differentiated support to ensure that PBL can be implemented optimally, fostering both equity and the achievement of learning objectives.

In conclusion, the success of the PBL model in this setting depends not only on encouraging students to engage actively but also on the proper management of external factors like available time, teacher guidance, and the varied backgrounds of learners. Hence, implementing PBL in vocational education requires contextual adjustments that harmonize inquiry-based learning with the practical conditions of classroom environments.

CONCLUSION

Based on the findings of the study, it shows that learning facilities and infrastructure using a problem-based learning model in class XI MPLB I SMKN 1 Gowa are considered effective. These findings are based on student interaction in the dynamics of the learning process, including students engaging in learning, asking and answering questions, searching and analyzing learning materials, and doing assignments well, and teachers also providing reflections related to students' misunderstandings. Factors that support the effectiveness of the problem-based learning model in the subject of facilities and infrastructure in class XI MPLB I

include the availability of adequate learning facilities, student readiness and learning methods, learning skills possessed, a conducive classroom atmosphere, teacher competence in carrying out learning, and student learning motivation. Meanwhile, the inhibiting factors are the limited learning time and the difference in students' capabilities in internalizing the material provided by the teacher.

Based on the conclusions presented, the suggestions given are as follows; (1) for schools, it is necessary to procure learning media evenly to support learning activities in the classroom, so that no student has difficulty accessing information related to learning materials; (2) For future research that will examine the effectiveness of the problem-based learning model, it is recommended to use different indicators so that the insight and understanding of the learning model can be further developed.

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