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Problem Based Learning (PBL) Model for Science Material on Prevention of Dengue Fever for Elementary School

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Abstract

This research aims to provide the concept of a problem based learning model to explain dengue fever lessons to students. The locus or object of this research is the learning material from the IPAS (Science and Social Science) subject for Grade III of Elementary School, specifically Chapter 2, Section C.2, which discusses the metamorphosis of the dengue mosquito. This study specifically examines the potential of the material to be developed into a contextual and applicative Problem-Based Learning (PBL) model as part of educational efforts to prevent dengue fever among elementary school students. The primary data source is the IPAS textbook, while the secondary data sources consist of relevant and credible scientific literature. The data collection technique was carried out through library research, while the data analysis technique employed descriptive qualitative analysis using a content analysis approach. The type of research used is descriptive qualitative. The results of this research are (1) Many students do not have comprehensive knowledge about dengue fever (2) The learning process about dengue fever is still carried out conventionally, namely by reading textbooks at school so that students do not have direct experience in preventing the spread of dengue fever mosquitoes (3) The problem based learning model provides a solution for explaning dengue fever in schools. Further research can develop the PBL learning model in practice.

Keywords Science Learning; Problem Based Learning; Dengue Fever

INTRODUCTION

Dengue fever is a phenomenon that occurs every year in Indonesia. Based on data compiled by the Ministry of Health of the Republic of Indonesia, in the 22nd week of 2024, the distribution of dengue fever cases cumulatively reached a total of 119,709 cases with a death rate of 777 cases. The data shows an increase in dengue cases from the previous year. In January 2023, 12,502 dengue cases were reported with 101 deaths (Ministry of Health, 2024). The following data is presented by the Ministry of Health:

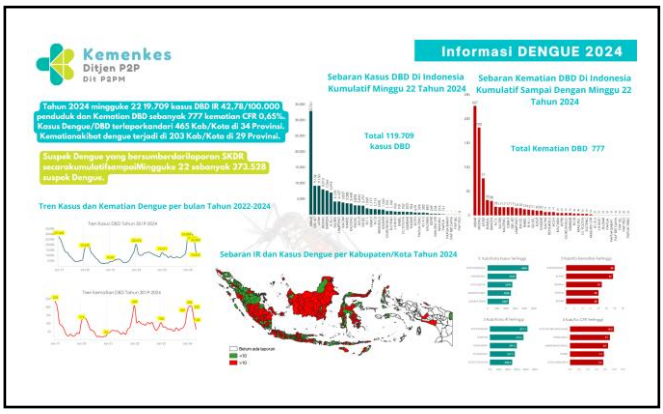

Figure 1. Informasi Dengue 2024

From the many cases of dengue fever, it turns out that children aged 5-14 years are in a vulnerable position to contracting dengue fever. In 2020, the proportion of deaths due to dengue fever at this age ranked first with a percentage of 34.13% (Ministry of Health, 2021). This means that they are children who are still pursuing formal education in elementary school. Of course, the rampant dengue cases are important to be the concern of educators and parents, especially in providing an understanding of taking care of themselves and the environment so that they can eliminate the potential for dengue fever.

The high incidence of dengue fever in Indonesia, especially in the age group of primary school children, is a strong signal of the need for strategic and applicative education-based interventions. In this context, the development of a Natural Sciences (IPA) learning model that not only focuses on information transfer, but also on empowering students to understand, analyze, and overcome real problems in their environment, is very urgent. According to data from the Ministry of Health (2024), the cumulative number of dengue cases shows how this problem cannot be underestimated. Especially with the highest proportion of deaths occurring in the age group of 5-14 years, the age range that coincides with the period of basic education. Therefore, problem-based

contextual education is an urgent need. This means that the science learning model must transform from simply conveying biological facts about mosquitoes and their diseases to a means of strengthening scientific literacy and students' preventive attitudes towards environmental health issues.

In elementary schools, science learning in general is still conventional, which is oriented towards mastering concepts and memorizing material through lecture and question and answer methods that do not stimulate student activity. In fact, in accordance with the Independent Curriculum which emphasizes student agency, learning should build students' ability to understand natural phenomena through direct experience and real problem-solving. The Problem Based Learning (PBL) learning model is present as one of the appropriate pedagogical approaches to answer these challenges (Oktalia et al., 2018). PBL is based on the idea that learning will be more meaningful if students actively explore, investigate, and find solutions to the problems they face on their own (Kurniawati, 2022). Through this model, students not only gain knowledge of the life cycle of Aedes aegypti mosquitoes, but also understand the environmental factors that support their breeding, as well as develop real-world action-based prevention strategies such as 3M (drain, cover, and recycle). This process also trains them to think critically, collaboratively, and responsibly about the surrounding environment.

The urgency of developing a PBL-based science learning model, especially in the context of preventing dengue fever in grade III of elementary school, lies not only in improving learning outcomes, but also in the formation of students' scientific character and social sensitivity. The main goal of developing this model is to create a contextual, active, and meaningful learning process, where students not only understand the content of the material, but are able to relate it to actual problems in their daily lives (Mayasari et al., 2022). That way, students are expected to be able to become agents of small changes in their environment, for example by recognizing and eliminating the potential for mosquito nests around homes and schools. In addition, teachers will also be better helped by the availability of systematic and structured learning model tools, so that the learning process becomes more directed and measurable. In the long term, the development of this PBL model is expected to contribute to a significant reduction in dengue cases through increasing environmental awareness from an early age.

Various research results in the last five years show that the PBL learning model has a significant influence in improving the quality of science learning in elementary schools. Yuristia,

Hidayati, and Ratih (2022) developed a PBL-based science learning module that was declared to be very valid and practical to be applied in grade IV of elementary school. Meanwhile, Hardiyanti (2023) through classroom action research showed that the implementation of PBL was able to significantly increase understanding of science concepts, from 55.6% to 81.81%. Similar results were also found by Fasza and Nursiwi Nugraheni (2024) who showed that the PBL model was able to improve student learning outcomes in three learning cycles with an increase in completeness from 0% to 75%. Experimental research by Putri (2018) and Damanik et al. (2024) also strengthens these findings, where the PBL model is statistically proven to be more effective than conventional approaches in improving the science learning outcomes of elementary school students.

However, from the five studies, it can be identified that there are relevant research gaps to be explored further. First, much of the research focus still revolves around general science topics such as organ systems or the environment without specifically addressing contextual public health issues such as dengue fever. Second, the majority of studies were conducted on students in grades IV and V, while grade III, which is the initial phase of formal education with developing cognitive and affective potential, has not been touched much. Third, no research has been found that explicitly integrates the 3M Plus Mosquito Nest Eradication (PSN) movement in the PBL learning model, even though this approach is important in building a contextual and meaningful learning experience for students.

Based on the identification of these gaps, this study presents novelty in the form of the development of a Problem-Based Learning-based science learning model focused on dengue fever prevention materials in grade III elementary schools, by systematically integrating the PSN 3M Plus movement into the learning syntax. This novelty not only contributes to pedagogical innovation in science learning, but also has high social value because it fosters health literacy from an early age. In addition, the model developed is expected to be able to form critical thinking skills, the ability to work together, and environmental awareness that are applicable to students, which in turn supports the government's efforts to reduce the incidence of dengue fever in the community (Taufiq Hidayat et al., 2023).

Based on the background that has been presented, the purpose of this study is to develop a science learning model based on Problem Based Learning on dengue prevention materials for grade III elementary school students. This research aims to ensure that students are not only able to understand scientific concepts about dengue fever, the life cycle of the Aedes aegypti mosquito, and

its spread factors, but also actively engage in concrete actions that promote environmental awareness and preventive attitudes towards the disease. The developed learning model is designed to provide a contextual, interactive, and fun learning experience, so that students are able to build a deeper understanding through active involvement in the learning process oriented towards real problem-solving.

The significance of this research can be seen from two sides, namely theoretical and pragmatic. From the theoretical side, this research contributes to the development of studies in the field of basic science education, especially in the innovation of learning models that are relevant to contextual environmental health issues. This research expands the horizon of the use of the PBL model in applicable materials, namely dengue fever prevention, and adds local and social dimensions in the context of science learning. Meanwhile, from the pragmatic side, the results of this research are expected to be a practical reference for educators in designing a more meaningful and responsive learning process to real problems around students (Yew & Goh, 2016). With this learning model, elementary schools can implement more effective health education strategies, so that students not only become cognitively savvy, but also encouraged to become agents of change in preventing the spread of dengue fever in their environment.

METODE

This research focuses on the collection and analysis of qualitative data that is descriptive. The data in this study is in the form of textual information that contains scientific concepts, pedagogical approaches, and learning strategies relevant to dengue prevention efforts through a problem-based learning model (*Problem Based Learning*) in the context of science learning in elementary schools. In particular, the data presented include the content structure of the learning material, the representation of the metamorphosis concept *of the Aedes aegypti mosquito*, and the integration of educational values related to clean and healthy living behaviors in the teaching materials (Fitri et al., 2022). In addition, the data also includes the principles of PBL instructional design, indicators of learning success, and empirical studies that support the effectiveness of the PBL model in developing students' critical thinking and problem-solving skills.

The data sources in this study are divided into two main categories, namely primary sources and secondary sources. The primary data source comes from the Natural and Social Sciences (IPAS) teaching material document for grade III elementary schools, especially in Chapter 2 which

discusses the life cycle of living things, including the discussion of the metamorphosis of dengue fever mosquitoes (Fitri et al., 2022). This source is the main reference in assessing the suitability of learning content with the PBL approach developed. Meanwhile, secondary data sources were obtained from various scientific books, accredited journals, previous research results, and relevant education and health policy documents. These secondary sources are used to enrich the analysis and support theoretical arguments in the development of the studied learning model.

The data collection method is carried out by collecting literature or research data in the form of literature. The data was obtained through books and scientific journals. Furthermore, the data obtained is processed and analyzed. The data presented is in the form of a descriptive narrative that has been managed and summarized in a more systematic manner. Data analysis is carried out by means of content analysis. After the data obtained has been processed, the conclusion is drawn (Sugiyono, 2023).

FINDINGS AND DISCUSSION

Findings

Based on the results of the analysis of the Natural and Social Sciences (IPAS) teaching material for grade III Elementary School in Chapter 2 with the title *"Let's Get to Know the Cycle in Living Things"*, especially in section C.2 which discusses the metamorphosis of dengue fever mosquitoes, it was found that this material contains very relevant information and potential to be developed into a problem-based learning model (*Problem Based Learning*). The material is presented systematically, starting from the presentation of the stages of perfect metamorphosis of the Aedes aegypti mosquito, starting from eggs, larvae (larvae), pupa, to becoming an adult mosquito. This explanation is accompanied by visual illustrations and learning activities that encourage students to observe and discuss in groups about the mosquito life cycle and efforts to prevent its spread.

The learning activities listed in the textbook encourage active participation of students, such as observing pictures of mosquito life cycles, compiling educational posters, and conducting discussions about the importance of maintaining a clean environment. This shows that the material is not only cognitive, but also contains affective and psychomotor values that can shape students' awareness of the importance of preventive measures against dengue fever (Fitri et al., 2022). Furthermore, the relationship between the content of the material and the daily life of students provides space for the development of contextual learning that relates science to the social reality

and environment around students. The results of the findings in detail can be seen in the following table:

Table 1. Research Findings Based on Analysis of Science Materials for Class III Elementary School, Chapter 2: Dengue Fever Mosquito Metamorphosis

No	Aspects	Description of Findings
1.	Placement of materials	Chapter 2: *Let's Get to Know the Cycle in Living Things*, Part C.2: *Dengue Mosquito Metamorphosis*
2.	Contents of the main material	Explaining the complete metamorphosis of the Aedes aegypti mosquito: eggs → larvae (larvae) → pupae → adult mosquitoes
3.	Emphasized biological processes	Emphasis on the stages of the mosquito's life cycle and their ecological needs such as stagnant water for spawning and breeding
4.	Learning objectives	- Observing images of mosquito life cycles - Discuss how to prevent the spread of mosquitoes - Create dengue prevention images, posters or infographics
5.	Learning objectives	Foster students' awareness of the importance of maintaining environmental cleanliness and understand the life cycle of mosquitoes as the basis for dengue fever prevention measures
6.	Linkage with PBL	The material has the potential to be developed through the Problem Based Learning approach because it is contextual and applicative, and allows students to be directly involved in problem identification and the search for solutions
7.	Innovation Potential	The material has the potential to be developed through the Problem Based Learning approach because it is contextual and applicative, and allows students to be directly involved in problem identification and the search for solutions, mosquito nests, flood water observations, and the 3M Plus PSN campaign

From this analysis, it can be concluded that the class III IPAS material has great potential to be integrated in the framework of the Problem Based Learning model. Materials that are contextual, applicative, and action-oriented are very suitable to be used as a basis for the development of learning models that require active involvement of students in problem solving. Therefore, in the next section, it will be discussed how the PBL model can be designed and implemented effectively in science learning related to dengue fever prevention, as well as how this model is able to develop students' critical thinking skills, environmental sensitivity, and social concern from an early age.

Discussion

Prevention of Dengue Fever

Learning about dengue fever is presented in the Natural and Social Sciences subject for grade III of Elementary School. This material is included in CHAPTER 2 Let's Get to Know the Cycle in Living Things. In more detail, the material is presented in section C.2 which explains the metamorphosis of dengue fever mosquitoes (Fitri et al., 2022). Students were invited to reflect on the phenomenon that exists in schools related to the number of students who do not attend school because they are infected with dengue fever.

Figure 2. Teaching Materials for Grade III

Students were introduced to dengue hemorrhagic fever. This disease is caused by the *dengue* virus carried by *the Aedes Aegypti mosquito.* In Indonesia, dengue fever first appeared in Surabaya in 1968. Dengue fever sufferers in Indonesia are most in the age range of 1-15 years with a percentage of 86%, while the mortality rate is more found in girls than boys (Mentari & Hartono, 2023). Based on research, dengue fever does not only attack urban communities, but also spreads in rural areas and other areas (N. Frida, 2019). According to the United Nations (UN) organization engaged in the field of health, *the World Health Organization* (WHO) explains that there are several clinical symptoms of dengue fever. Most people with dengue fever have mild or no symptoms that will gradually improve within 1-2 weeks. However, dengue fever can become severe and even result in death. Symptoms of this disease often appear 4-10 days after infection (World Health Organization, 2024).

This *Aedes Aegypti* mosquito also has anthropophilic properties that like humans, so it likes to bite repeatedly. Female mosquitoes usually like to bite humans while male mosquitoes prefer sugar-containing liquids such as flowers and other plants. Female mosquitoes that cause dengue fever need proteins in human blood that can mature their eggs or to be fertilized by the sperm of male mosquitoes. The life cycle of *Aedes Aegypti* mosquitoes starts from eggs, larvae, pupae and adult

mosquitoes. These mosquito eggs are commonly found in clear water and protected from light. After 1-2 days, the eggs will hatch and become larvae or mosquito larvae (N. Frida, 2019) Without prevention from the community, dengue fever mosquito breeding can occur and is very numerous. Of course, this will endanger humans who are susceptible to dengue fever. Unfortunately, there are studies that show that students who are part of the community have a fairly low knowledge about dengue fever (Tokan & Artama, 2022).

By looking at the phenomenon that has been described above, learning about dengue fever for students is very important. Educators need to explain and instill the importance of avoiding dengue fever. So that the presentation of proper learning is needed by students. Not only strengthening the cognitive realm or knowledge, but students are also involved and have direct experience of dengue fever prevention as their anticipation space. The government has actually offered a joint movement to minimize the spread of dengue fever, namely by implementing PSN 3M Plus or 3M Plus Mosquito Nest Eradication.

Prevention and control through the PSN 3M Plus movement is expected to involve all levels of society. 3M can be understood as the behavior of draining water reservoirs, closing water reservoirs, and recycling or reusing used goods that have the potential to become nests for *Aedes Aegypti* mosquitoes, if they cannot be used, they can bury the used goods (Ministry of Health, 2019). This behavior is also supported by additional movements such as sprinkling larvicide powder (abate), using mosquito repellent and so on. The government believes that if this movement is practiced properly and sustainably and involves all levels of society, it will reduce the number of mosquito breeding. This success can be measured by the larvae-free number (ABJ) (Sutriyawan et al., 2022). In addition, educational institutions such as schools are also encouraged to have a Larval Tracker (Jumantik), although not many schools have implemented this jumantik program (Rubandiyah & Nugroho, 2018).

Problem Based Learning for Dengue Fever Prevention

Based on the phenomenon that has been explained earlier, it is important to provide interactive learning for students about the prevention of dengue fever. The science learning model for dengue fever prevention should not use conventional methods because it has a tendency to make it easy to get bored in receiving material and students are not directly involved with the discussion that wants to be conveyed. Many students end up not paying attention to the teacher's explanation when using conventional methods (Peranginangin et al., 2020). The researcher developed a science

learning model to prevent dengue fever using *a problem-based learning* (PBL) learning model.

Problem based learning (PBL) is a learning model that relates to students' real-world problems. This PBL model is centered on students, while teachers/educators are facilitators so that before carrying out the learning process, it is necessary to prepare the situation and conditions of students. There are 3 simple strategies that educators can do, namely:

1. Write down the learning process that will be carried out, so that students have an overview of the process that will be undertaken.
2. Mention the directions clearly and ask a few learners to re-explain the instructions that have been given.
3. Identify and provide clear signs for the location of activities during learning (Ardianti et al., 2021).

Conditioning students before the learning process helps them to be more cooperative and understand the meaning of the learning in progress. In the PBL learning model, there are 5 steps or learning syntax, namely:

Table 2. Syntax of Problem Based Learning Model

No	Indicator	Activity
1.	Orientation of students into problems	Educators explain learning objectives, materials to be used, problem solving, motivate students to be actively involved in problem solving
2.	Organizing learners to learn	Educators help define and organize learning tasks related to the problem raised, educators can guide to find solving/problem-solving
3.	Guiding students' research	Educators ensure that students gather appropriate information, conduct experiments to get explanations of problem-solving by maximizing the use of their five senses
4.	Develop and present works	Educators assist students in planning and preparing appropriate works such as reports, videos, models and so on. Educators can guide the creative work that is produced
5.	Analyze and evaluate the problem-solving process	Educators help students reflect or evaluate the investigations that have been carried out

Source: (B. Elaine, 2007)

The first step in problem-based learning syntax is to direct students to the problems to be explored. In this context, educators act as facilitators who explicitly introduce the learning objectives and provide an overview of the topics to be discussed. Not only that, educators also convey teaching materials that will be used and propose *real-world problems* that are relevant to students' lives. This process aims to arouse curiosity and motivate students to be active in the learning process. With the

right orientation, students will be encouraged to think critically and start building an initial schema for the problem to be solved.

The second stage focuses on the ability of educators to help students define and organize learning tasks related to the problems that have been asked. In this phase, educators encourage learners to work in groups, build collaborative communication, and form roles and responsibilities in teams. This organization is important so that students have a clear direction and a systematic problem-solving strategy. The pedagogical function of educators at this stage is as *a learning designer* and *learning guide*, which directs students to find solutions through a structured investigative approach.

In the third phase, students begin to conduct an investigation process into problems by collecting various relevant information and data. Educators guide them to take advantage of various resources, both from literature, experiments, and direct observation. The maximum use of sensory devices is highly emphasized, because in PBL, direct experience and sensory involvement greatly support deep understanding. Here, educators function as *inquiry coaches*, who not only direct, but also stimulate students to be able to develop hypotheses, conduct experiments, and draw temporary conclusions based on the data collected.

After the investigation process is completed, students are directed to develop and present the results of their learning process in the form of works. This work can be a written report, presentation, documentary video, three-dimensional model, or other creative product. This process trains learners to structure the results of their thinking and research into a communicative and representative form. Educators have an important role in guiding the technical and aesthetic aspects of the final product, as well as providing encouragement to produce work that is not only informative but also innovative. The presentation of works is also a medium of academic accountability and reflection on the learning process that has been passed.

The final step is reflection and evaluation, where the educator facilitates students to review the entire process that has been undertaken, including the strategies used in solving problems. This evaluation includes an analysis of the successes and obstacles faced as well as the effectiveness of the solutions developed. This critical reflection aims to increase students' metacognitive awareness, so that they are able to assess and develop a more systematic and logical mindset in the future. At this stage, the educator acts as *a reflective facilitator*, which helps students identify important lessons from the learning process as well as internalize the scientific values gained.

With this learning model, educators do not only provide material in class which must then be memorized by students. Educators must be careful that the theme of dengue fever prevention becomes a discussion for students both in the classroom and outside the classroom. Students are invited to actively seek information, observe, process data until they are able to draw conclusions about the problems they face. The following are the steps that can be taken to develop PBL in dengue fever prevention materials, as follows:

Table 3. PBL Model for Dengue Learning

No	Indicator	Activity
1	Pre-Learning	The teacher explained the purpose of learning about dengue fever. The teacher gave an explanation of the theme that will be discussed in class, namely dengue fever (metamorphosis of dengue fever mosquitoes), as well as explaining the factors that cause and how to prevent dengue fever in the surrounding environment. Students are encouraged to reflect on the surrounding phenomena such as there are friends who are sick with dengue fever, the conditions of the surrounding environment that can become a dengue mosquito nest, dengue fever and so on Students are encouraged and motivated to eradicate *the Aedes Aegypti* mosquito that causes dengue fever
2	Learning Activities	Students are invited to explore problems related to dengue fever Students are invited to experiment in the school environment to find dengue mosquito nests or places that have the potential to be a place for mosquito larvae to breed Students take 3M actions to suppress the spread of dengue fever After conducting the experiment, students were asked to write down their experiences, which could also be accompanied by pictures. This is the work of students and teachers can help students to make creative works Students can present their work in front of the class
3	Post-Learning	Students are invited to reflect on the learning process that has been gone through Students give a conclusion from their observations Teachers encourage students to evaluate learning Students are tasked with making additional observations observing the environment around their homes that have the potential to become mosquito nests

The pre-learning stage is the foundation in the Problem-Based Learning process, especially in the context of introducing public health issues such as dengue fever. In this phase, the teacher facilitates the formation of students' initial knowledge by explicitly explaining the learning objectives, which are to understand the intricacies of dengue fever, starting from the life cycle of *the Aedes aegypti* mosquito, the causative factors, to preventive measures that can be taken in the surrounding environment.

This process is not only informative, but also oriented towards strengthening students' critical awareness of the social and ecological realities around them. The teacher encouraged students to reflect on factual phenomena such as dengue fever cases among peers, as well as unhygienic environmental conditions that have the potential to become mosquito larval habitats. This strategy is designed to arouse students' empathy and concern for environmental health issues, as well as motivate them to contribute to efforts to eradicate this disease. With this contextual approach, students are invited to become active subjects in learning, not just recipients of information.

Then, in the second stage, the PBL approach actualizes the role of students as small researchers who are faced with authentic problems. Students are encouraged to explore various issues directly related to the spread of dengue fever through a series of investigative activities. One of the important activities in this stage is a field experiment in the school environment, where students actively seek out locations that have the potential to be breeding grounds for mosquito larvae. It involves the application of observational skills, data recording, and initial conclusion-making, which are part of basic scientific skills.

Furthermore, preventive measures such as the application of the 3M principle (Drain, Cover, and Recycle used goods) are applied directly by students, which at the same time strengthens the connection between theoretical knowledge and real practice. The results of these activities do not stop at the cognitive level alone, but are developed into creative products such as reflective writing and pictures that document their learning experiences. Teachers have the role of facilitators who not only guide academically, but also encourage students' creative expression. Presenting the work in front of the class not only improves communication skills, but also forms a sense of confidence and responsibility for the learning product.

The post-learning stage marks the metacognitive phase in the PBL model, which is aimed at strengthening conceptual understanding and fostering students' reflective awareness. In this context, teachers facilitate students to reflect deeply on the learning process that has been undertaken, both in terms of cognitive achievement, social skills, and attitudes towards the environment. This reflection is followed by the preparation of conclusions based on the data that has been collected during the learning activities. In addition, teachers provide space for students to evaluate the effectiveness of the methods used and identify potential improvements. This strengthens students' critical and evaluative thinking skills towards their own learning processes and outcomes. Last but not least, this stage also involves the provision of follow-up tasks in the form of observation of the home environment, which aims to expand the scope of learning to the realm of students' real lives. This is a form of strengthening the principle of sustainability in problem-based education, where students do not only learn for knowledge, but for life. This task also supports the creation *of contextual and meaningful* lifelong learning (Lestari & Wiwiteria, 2024).

The learning carried out should be directed to foster students' critical thinking skills and encourage students to solve problems that have been given in learning. PBL learning can also increase students' motivation and learning outcomes, because they not only listen but are also directly involved in the learning process (Gulo, 2022). Students are invited to actively seek information, observe, process data until they are able to draw conclusions about the problems they face. The advantages and disadvantages of the application of the PBL learning model for learning about dengue fever in schools are as follows:

Table 4. Keunggulan dan Kelemahan Model Pembelajaran *Problem Based Learning*

No	Indicator	Student	Teacher
1	Strength	The student-centered approach, so students have an active role during the learning process Students are happier and feel satisfied because they are involved in the learning process Students can more easily understand the material through good practice done (experiment) Developing students' skills for lifelong learning, PBL provides provisions for life in the community	Interest in students increases, because it involves students directly in the learning process. Teachers as moderators/facilitators There is an intrinsic reward Learning becomes more comprehensive and in-depth Have a longer study time Improve interdisciplinarity in the learning process
2	Debilitation	Students' initial knowledge determines learning preparation so it is important to	Teachers need to continue the learning scenario Increase time for preparation

	strengthen students' knowledge at the beginning of learning (pre-condition) Takes longer Requires security control during activities outside of the classroom	There is a request for troubleshooting What is assessed and how is it assessed

Source: (Sumarmi, 2012)

The Problem Based Learning (PBL) learning model has a number of significant advantages, both from the perspective of students and educators. From the student side, the main advantage of this model lies in its *student-centered nature*. In practice, students are not only passive objects in the learning process, but also take an active role as subjects who are directly involved in problem exploration, investigation, and problem-solving. This encourages increased emotional and intellectual engagement of students, so that learning becomes more meaningful and memorable. This active involvement also increases students' intrinsic motivation, which is characterized by feelings of happiness and satisfaction when they successfully complete a learning assignment or project (Asni & Hamidy, 2017).

Furthermore, PBL allows students to understand the subject matter more deeply through a hands-on approach, such as experiments or field observations (Surianto, 2022) (Rosida & Nuvitalia, 2024). This activity not only strengthens conceptual understanding, but also trains skills of scientific processes, such as critical, analytical, and reflective thinking. One of PBL's greatest contributions is its ability to equip students with *lifelong learning skills*, which are critical in facing the challenges of complex and dynamic society.

From the teacher's point of view, the implementation of PBL changes their role from a conveyor of information to a facilitator and moderator in the learning process. Teachers focus more on providing thought stimuli, facilitating discussions, and guiding students' investigation processes. Because students are actively involved, teachers' attention to individual student development increases. In addition, this model encourages more comprehensive and in-depth learning because it emphasizes *interdisciplinary learning*. Longer learning time also allows for gradual and repetitive deepening of the material, so that learning is not superficial or rushed. In the long run, this approach contributes to the formation of a scientific character and a solutionive mindset oriented towards solving real problems.

Although it has many advantages, the PBL model is also inseparable from various weaknesses that need to be critically considered. From the student's side, one of the main obstacles is the need for sufficient prior knowledge as a prerequisite to understand and solve the problem

posed. Without an adequate basic understanding, students will find it difficult to follow the complex flow of thinking in PBL. Therefore, it is important for teachers to build strong *pre-conditions* through orientation or concept reinforcement activities before problem-based learning begins.

In addition, PBL requires a relatively longer implementation time compared to conventional learning approaches. The process of investigation, group discussions, experiments, and presentation of results requires a fairly long duration, so it is less than ideal if applied in an education system that is very bound by a dense curriculum and strict schedule. Extracurricular activities such as field observations also require extra supervision to ensure the safety and security of students, especially if they are carried out in an environment that is not fully controlled.

From the teacher's perspective, this model demands more complex and sustainable learning planning. Teachers are required to develop systematic learning scenarios, flexible, yet still in tune with the expected learning outcomes. This process requires a high degree of time, effort, and creativity (Shupaeroh et al., 2024). Another challenge is in terms of evaluation. Assessment in PBL includes not only the final results, but also the thought process, student participation, and group collaboration. Therefore, teachers must design valid and reliable assessment instruments, capable of capturing various dimensions of learning holistically. Thus, the implementation of the PBL model requires strong support, both in pedagogic, structural, and administrative aspects. An in-depth understanding of the strengths and weaknesses of this model will help educators and policymakers design optimal, contextual, and sustainable learning strategies.

CONCLUSION

One of the things that can be pursued is the involvement of students. Students are not only objects in the search for solutions for dengue prevention prevention, but become subjects in overcoming problems. It is necessary to formulate the right learning model to deliver dengue fever material in IPAS subjects. With the problem based learning (PBL) model approach, students not only understand and memorize the material, but they actively seek information, make observations in the environment, and are able to formulate conclusions. This learning model encourages students to be more interactive, hone their critical thinking and problem-solving skills. The material presented in the IPAS textbook has contained the concept of Aedes aegypti mosquito metamorphosis and its prevention efforts contextually and applicatively, which has great potential to be processed in the PBL syntax. By integrating problem-based learning into the material, students not only understand

scientific concepts more deeply, but are also encouraged to think critically, act preventively, and play an active role in maintaining environmental health. This model is effective in shaping meaningful learning experiences and fostering students' awareness of public health issues such as dengue fever from an early age.

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