



The Effect of Problem-Based Learning Models and Prior Knowledge toward Critical Thinking Skills on Human Digestive and Circulatory System

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Abstract: Technological developments demand that education is directed at learning that equips students with 21st century skills. One of them is critical thinking skills. Students' critical thinking skills can be developed through the use of appropriate learning models and supported by prior knowledge that students already have. However, the use of learning models applied in schools has not optimally developed students' critical thinking skills and tests have never been carried out to determine students' prior knowledge. One of the learning models that can develop critical thinking skills is the problem-based learning model. The purpose of this study was to determine the effect of problem-based learning models and prior knowledge on the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang. This type of research is a quasi-experimental with a population of class VIII students at SMP Negeri 1 Lengayang in the odd semester of the 2022/2023 academic year. Taking two sample classes using purposive sampling technique. The design of this research is Randomized Control-Group Posttest Only Design. The instrument used in this study was a written test. The data analysis technique for testing the hypothesis is the independent sample t test and the two-way ANOVA test. The results of this study prove that: The problem-based learning model influences the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang; the problem-based learning model and high prior knowledge affect the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang; The problem-based learning model and low prior knowledge affect the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang; The problem-based learning model has no interaction with prior knowledge in influencing the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang.

Keywords: Critical thinking skills; Prior knowledge; Problem based learning

Introduction

Technological developments cause changes in 21st century life. According to Hidayatullah et al. (2021), the 21st century is marked by globalization which causes changes in all aspects of life. Education as a fundamental aspect of life is not spared from these changes, so education is directed at learning that equips students with 21st century skills. According to the Kemdikbud (2017), one of the 21st century skills is critical thinking

skills. This skill is a fundamental skill that must be mastered by students to face a life that is full of information. According to Zubaidah (2018) Critical thinking skills are basic skills in solving a problem, training students to have the ability to find problems, find and determine the right solutions to problems that occur.

However, in the schools that were observed, an assessment of students' critical thinking skills had never been carried out, so the teacher did not know the

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students' ability to think critically. Meanwhile, Fuad et al. (2017) suggested that students' critical thinking skills at the junior high school level were still low with an average achievement of 21.89 in the range 1-100. This low score is due to the use of a learning model that is still teacher centered. Thus, critical thinking skills can be developed in learning through the application of appropriate learning models, including science learning. According to Aswan et al. (2018), science education is expected to be able to lead students to fulfill the skills needed in the 21st century.

In fact, science learning is still often carried out using the lecture method so that learning tends to be teacher-centered. This causes students to develop less thinking skills in learning so that it has an impact on their learning outcomes. According to Lufri (2005) that learning is still often carried out using the lecture method so that it is not optimal for developing students' thinking skills.

According to Pamungkas et al. (2017), the ability to think will emerge when someone faces a problem and its solution requires knowledge or experience that they already have. Knowledge that students already have is called prior knowledge. Prior knowledge is a knowledge that already exists within a person to acquire new knowledge or to find solutions to similar problems or new problems encountered. Meanwhile, Razak (2017) revealed that students' initial knowledge determines their ability to think critically in solving problems. Thus, prior knowledge is used by students to solve problems encountered in learning so as to train them to develop critical thinking skills.

According to Noervadila et al. (2020), prior knowledge is a prerequisite for students to continue the subject matter and the results they will get. Hailikari et al. (2008) revealed that through students' prior knowledge, teachers can group them according to their abilities. Thus, the initial knowledge of students needs to be known by the teacher to continue the subject matter and classify students according to their abilities through tests. However, tests have never been carried out in the field to determine students' prior knowledge.

Efforts made by the government to respond to the needs of 21st century skills in the field of education are to revise the curriculum as a guide in carrying out learning. The 2013 curriculum mandates learning with a scientific approach. In addition to a scientific approach, the 2013 curriculum also recommends the use of several learning models that support students' skills, one of which is the Problem Based Learning (PBL) model.

The PBL model can help students to develop thinking skills and respond to problems that occur in their environment. Students are able to recognize problems in their environment so that they can use existing knowledge and knowledge obtained in learning

to provide solutions to problems that arise. Zubaidah et al. (2017) explained that problem-based learning is a learning model that can develop students' ability to solve problems and develop characters such as critical thinking, working together, being responsible and playing an active role in the future. While Maya et al. (2020) revealed that PBL can build students' critical thinking skills in addition to increasing their knowledge through problem solving and forming independence and being social. Thus, PBL can be applied in learning to improve students' thinking skills, especially critical thinking skills as basic skills for dealing with 21st century life.

Several studies have been conducted regarding the PBL model, prior knowledge and critical thinking skills, including research by Aswan et al. (2018) and Fakhriyah (2014) concluded that PBL can develop students' critical thinking skills. Meanwhile, Sundahry et al. (2021) concluded that prior knowledge can affect students' critical thinking skills. Thus, it can be concluded that PBL and prior knowledge affect students' critical thinking skills.

Based on this background, the researcher wanted to know the effect of the PBL model on the critical thinking skills of students at schools which were observed by paying attention to the prior knowledge possessed by students. The research was conducted under the title *The Effect of Problem-Based Learning Models and Prior Knowledge on the Critical Thinking Skills of Class VIII Students of SMP Negeri 1 Lembang*.

Problem Based Learning (PBL)

The PBL is a learning process that confronts students with real-life problems that they must solve in groups. Darhim et al. (2020) defines PBL as a learning model that provides real-world problems to students to facilitate learning about critical thinking skills and problem solving, as well as to acquire important knowledge and concepts from the subject matter. Meanwhile, Arends (2012) states that PBL presents students with authentic and meaningful problem situations that can serve as springboards for investigation. PBL seeks to help them become independent learners. They are guided by the teacher repeatedly, encouraging and rewarding them for asking questions and finding solutions to real problems on their own, as they learn to perform tasks independently later on. Thus, PBL can be used in learning that demands solving real-world problems and developing students' critical thinking skills. Arends (2012) describes the PBL syntax consisting of five phases. These phases can be seen in Table 1.

A learning model used in learning has advantages and limitations. Akinoğlu et al. (2007) revealed the advantages and limitations of PBL. The advantages of

PBL include student-centered classes, developing self-control in students, enabling students to see events in multi dimensions, developing students' problem-solving skills, encouraging students to learn new materials and concepts when solving problems, developing the level of socialization and communication skills of students in teams, motivating both teachers and

students and developing students' high-level critical and scientific thinking/ thinking skills. While the limitations of PBL include: It may be difficult for teachers to change teaching styles, it takes more time for students to solve problematic situations when it is first done in class, groups or individuals can finish work earlier or later and it is difficult to apply it in all classes.

Table 1. Syntax for PBL

Phase	Teacher Behavior
Orient students to the problem	Teacher goes over the objectives of the lesson, describes important logistical requirements, and motivates students to engage in problem-solving activity
Organize students for study	Teacher helps students define and organize study tasks related to the problem
Assist independent and group investigation	Teacher encourages students to gather appropriate information, conduct experiments, and search for explanations and solutions
Develop and present artifacts and exhibits	Teacher assists students in planning and preparing appropriate artifacts such as reports, videos, and models, and help them share their work with others
Analyze and evaluate the problem-solving process	Teacher helps students to reflect on their investigations and the processes they used

Prior Knowledge

Hailikari et al. (2008) defines prior knowledge as a multidimensional thing that is dynamic and consists of various knowledge and skills. In line with Siregar et al. (2018), initial knowledge is the knowledge and skills that students already have including prerequisite material for the material to be delivered in learning. Thus, prior knowledge is the knowledge and skills that students already have which are used as provisions for learning the material they will learn.

More Hailikari et al. (2008), revealed that prior knowledge as an important means to support learning objectives that can be used for various purposes, namely identifying student study achievements, finding appropriate levels or materials to start learning, providing feedback to students, bridging learning objectives with ability of students, and group students according to their abilities.

This study uses prior knowledge to classify students into groups with high prior knowledge and groups with low prior knowledge. The grouping is based on the prior knowledge test results obtained before the research is carried out on the sample class.

Critical Thinking Skills

Critical thinking skills or critical thinking is one of the competencies included in the 2013 curriculum that must be mastered by students in dealing with various life problems in the 21st century. According to Ismail et al. (2018), critical thinking skills are cognitive strategies used to help solve problems effectively. Ennis (2011) defines critical thinking as reasonable reflective thinking that focuses on deciding what to believe or what to do. Sidiq et al. (2021) states that good critical thinking skills

can be seen from the ability to analyze, inferring skills, evaluating skills, induction skills, and deduction skills.

Haviz et al. (2021) revealed that critical thinking includes the concept of analyzing information, implementing strategies, ideas, and logical investigations. Furthermore, Ucisaputri et al. (2020) added that critical thinking is a mental activity in solving problems so as to produce logical and proven or valid conclusions. Thus, critical thinking is a skill to analyze problems in life and be able to provide appropriate solutions to these problems.

Rositawati (2018) states that critical thinking makes students involved in learning activities and finds the essence of learning, then helps them manage their thoughts in order to get the right way of learning and get meaning from their lessons. Ismail et al. (2018) states that it is necessary to apply appropriate teaching and learning strategies so that students can think about and relate learning components to one another. Thus, it is necessary to apply appropriate learning models to develop students' critical thinking skills.

Rahmawati et al. (2016) identified indicators in critical thinking skills into 12 indicators grouped into five activities, namely: providing simple explanations (elementary clarification), building basic skills (basic support), concluding (inference), making further explanations (advanced clarification), and set strategy and tactics (strategy and tactics).

Method

This type of research is quasi-experimental research using a randomized control-group posttest only design. This study consisted of two classes, namely the

experimental class and the control class. The experimental class was given treatment with the PBL model while the control class used learning with a scientific approach. In both classes the sample was given a prior knowledge test before the study. The test results are used to group students into high prior knowledge groups and low prior knowledge groups. After the research, the two sample classes were given a posttest in the form of critical thinking skills tests.

The population in the study were all class VIII students of SMP Negeri 1 Lengayang in the odd semester of the 2022/2023 academic year. The number of class VIII students consists of 224 people who are divided into seven classes, starting from class VIII/1 to class VIII/7. For the selection of the sample class using purposive sampling technique, class VIII/1 was selected as the experimental class and class VIII/2 was selected as the control class.

The variables in this study consisted of three variables, namely the independent variable (X) was the PBL model, the moderator variable was the students' prior knowledge and the dependent variable (Y) was the students' critical thinking skills.

The data in this study is primary data obtained directly from students in the two sample classes. The instrument in this research is a matter of critical thinking skills test given for the posttest. The data analysis technique used is the prerequisite test which consists of the normality test and homogeneity test while the hypothesis test uses the independent sample t-test and two-way ANOVA test. Prerequisite testing and hypothesis testing were carried out using SPSS version 22 software.

Result and Discussion

Data Description

The results of this study show data about students' critical thinking skills. The data was taken through a posttest with written test techniques and the form of multiple choice questions. Posttest was given to students of both sample classes at the end of the study. Data on students' critical thinking skills research results can be seen in table 2 below.

Table 2. Student Posttest Results in the Sample Class

Class	Number of Students	Average Value	Percentage Difference (%)
PBL	32 People	65.85	7.71
Scientific	27 People	56.42	

Based on Table 2 it is known that the average value of the PBL class is higher than the scientific class with the percentage difference in the average value of the two classes being 7.71%. The data proves that the critical

thinking skills of students in the experimental class who are treated with a problem-based learning model are higher than the control class which uses a scientific approach in learning.

Each sample class was divided into two groups, namely the group of students who had high initial knowledge and the group of students who had low initial knowledge. Data on students' posttest results based on prior knowledge groups are presented in Table 3.

Table 3. Posttest Results of Sample Class Students Based on Prior Knowledge Group

Class	Prior Knowledge	Average Value	Percentage Difference (%)
PBL	High	70.89	7.37
		61.16	
Scientific	Low	60.81	8.46
		51.32	

Based on Table 3 it is known that the average value of students' critical thinking skills with high prior knowledge, the PBL class is higher than the scientific class with a difference of 7.37%. Likewise with students who have low prior knowledge, the average score of the PBL class is also higher than the scientific class with a difference of 8.46%. Thus, the critical thinking skills of students in the high prior knowledge group using problem-based learning models are higher than students using a scientific approach in learning. Similar to the low prior knowledge group, the critical thinking skills of students with problem-based learning models are also higher than the critical thinking skills of students with a scientific approach.

Based on the criteria for critical thinking skills, the posttest results of students with high prior knowledge in the PBL class were 70.89 having critical criteria while the scientific class was 61.16 also having critical criteria. In the low prior knowledge group, the PBL class reached 60.81 with critical criteria while the scientific class reached 51.32 with sufficiently critical criteria.

Prerequisite Testing

The prerequisite test is carried out before carrying out the hypothesis test which consists of a normality test and homogeneity test. The test aims to determine whether the data comes from a population that is normally distributed and has a homogeneous variance. The results of the normality and homogeneity tests on the results of students' critical thinking skills tests are as follows. Normality test and homogeneity test using SPSS software version 22.

Normality test

The criteria for normally distributed data are if the significance value is > 0.05 . The results of the normality test for critical thinking skills in each sample class can be seen in Table 4.

Table 4. Results of the Normality Test of Students' Critical Thinking Skills in the Sample Class

Class	Students' Critical Thinking Skills	
	Significance	Information
PBL	0.079	Normal Distribution
Scientific	0.085	Normal Distribution

Based on Table 4 it is known that the significance value of the normality test for critical thinking skills in the PBL class is $0.079 > 0.05$, meaning that the data is normally distributed. Likewise, the significance value of the normality test for the scientific class is $0.085 > 0.05$, which means that the data is also normally distributed. The results of the normality test for critical thinking skills based on students' prior knowledge can be seen in Table 5.

Table 5. Results of the Normality Test of Students' Critical Thinking Skills Based on Prior Knowledge

Class	Prior Knowledge	Students' Critical Thinking Skills	
		Significance	Information
PBL	High	0.109	Normal Distribution
		0.124	Normal Distribution
Scientific	Low	0.077	Normal Distribution
		0.200	Normal Distribution

Based on Table 5 it is known that the significance value of the normality test for students' critical thinking skills with high prior knowledge, PBL class is $0.109 > 0.05$ and scientific class is $0.124 > 0.05$. This means that the data on critical thinking skills with high prior knowledge in the PBL class and the scientific class are normally distributed. Likewise with the significance value of the normality test for students' critical thinking skills with low prior knowledge, in the PBL class the significance value was $0.077 > 0.05$ and in the scientific class the significance value was $0.200 > 0.05$, meaning that the data in both sample classes were normally distributed.

Homogeneity Test

The criteria for testing the homogeneity test is if the significance value is > 0.05 then the data has a homogeneous variance. The results of the homogeneity test of students' critical thinking skills in the sample class can be seen in Table 6.

Based on Table 6 it is known that the significance value of the PBL class data homogeneity test and the scientific class is $0.751 > 0.05$, meaning that the data of

the two sample classes has a homogeneous variance. The results of the homogeneity test of critical thinking skills based on students' prior knowledge can be seen in Table 7.

Table 6. Homogeneity Test Results of Students' Critical Thinking Skills in the Sample Class

Class	Students' Critical Thinking Skills	
	Significance	Information
PBL	0.751	Homogeneous
Scientific		

Table 7. Homogeneity Test Results of Students' Critical Thinking Skills Based on Prior Knowledge

Class	Prior Knowledge	Students' Critical Thinking Skills	
		Significance	Information
PBL	High	0.122	Homogeneous
Scientific	Low	0.267	Homogeneous

Based on Table 7 it is known that the significance value of the homogeneity test of critical thinking skills of students with high initial knowledge is $0.122 > 0.05$. This means that the data has a homogeneous variance. Meanwhile, the significance value of the homogeneity test for students' critical thinking skills with low prior knowledge is $0.267 > 0.05$, which means that the data also has a homogeneous variance.

Hypothesis Testing

Hypothesis testing used the independent sample t test and the two-way ANOVA test. The t test was used to test the hypothesis of the effect of PBL and high or low prior knowledge on students' critical thinking skills, while the two-way ANOVA test was used to test the hypothesis of the interaction between the PBL model and prior knowledge in influencing students' critical thinking skills. Hypothesis testing was carried out with SPSS software version 22. The criteria for testing the hypothesis were that if the significant value was > 0.05 then H_0 was accepted and H_1 was rejected and if the significant value was < 0.05 then H_0 was rejected and H_1 was accepted. The results of hypothesis testing can be seen in Table 8.

Based on Table 8 it is known that the significance value for the first hypothesis is $0.039 < 0.05$ so that H_1 is accepted. This shows that the problem-based learning model and high prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang. The significance value for the second hypothesis is $0.019 < 0.05$ so that H_1 is accepted. This means that the problem-based learning model and low prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang. While the

significance value for the third hypothesis is $0.968 > 0.05$ so that H_1 is rejected, meaning that the problem-based learning model has no interaction with prior knowledge

in influencing the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang.

Table 8. Hypothesis Test Results

Hypothesis	Significance	Conclusion
The problem-based learning model influences the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang	0.005	H1 Accepted
The problem-based learning model and high prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang	0.039	H1 Accepted
The problem-based learning model and low prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang	0.019	H1 Accepted
The problem-based learning model interacts with prior knowledge in influencing the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang	0.968	H1 Rejected

Discussion

The problem-based learning model influences the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang

In general, the average value of students' critical thinking skills in the PBL class, namely 65.85, is in the critical criteria, while in the scientific class, namely 56.42, the criteria are quite critical. Based on the results of this study it is known that the PBL class scores higher critical thinking skills than the scientific class. This is because the problem-based learning model is a learning process that confronts students with real-life problems so that they are actively involved in solving problems effectively. Thus, it can be concluded that the problem-based learning model affects students' critical thinking skills.

In accordance with the results of research by Monalisa et al. (2019) that PBL can improve students' critical thinking skills, besides that, PBL helps students become active learners because it places learning in the real world as a problem and makes students responsible for their learning. Darmayanti et al. (2022) added that PBL encourages students to be more active and more responsive to the problems they face. In learning, students are given the opportunity to find solutions to problems using various sources so that the solutions found are immediately stored in memory and become meaningful for themselves. Thus, PBL encourages students to be more active in learning and more responsive to the problems they face in their lives so that they take responsibility for solving these problems and become meaningful for them. This is a process of training students to develop critical thinking skills.

As revealed by Rositawati (2018) that critical thinking skills make students actively involved in learning, find the right solution to the problem or the essence of the lesson, train the mind to get the right learning process and what is learned becomes meaningful. While Ismail et al. (2018) suggests that critical thinking skills are cognitive strategies used to

help solve problems effectively. Furthermore, according to Ennis (2011), critical thinking skills are reasonable reflective thinking that focuses on deciding what to believe or what to do. Thus, critical thinking skills are the ability of students to develop thinking skills through the process of solving problems, being able to find solutions that are appropriate to the problems faced in life and being able to make the right decisions in solving problems.

The PBL model is applied in learning by confronting students with real-life problems and then students are given the opportunity to be actively involved in finding solutions in discussion groups. According to Darhim et al. (2020), PBL confronts students with problems then holds discussions in small groups to conduct studies related to the problems to be solved, then presents the results of the discussions with the teacher's guidance. Meanwhile, Arends (2012) states that PBL presents students with authentic and meaningful problem situations that can make students participate in conducting investigations or be involved in problem solving. Thus, PBL is a learning model that can develop students' critical thinking skills.

The problem-based learning model and high prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang

In this study it was found that based on the high initial knowledge of students, the average value of students' critical thinking skills who were treated with problem-based learning models was higher than students who were given learning with a scientific approach. The PBL class obtained an average score of 70.89 with critical criteria while the scientific class was 61.16 with critical criteria. This is because the prior knowledge possessed can be used by students in determining strategies to solve problems effectively so as to train students to think critically. Besides that, Sardiman revealed that students with high prior knowledge have a high chance of developing critical

thinking skills because they are more motivated, more active and have a high curiosity in learning (Danial et al., 2017). In accordance with the results of the t test on the hypothesis of problem-based learning models and high initial knowledge affecting the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang, it is known that critical thinking skills are influenced by problem-based learning models and students' high prior knowledge.

The findings in this study are in line with the results of research conducted by Wenno et al. (2021), that the problem-based learning model has proven to be influential in improving students' critical thinking skills. Meanwhile, research conducted by Razak (2017) revealed that there is a relationship between prior knowledge and students' critical thinking skills. As for research by Danial et al. (2017) illustrates that there are differences in critical thinking skills between students with high initial knowledge and low knowledge. Students with high initial knowledge are more actively involved in learning, both in the form of experiments and literature studies so that their critical thinking skills are better trained.

In the PBL class, students are more active in solving problems. As stated in the literature review, the problem-based learning model is carried out by guiding students to find contextual problems, then it is necessary to find solutions through collaboration with group members and presenting the results of problem solving in front of the class. Therefore, curiosity arises and the willingness of students to find solutions to problems that have been found. In line with Kardoyo, problem-based learning helps students explore the causes of problems, formulate real problems, offer solutions, work together to solve problems and present them (Wenno et al., 2021). Problems in learning are found through video observations and reading discourses in Student Worksheets (SW). While the solution to the problem is obtained by using various sources.

The learning process of students in the sample class both use SW. The difference is, the SW in the PBL class corresponds to the syntax of the problem-based learning model while in the SW in the scientific class, students are asked to make reports from the answers to the questions that arise in the questioning step during the learning process with a scientific approach. Thus, the critical thinking skills of students in the PBL class using worksheets were better than the control class. This is almost the same as the results of research by Rahayu et al. (2019) which revealed that the problem-based learning model assisted by SW was effective on students' critical thinking skills.

The first stage carried out by students in the PBL class is to observe the video presented by the teacher and read the discourse containing contextual problems in

SW. After that, students are guided by the teacher to find problems to be solved through cooperation in groups. Furthermore, students seek solutions to problems through experimentation and using various sources, such as student books and the internet. Then students present the results of problem solving in groups and conduct question and answer with other groups. The final stage is that students take quizzes which are held orally to find out students' understanding of the subject matter they have studied. A series of learning activities carried out in a problem-based learning model can help students to develop critical thinking skills.

Meanwhile, in the scientific class, those who study with a scientific approach have lower critical thinking skills than the PBL class. Learning in scientific classes, initially students observe charts and then they are given the opportunity to ask questions related to observations. Furthermore, the questions that have been collected are selected based on Competency Achievement Indicators (CAI) to find answers. If the question does not include CAI, the teacher will add questions. Then the students discussed in gathering information to answer questions through experiments using Student Book sources. In the final stage, students make conclusions, present the results of the discussion and conduct questions and answers with other groups.

In contrast to students in scientific classes, they are less active in learning because some of the questions that arise are not contextual and more dominant questions come from the teacher. In addition, the source used as a reference only uses Student Books. Therefore, not all group members participate, both in discussing and presenting the results of group work. This causes students to develop less critical thinking skills so that the value of critical thinking skills in the scientific class is lower than that in the PBL class.

The problem-based learning model and low initial knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang

If seen based on the low prior knowledge of students, it can be proven that the average value of critical thinking skills of students who are treated with problem-based learning models is higher than students who are given learning with a scientific approach. The PBL class obtained an average score of 60.81 with critical criteria while the scientific class was 51.32 with moderately critical criteria. Thus, critical thinking skills are influenced by problem-based learning models and students' low prior knowledge.

According to Sardiman, students with low initial knowledge do not develop critical thinking skills because they are less motivated in learning (Danial et al., 2017). However, this research reveals that students with low prior knowledge who are taught using a problem-

based learning model have higher critical thinking skills than students with low prior knowledge who are taught using a scientific approach. The high achievement of students' critical thinking skills in the experimental class proves that the problem-based learning model can encourage students with low prior knowledge to be more active in the learning process to find solutions to the problems they face. This also affects the increase in critical thinking skills of students who have low initial knowledge.

During the learning process with a problem-based learning model, students with low prior knowledge become active in collaborating with their group members to find solutions to the problems being solved. Besides that, they also try to study the subject matter in order to get solutions to the problems being discussed. They study subject matter using various sources, such as the internet and student books. Through these activities, students with low initial knowledge are willing to participate in solving problems as well as practicing their critical thinking skills. In accordance with Akinoglu et al. (2007) that the advantages of the problem-based learning model include motivating students in learning, developing problem-solving skills and developing students' critical thinking skills.

The difference in the critical thinking skills of students who have low prior knowledge between the PBL class and the scientific class is influenced by the differences in the learning process applied to each sample class. This means, differences in learning models affect students' critical thinking skills. In accordance with research conducted by Danial et al. (2017) with the conclusion that there are differences in learning models for students' critical thinking skills.

So, there are significant differences in the learning process carried out in the two sample classes. The experimental class that applies the problem-based learning model has an average value of critical thinking skills that is higher than the control class that applies a scientific approach. This is also proven by Monalisa et al. (2019) that in addition to increasing the fun learning process, problem-based learning can also improve students' critical thinking skills. The findings in this study are also supported by research conducted by Merritt et al. (2017) which shows that the problem-based learning model is effective for improving students' science academic achievement, including knowledge, conceptual development and attitudes.

Likewise, when viewed from the initial knowledge of the students, both the high prior knowledge group and the low prior knowledge group, the critical thinking skills of the PBL class were also higher than the scientific class. Thus, students with high and low prior knowledge who are taught with a problem-based learning model

can achieve higher critical thinking skills than learning with a scientific approach.

The problem-based learning model interacts with prior knowledge in influencing the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang

Based on the results of the two-way ANOVA test, a significance value of $0.968 > 0.05$ was obtained, meaning that there was no interaction between the problem-based learning model and prior knowledge in influencing students' critical thinking skills. These findings are almost the same as the results of research conducted by Sari et al. (2018) which revealed that there was no interaction between problem-based learning models and prior knowledge of student learning outcomes. Meanwhile, the conclusions from the research of Danial et al. (2017) revealed that there was no interaction between the learning model and prior knowledge of students' critical thinking skills.

The students' critical thinking skills in the PBL class were higher than in the scientific class, but there was no interaction between the PBL model and students' prior knowledge. There is no interaction between the problem-based learning model and students' initial knowledge caused by several factors, such as the teacher being able to make good learning preparations, the PBL model confronts students with contextual problems so that it encourages groups of high and low knowledge to develop a willingness to solve problems or develop skills. critical thinking, the PBL model can encourage students with high and low prior knowledge to actively learn. This can be seen from actively collaborating, being willing to give opinions, wanting to ask questions and presenting the results of problem solving. In addition, Akinoglu et al. (2007) revealed that the PBL model allows students to combine their prior knowledge with new knowledge in finding solutions to real problems in their lives. Furthermore, Sari et al. (Sari, 2016) argued that there was no PBL interaction with initial abilities on learning outcomes due to good learning planning by the teacher, PBL involved and activated all students and PBL provided meaningful learning experiences to students.

Conclusion

Based on the research that has been done, the following conclusions can be obtained: The problem-based learning model influences the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang; The problem-based learning model and high prior knowledge affect the critical thinking skills of class VIII students at SMP Negeri 1 Lengayang; The problem-based learning model and low prior knowledge affect the critical thinking skills of class VIII students at SMP

Negeri 1 Lengayang; The problem-based learning model has no interaction with prior knowledge in influencing the critical thinking skills of class VIII students of SMP Negeri 1 Lengayang.

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Author Contributions

Maiyusri Eka Putri conceptualized the research idea, designed the methodology, conducted the research process, analyzed the data, and reviewed the literature. Yuni Ahda, Azwir Anhar, and Dwi Hilda Putri provided corrections, suggestions, and critical feedback on the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest in this research.

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