

The Influence of Problem-based Learning Models Assisted by Open-ended Worksheet on Problem Solving Ability and Ability to Ask of Junior High School Students

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Abstract

Students' ability to ask questions can be measured by looking at the quantity and quality of questions, in addition to the ability to ask questions there is also the ability to solve problems. One way to improve the ability to ask questions and problem-solving skills is by using the problem-based learning (PBL) model assisted by open-ended worksheets. The research objectives are: (1) to determine the effect of the problem-based learning model assisted by open-ended worksheet on problem-solving ability at junior high school. (2) to determine the effect of a problem-based learning model assisted by an open-ended worksheet on the ability to ask questions at junior high school. (3) to find out the relationship between the ability to ask questions and the problem-solving ability of students who are taught using the problem-based learning model assisted by open-ended worksheets at junior high school. This research was conducted in the even semester of the 2022/2023 school year in class VIII of SMPN 4 Tanantovea. This research is quasi-experimental. The samples used were VIIIA and VIIIB classes totaling 21 students. Based on the results of the study, it can be concluded that (1) a problem-based learning model assisted by an open-ended worksheet affects problem-solving ability. (2) The problem-based learning model assisted by open-ended worksheets affects the ability to ask questions in a good category. (3) There is a relationship between relationship between problem-solving ability and the ability to ask students who are taught using problem-based learning models assisted by open-ended worksheets.

Keywords: Problem-based learning models, open-ended worksheet, problem-solving ability, ability to ask questions.

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Introduction

The development of science and technology can be overcome if the learning process in schools uses 21st-century learning. 21st-century learning is learner-centered learning. The thing that students need to support the 21st-century learning process is the ability to solve problems. In addition, teachers need to pay attention to the ability to ask students to support 21st-century learning. Because teachers can see obstacles in the thinking process among students can be seen by teachers through the ability to ask students.

Questioning is a form of conveying unknown learning content/points or as a response to the teacher in learning expressed in the form of questions. More than that, questioning is also a measuring tool in thinking because asking questions can help create ideas and increase mastery of physics concepts and phenomena. The act of asking questions and searching for answers is the key to active learning (Musifangi & Muranda, 2014).

Students have a low ability to ask questions in terms of quantity and quality in using the problem based learning (PBL) learning model (Ika et al., 2019). In addition, research using a modified problem-based learning (PBL) model assisted by heart cage media can facilitate students in improving their ability to ask questions, increase learning motivation, and reduce learning time (Jaya et al., 2019). Research conducted by Susilowati and Suyatmi (2019) on the application of Problem Based Learning can improve the ability to ask questions and learning outcomes.

Based on the description above, one of the efforts to improve the ability to ask questions is to use question-and-

answer techniques besides that, teachers do not only focus on the quantity of questions but also the quality of students' questions. Thus, researchers examined the ability to ask questions based on quantity and quality. The research focuses more on the quality of questions, to see the quality of students in terms of asking. So that researchers are interested in researching the problem-based learning model assisted by open-ended worksheet on the ability to ask students.

In addition to the ability to ask questions, the 21st century learning process that needs to be considered is problem solving ability. Problem solving ability is defined as a process of using the ability to answer a problem through steps: (1) determining the suitability of data to solve problems; (2) creating a mathematical model of a situation or daily problem and solving it; (3) selecting and applying strategies to solve mathematical and/or non-mathematical problems; (4) interpreting and interpreting results according to the original problem, and verifying the accuracy of the results or answers; (5) applying mathematics meaningfully (Marzano & Kendall, 2008).

Research on problem-solving skills, among others by Herlinda et al. (2017) showed the successful application of the problem-based learning (PBL) model using a scientific approach to problem-solving skills. Meanwhile, Sitinjak and Banurea (2022) research showed that learning using the problem-based learning (PBL) model is good for problem-solving skills. Furthermore, the use of the problem-based learning (PBL) model has a significant effect on problem-solving skills (Salahuddin et al., 2022). Research conducted by Riswari et al.

(2018) showed that the problem-based learning model with the demonstration method affected problem solving skills. Research by Irnaningsih et al. (2022) showed that the problem-based learning model had a significant effect on problem solving skills. Research conducted by Irawan et al. (2022) shows that the problem-based learning model with STEM using mobile learning has an effect on problem solving skills.

Based on the description above, one of the efforts to improve problem-solving ability is by choosing the right and innovative model and choosing the right model by using the problem-based learning (PBL) model. Problem-solving skills can be improved by learning that begins with the delivery of objectives, conveying information to students in the form of examples of events that occur in everyday life. The problem-based learning (PBL) model assisted by open-ended worksheet makes students not only required to find solutions to the problems given but also provide arguments about the answers and explain how students find answers. So that students not only know the solution to the question but students explain how the steps of students in getting the answer. The research objectives in this study are (1) to determine the effect of the problem-based learning (PBL) model assisted by open-ended worksheet on problem-solving skills. (2) to determine the effect of the problem-based learning (PBL) model assisted by open-ended worksheet on the ability to ask. (3) to determine the relationship between problem-solving ability and questioning ability.

Methods

This type of research is quantitative research using the quasi-experiment method. The design used in this research is the non-equivalent control group design. The population in this study were all students of SMPN 4 Tanantovea, 2022/2023 school year consisting of 6 classes with a total 107 people. Based on the characteristics of the population, sampling was carried out using the Purposive Sampling technique. Purposive Sampling is a sampling technique with special considerations so that it is feasible to be sampled. The sample of this study was the VIII class of SMPN 4 Tanantovea, namely class VIIA consisting of 11 males and 10 females as the experimental class which was given the treatment of the problem-based learning (PBL) model assisted by Open-ended worksheet and class VIIB consisting of 5 males and 16 females as the control class which was given the problem-based learning (PBL) model assisted by worksheet.

This research uses quantitative analysis, which is an analysis technique whose analysis is carried out by mathematical calculations because the data obtained is in the form of numbers, namely the problem-solving ability test given to students and observations made to see the ability to ask questions. The instrument given is an essay test consisting of 7 questions consisting of indicators of problem-solving ability, namely understanding the problem, planning a solution, completing the solution plan, and checking back. While the questioning ability observation sheet is an observation sheet that measures the quality of questions consisting of low-level questions, namely questions that refer to questions of remembering, understanding, and applying and high-level questions, namely questions that refer to questions of analysis, synthesis, and evaluation.

Data collection techniques in this study consisted of giving tests on pretests and posttests to measure problem-solving skills in control and experimental classes and observing the ability to ask students by filling out an observation sheet of the quality of students' questions during the learning process.

The data analysis technique in the study consisted of

prerequisite tests, namely normality test and homogeneity test, hypothesis testing, namely t-test and effect size using statistic software, analysis of questioning ability by looking at the percentage of questioning ability, and correlation test tested using statistic software.

Results and Discussion

The ability to ask is measured using an observation sheet of the ability to ask students based on Bloom's revised taxonomy which is divided into 6 cognitive dimensions, students' oral questions during 3 meetings which can be seen in the Figure 1.

Based on Figure 1a the ability to ask students the first meeting of the control class with a percentage of 100% who asked questions for cognitive level C1 42.8%, C2 14.28%, and C3 4.70% for cognitive level C3 C4 C5 and C6 there were no questions, while students who did not ask were 38.1%. Based on Figure 1b the ability to ask students the first meeting of the experimental class with a total percentage of 100% who asked questions for cognitive level C1 47.60%, C2 19% and C4 4.70% for cognitive level C3, C5, and C6 students there were no questions while students who did not ask were 28.58%.

Based on Figure 1c the ability to ask questions of students in the second meeting of the control class with a percentage of 100% who asked questions for cognitive level C1 28.57%, C2 14.28% and C3 9.52% for cognitive level C4, C5, and C6 students did not ask questions, while students who did not ask were 48%. Based on Figure 1d the ability to ask questions of students in the second meeting of the experimental class with a percentage of 100% who asked questions for cognitive level C1 47.60%, C2 14.28%, and C4 4.70% for cognitive level C3, C5, and C6 students did not ask questions, while students who did not ask were 33.42%.

Based on Figure 1e the ability to ask questions of students in the third meeting of the control class with a percentage of 100% who asked questions for cognitive level C1 52.38% and C2 4.70% for cognitive level C3, C4, C5, and C6 students did not ask questions, while students who did not ask were 43%. Based on Figure 1f the ability to ask students on the third meeting of the experimental class with a percentage of 100% who asked questions for cognitive level C1 19%, C2 14%, C3 33.33%, C4 10% for cognitive level C5, and C6 students did not ask questions, while students who did not ask were 23.62%.

The results of the correlation test of problem-solving ability and ability to ask the control class. Person correlation $r_{\text{count}} > r_{\text{table}}$ then there is a correlation or relationship for r_{count} problem-solving ability and ability to ask is 0.699 and r_{table} is 0.413 then $r_{\text{count}} > r_{\text{table}}$ is 0.699 > 0.413 then there is no relationship between problem-solving ability and ability to ask. The significance level, namely Sig 2-tailed, is 0.000 for Sig < 0.01, so based on the significance level of 0.000 < 0.01, there is a relationship between problem-solving ability and the ability to ask the control class.

While the results of the correlation test of problem-solving ability and questioning ability. Person correlation $r_{\text{count}} > r_{\text{table}}$ then there is a correlation or relationship for r_{count} problem-solving ability and ability to ask is 0.792 and r_{table} is 0.413 then $r_{\text{count}} > r_{\text{table}}$ is 0.792 > 0.413 then there is no relationship between problem-solving ability and ability to ask the experimental class. The significance level is Sig 2-tailed which is 0.156 for Sig < 0.01, so based on the significance level of 0.000 < 0.01, there is a relationship between problem-solving ability and the ability to ask the experimental class. Based on the results of research on the control class and the experimental class, after

conducting a paired t-test on the control class before and after learning using the problem-based learning model on problem solving ability that there is a difference in the average score of students in class VIII SMPN 4 Tanantovea. Through the paired

t test in the experimental class before and after learning using the problem-based learning model assisted by open-ended worksheet on problem solving ability, there is a difference in the average score of students in class VIII SMPN 4 Tanantovea.

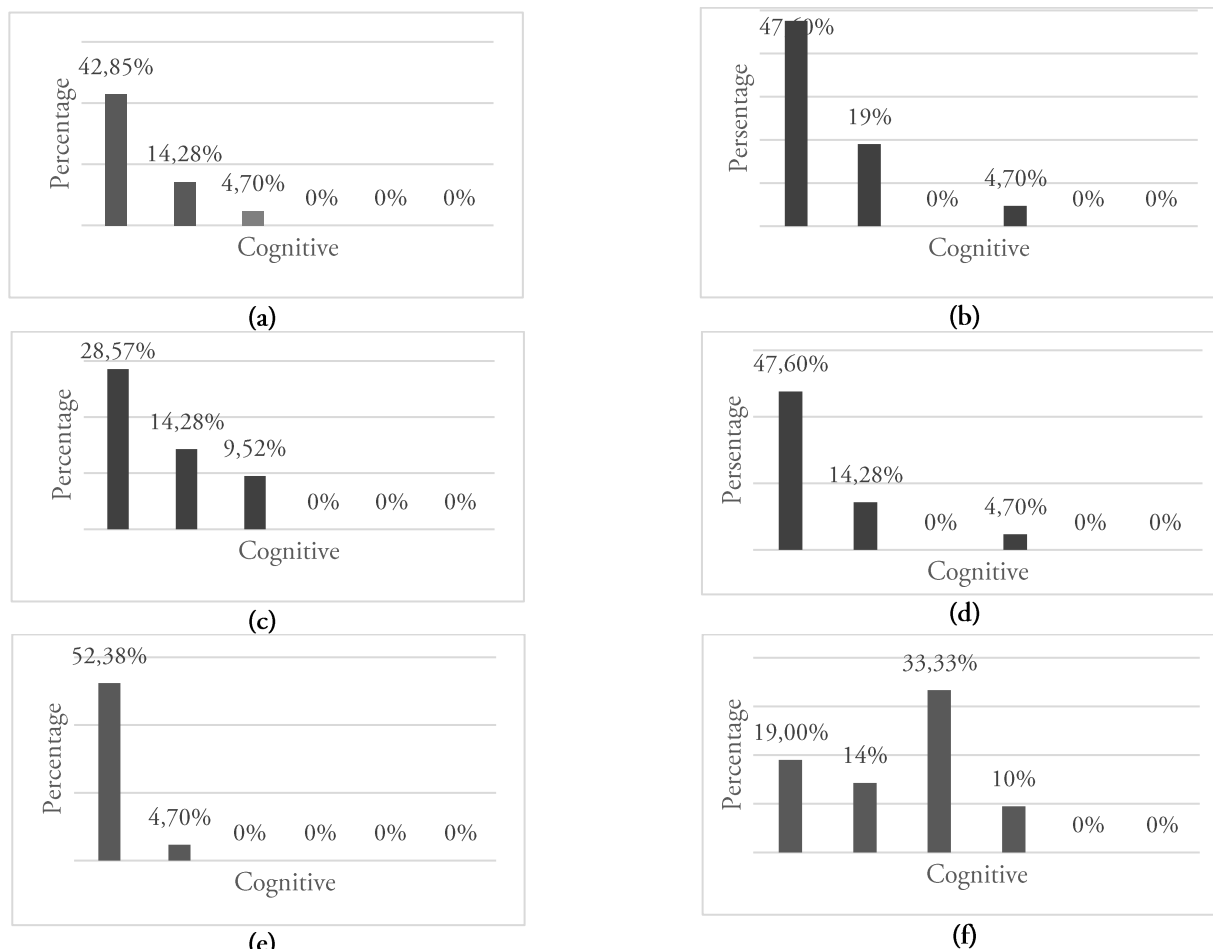


Figure 1. Ability to ask questions (a) meeting 1 control class; (b) meeting 1 experimental class; (c) meeting 2 control class; (d) meeting 2 experimental class; (e) meeting 3 control class; and (f) meeting 3 experimental class.

In the independent t test on the control and experimental classes, on the pretest for independent there is no difference in pretest between the control class and the experimental class on problem solving ability. This shows that there is no difference in problem solving ability between the control class and the experimental class or have the same initial ability. While in the independent t test posttest there is a difference in the average value after using the problem-based learning model assisted by Open-ended worksheet on problem solving skills. This shows that there is an effect of the problem-based learning model assisted by open-Ended worksheet on problem solving ability. To see how big the impact of the problem-based learning model has been tested using the effect size test based on the effect size test, the impact of the problem-based learning model assisted by Open-ended worksheet on problem solving ability is 5.4 in the large category. This shows that problem solving ability can be influenced by the problem-based learning model assisted by open-ended worksheet. While the effect of the problem-based learning model assisted by worksheet on problem solving ability is 5.0 in the high category. This shows the problem solving ability of experimental and control classes in the large category. However, in the experimental class is greater than the control class, this is due to the difference in worksheet which is the use of worksheet commonly used by the school and open-ended

worksheet differs in questions to find steps to do the practicum, when using open-ended worksheet students are given questions to guide the practicum while in the control class worksheet there are steps about doing the practicum. Therefore, students are less in exploring the ability to solve because there are already steps that can be followed without having to look for the steps again.

In addition, the factor that affects problem solving ability is the use of problem-based learning model. This success is in accordance with the advantages of the Problem Based Learning model, which can train students to design a discovery, students have the ability to think and act creatively, students can solve a real problem, students can also identify and evaluate investigations, and can stimulate the development of students' thinking progress to solve a problem faced appropriately. In addition, the success of problem solving in the experimental class is supported by the use of Open-ended worksheet which is still rarely used so that students are encouraged to solve and find their own questions in the worksheet so that they can improve problem solving skills.

This is in accordance with, research conducted by [Firmansyah et al. \(2022\)](#) the use of the Problem Based Learning model has a significant effect on the ability of students to solve physics problems in the cognitive domain. Meanwhile, according to research by [Sumiantari et al. \(2019\)](#) the results

showed that students who studied with the PBL model had better problem solving skills than students who studied with the STAD type cooperative model. In addition, research conducted by Togatorop & Sinuraya (2019) shows that the Problem Based Learning model affects the problem solving ability of students. Research conducted by. Meanwhile, in Ramadhani et al.'s (2019) research mathematics learning with a flipped-problem based learning model with LMS-Google Classroom has a significant effect in improving math learning outcomes. Surur et al. (2020) research shows that there are differences in the use of problem based learning models on problem solving abilities.

The ability to ask questions in the experimental class is for the first session, namely 65% in the good category, the second session is 60.8% in the good category and the third session is 69.5% in the good category. While in the control class for the first meeting, 61.9% in the good category, the second meeting was 52.38% in the good enough category and the third meeting was 57% in the good enough category. Based on the results above, it is appropriate to show that the use of a problem-based learning model assisted by open-ended worksheet on the ability to ask students in a good category. This is because in the open-ended worksheet experimental class given questions to find practicum steps so that students ask more often compared to the control class which is given steps so that students do not ask. In addition, although the quantity of questions is categorized as quite good in terms of the quality of questions for the control class and experimental class, students are still in the low category where at the cognitive level C1 and C2 in the control class and C1, C2 and C3 in the experimental class.

The ability to ask students is still classified as low-level cognitive, namely C1-C3, this is due to the lack of two-way communication between teachers and students and students with students. Although the teacher has used the problem-based Learning model in class where students in their learning activities are directed to discussion activities to stimulate the ability to ask questions. But in reality, most learners are less interested in problem-based discussion activities so that the quality of questions asked is only classified at a low cognitive level. Only a few learners are active in conducting discussions, most learners are less interested. This was due to: 1) learners who are individualistic in character, 2) learners still tend to be shy to ask questions, and 3) the willingness to have active discussions is still small.

Research by Ika et al. (2019) the ability to ask VII F students obtained data on the quantity of questions amounting to 35.48% and the quality of asking students classified as low cognitive level which shows the absence of questions classified as high cognitive level. Meanwhile, research conducted by WR et al. (2019) showed that the problem-based learning model improved students' ability to ask questions. Research conducted by Susilowati and Suyatmi (2019) showed that the application of the problem-based learning model can improve the ability to ask students. Research conducted by Surya et al. (2018) shows that there is a significant effect of learning models (PBL, conventional) on mathematical communication skills.

The relationship between problem solving ability and questioning ability of the control class analyzed by Paerson's correlation test shows that there is a relationship between problem solving ability and questioning ability of the control class. The relationship between problem solving ability and questioning ability in the experimental class shows that if problem solving ability and questioning ability have a strong relationship.

Conclusion

Based on the results of the research and discussion, it can be concluded that based on the results of research and discussion, it can be concluded that Problem-based learning model assisted by an open-ended worksheet affects problem-solving ability. Based on the independent sig < 0.05 test for the pretest of the experimental class and the control class, the results obtained $0.532 < 0.05$ indicate that there is no difference in the problem-solving ability of the experimental class when using the problem-based learning model assisted by open-ended worksheet and the control class using the problem-based learning model. While the independent test sig < 0.05 for the posttest of the experimental class and control class, the results obtained were $0.010 < 0.05$, this indicates that there is a difference in the problem-solving ability of the experimental class using the problem-based learning model assisted by open-ended worksheet and the control class using the problem-based learning model. The impact of using a problem-based learning model assisted by an open-ended worksheet on problem-solving ability is 5.4 in the large category while using a problem-based learning model assisted by a worksheet on problem-solving ability is 5.0 in the large category

Problem-based learning model assisted by an open-ended worksheet affects the ability to ask a question. Based on the results of the study, it was found that the ability to ask students when using the problem-based learning model in the control class for the first meeting was 61.9% in the good category, the second meeting was 52.38% in the good enough category, the third meeting was 57% in the good enough category. In the experimental class, the first meeting amounted to 65% in the good category, the second meeting amounted to 60.8% in the good category, and the third meeting amounted to 69.5% in the good category. However, the quality of questions in the control class is still at a low cognitive level, namely C1, and C2, and in the experimental class at the cognitive level, namely C1, C2, and C3. Based on the Pearson statistical correlation test, there is a relationship between problem-solving ability and questioning ability in the experimental class. While the problem-solving ability and the ability to ask questions in the control class there is a significant relationship. This shows that by increasing the problem-solving ability, the ability to ask questions also increases.

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Conflicts of Interest

All authors declare that they have no conflicts of interest.

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