# Profile of Students' Problem-solving Ability in Physics and Implementation of Contextual Teaching Learning

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**Abstract.** Problem-solving is an important ability that students must have in learning physics. Contextual learning is closely related to students' problem-solving abilities. The ability to connect the content of the material studied with the real context of the surrounding world can stimulate students' problem-solving abilities. This research aims to provide an overview of the profile of problem-solving abilities and physics and implementing contextual learning on optical instrument material. The participants in this research were 63 students in class XI SMA Negeri 1 Ngaglik, Yogyakarta. This research uses analyzed using qualitative descriptive method. The data collection instruments used were problem-solving ability tests and learning observation sheets. Problem-solving ability is calculated per aspect according to Polya. The results of the research showed that the ability to understand problems was classified as enough at 67.28, planning the strategy to solve the problem was classified as very low 47.56 to implement the strategy as well as review and check was classified as enough at 69.56. The implementation of contextual learning is influenced by prior knowledge and basic abilities. Therefore, to train problem solving skills through contextual learning, teachers must ensure student readiness.

**Keywords:** Contextual learning, Problem-solving, Physics.

## 1 Introduction

Physics learning is part of the national curriculum which aims to improve human resources in Indonesia. Physics learning is related to technology development and the prediction of physical phenomena in the future. Science (physics) is the study of nature which forms the basis of knowledge and has predictive power that can be applied in social life and influence technological developments [1]. Understanding aspects of physics makes it easier for humans to face and overcome problems in everyday life [2]. Therefore, Physics Learning in class must be optimized to produce graduates who are following the demands of Education.

Problem-solving ability is a fundamental ability to optimize Physics learning. Students are expected to be able to master the ability to analyze complex ideas then summarize the results and convey arguments that support their thinking based on accurate data [3]. According to Polya (2004) problem-solving ability is an activity that starts from understanding the problem, making a problem-solving plan, implementing the problem-solving plan, and looking (checking) again [4].


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Results of observations carried out at SMA N 1 Ngaglik. Physics is still a subject with low learning outcomes and student enthusiasm during class is lacking. Learning outcomes in physics learning are related to students' problem-solving abilities. One of the causes lacks student enthusiasms in class could be because students feel that the material or content in physics learning is not useful in everyday life. The biggest problem that causes students' low learning outcomes related to understanding physics concepts is that they still have difficulty making the connection between what they learn and how that knowledge is used in everyday contexts [5]. One of the biggest difficulties in learning physics is associated with students' problem-solving abilities [6].

This low problem-solving ability can be caused by learning that is not contextual. In several studies found the root cause of difficulties in learning physics in high school is the lack of a contextual approach used by teachers in learning [7], [8], [9]. Contextual learning is learning that connects the content of the material being studied with the real-world context around it. Many people succeed in solving everyday problems but fail when these problems are placed in a formal context with problems and material that are foreign to them [10]. On the contrary, many people are successful in solving problems in formal contexts in the classroom but have difficulty when dealing with problems in the real world. Experience using problem solving skills in everyday life is unstructured, complex, and diverse, the reason why students are unable to solve problems outside the classroom is due to the lack of opportunities to apply their knowledge in real-life contexts [11].

Contextual learning aims to help students recognize the benefits of learning by connecting the material and processes to real-world issues and experiences. Contextual learning experiences not only occur and are owned when a student is in class, but far more important than that is how to bring the learning experience out of class, namely when he is required to respond and solve problems [12]. The reality encountered every day. So, this contextual learning ideally connects problems that exist in the real world with the theory that will be taught or conveyed to students, and students actively solve these problems according to what they get through experience and connect it with the theory they learn at school from their experiences. There are seven main components in contextual learning, namely constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment [13].

Contextual learning in the classroom is influenced by the teacher's ability to present real problems/experiences in the classroom. According to research [3] so that students can solve problems, the problems presented in learning must be well structured and involve the context of everyday problems. Several factors become an obstacle in contextual learning, namely the problem of facilities such as limited classrooms and short learning time.

In optical instrument material, students often have difficulty solving complex problems, especially in binocular material. Not all schools have binoculars. Apart from being unaffordable, the availability of supporting suggestions is an important factor in contextual learning. Therefore, in this study, a simple binocular teaching aid was used which can be made in such a way as to resemble binoculars to optimize contextual learning. Utilization of teaching aids to assist contextual learning.

## 2 Method

This research was conducted at SMA Negeri 1 Ngaglik Yogyakarta. This research used descriptive qualitative method to analyze the profile of students' problem-solving ability in physics learning and the implementation of Contextual Teaching Learning. The research subjects were taken using purposive sampling technique, namely XI MIPA 1 and XI MIPA 2 classes with a total of 63 students.

This research design aims to see students' problem-solving ability after the implementation of contextual learning. The learning tools used in this contextual learning are Learning Implementation Plans (RPP), Learner Worksheets (LKPD) and teaching materials for optical devices. The test instrument used is a written test to measure problem solving ability and an observation sheet to see the contextual learning picture carried out.

Indicators of problem-solving ability that will be analyzed in this study use aspects of problem solving from Polya as shown in Table 1.

**Table 1.** Indicator of problem-solving ability.

| No. | Indicator of problem-solving | Description |
|---|---|---|
| 1 | Understanding the problem | - Identify known variables.<br>- Know what to know and ask questions.<br>- Visualize problems or identify variables that support the problem.<br>- Solving. |
| 2 | Planning the strategy | Determine the theory or the right one to solve the problem. |
| 3 | Implementing the strategy | Using the theory or formula prepared to solve. |
| 4 | Review and Check | - Check the correctness of the answers.<br>- Check all the information and calculations involved.<br>- Check the theory, values, and units used. |

Students were given four essay questions linked from number one to number four. Each number represents one indicator of problem-solving ability. To find out the profile of students' problem-solving ability, the score for each problem-solving indicator was calculated. The calculation of the value per aspect of student problem solving is calculated using Formula 1.

$$P_x = \frac{R_x}{S_x} x 100 \quad (1)$$

Information:
x = Problem-solving indicator 1, 2, 3 and 4
$P_x$ = score obtained on indicator 1, 2, 3 and 4
$R_x$ = score acquisition on indicator x
$S_x$ = maximum score of indicator x

The results of the calculation of problem-solving ability are classified based on the criteria in Table 2.

**Table 2.** Criteria for problem-solving abilities.

| Interva l | Criteria |
|---|---|
| 86 – 10 | Very Good |
| 76 – 85 | Good |
| 60 – 75 | Enough |
| 55 – 59 | Less/low |
| < 54 | Very less/Very low |

## 3 Findings and Discussion

Scalar data on students' problem-solving abilities is described based on aspects of problem-solving abilities in the following bar diagram. Problem-solving ability data is measured based on four indicators.

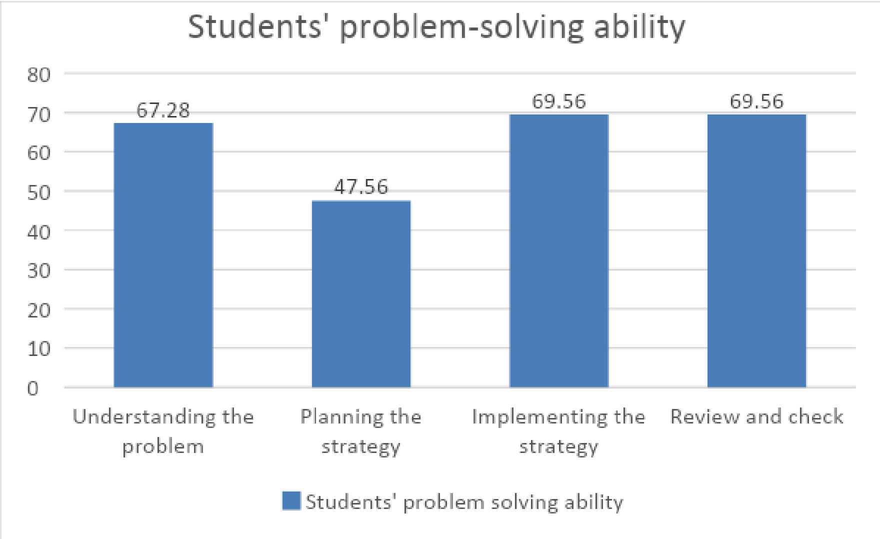


**Fig. 1.** Problem-solving ability diagram for each indicator.

Based on Figure 1, it is known that in terms of the ability to understand students' problems in the posttest, it is categorized as enough, namely 67.28, while making a solution plan is in the low category, namely 47.56. For the aspect review and check the enough category is 69.56.

### 3.1 Understanding the Problem

In this aspect, students are expected to be able to understand the context of the problem, demonstrated by the ability to identify the physical quantities involved, understand what is being asked or the questions that will lead to solving the problem. The Process of understanding problems, students are expected to be able to read the problem or question carefully, identify the questions to be answered, and visualize the problem, namely translating the problem into a physics description, writing down the quantities known and asked [14].

The ability to understand problems is influenced by students' initial abilities. Prior knowledge influences how students understand the problem to be solved [15]. In this research, the ability to understand problems regarding the analysis of image formation in binoculars requires prerequisite abilities regarding the process of image formation in lenses and mirrors which was studied in the previous chapter.

The percentage of ability to understand problems after being given contextual learning is classified as enough at 67.28. In the preliminary contextual learning activities in this research, the teacher first checked the students' prerequisite abilities regarding the material of refraction and reflection in lenses and mirrors. It was seen that several students had mastered the prerequisite skills, but many students were passive and had not yet mastered the prerequisite knowledge.

$$Convex\ lens = \begin{array}{c} +\ 100\,mm \\ +\ 300\ \mathrm{mm} \end{array}$$

Based on this answer, students also need knowledge of the characteristics of the lens so that it can be placed as an objective lens and an ocular lens. The problem-solving ability in this aspect is also considered good.

### 3.2 Planning the Strategy

In the process of making a resolution plan, the ability to connect the information provided with the information to be asked is required. Activities that can be carried out in the stages are identifying the main concepts and principles that can be used as questions, translating physics descriptions into appropriate mathematical representations, and using the identified concepts and principles in the form of equations. The ability to make a resolution plan is the aspect with the lowest achievement in this research. It is known that the ability to make problem-solving plans is 47.56 and is considered low.

The ability to make problem-solving plans is not only influenced by students' initial abilities in the form of prerequisite knowledge but is also influenced by the ability to translate physics descriptions or concepts into mathematical representations. According to research [16] [17]. Mathematical representation abilities influence students' ability to solve a problem.

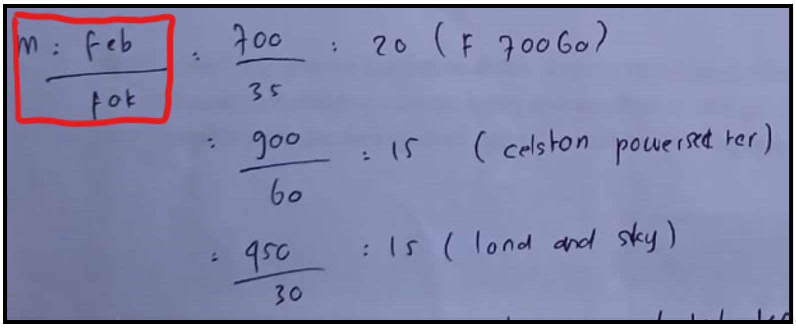


**Fig. 2.** Calculation of telescope magnification formula.

Based on the results of student work, these students were able to make a solution plan by determining the right type of binoculars according to the context of the problem, namely those with magnification the best. So, a formula or formula is needed that magnifies the telescope ($M = \frac{f_{ob}}{f_{ok}}$). In aspect planning to solve the problem student x has used the correct formula. From the results of observations, there are still some students who have difficulty translating verbal meanings into symbolic forms. Problem-solving ability is closely related to representation ability. Good representation skills can be a tool for solving problems. On the other hand, to improve problem-solving abilities you can present problems in various representations [18].

## 3.3 Implementing the Strategy

At this stage, students carry out the solution plan that has been written previously by entering the values into the formula required for mathematical calculations to obtain a numerical solution.

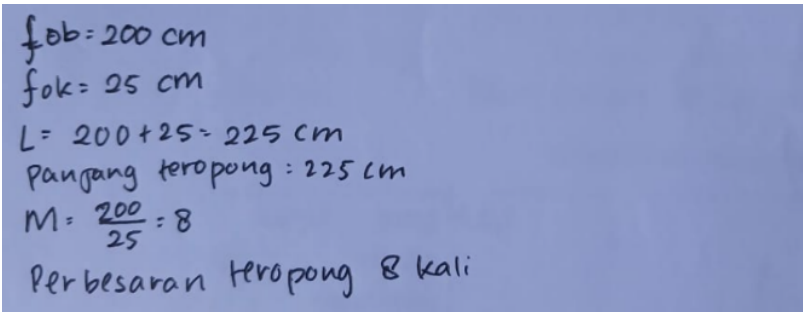


**Fig. 3.** The result of value input into the formula done by students.

The results of student x's work show that students can determine the magnification value of the image produced by two convex lenses forming binoculars. They chose the two required quantities correctly, namely the focus of the objective lens $f_{ob}$ and the focus of the eyepiece lens $f_{ok}$. But this student didn't write down the required formula, namely ($M = \frac{f_{ob}}{f_{ok}}$). Ability to carry out plans Problem-solving in this study was in the enough category at 69.56. When students do not write down theories or formulas that can be the key to solving problems (the aspect of making a solution plan) but carry out procedures correctly, as in the case of student x above, the student's ability in the aspect of implementing a solution plan will be doubted.

There is a possibility that the answer or procedure written is the result of guessing or forgetting to write the formula. Another possibility that arises is that students have difficulty writing mathematical formulas, which in this case are related to mathematical representation abilities, but the students understand the concept of physics or understand how the two physical variables are related so they carry out calculations without writing the mathematical symbols first.

### 3.4 Review and Check

At this stage students are asked to evaluate the results of their answers. Students are asked to check the solution to the problem. Does that answer make sense? Are the calculations correct? Are the units written correctly? Have all questions been answered?

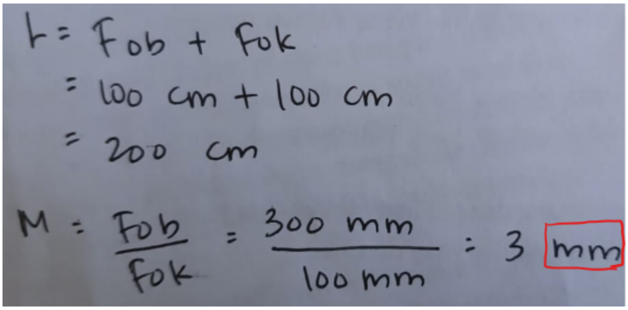


**Fig. 4.** Evaluation of students' answers.

Based on the students' answers above, it is known that the students have mastered the aspects of understanding the problem, the planning aspects, and the aspects of implementing the solution plan. However, he did not master the aspects of assessing and checking again. At this stage, a thorough attitude is required, one of the factors of error in the problem-solving process is not being thorough in the process of working on the questions [19]. Common mistakes that occur at this stage are because students are not careful. Some answers were not careful in carrying out calculations, while other errors were not careful in writing units.

The contextual learning carried out consists of six steps, namely constructivism, modelling, questioning, learning community, inquiry, reflection, and authentic assessment. Based on the results of observations in the classroom, all contextual learning syntax has been implemented well. The obstacles faced during learning include (1) mastery of prerequisite knowledge which is still diverse, (2) basic abilities such as mathematical representation skills which are still lacking, and (3) the presence of several technical problems during learning is like a student who arrives late. During contextual learning, students are enthusiastic in studying optical material with the help of teaching aids.

## 4 Conclusion

Based on the results of analysis from research that has been carried out, the problem-solving abilities students of SMAN 1 Ngaglik are categorized as good. In the aspects of understanding problems, planning the strategy, Implementing the strategy and review and check. The profile of problem-solving abilities is calculated based on its aspects. In the aspect of understanding the problem, it was categorized as enough at 67.28. In the aspect planning the strategy 47.56 is in the low category. In the aspect of implement the strategy and reviewing and re-examining it, the highest was with 69.56 in the enough category. Problem-solving abilities are also influenced by several factors such as understanding prerequisite knowledge or initial abilities which influence the aspect of understanding the problem. The ability to plan problem-solving is also influenced by students' representation abilities, especially mathematical representation. The ability to carry out plans and review aspects requires good accuracy. This can be accustomed to through contextual learning and habits in solving problems that require problem-solving abilities.

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