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PROBLEM-SOLVING ABILITY OF SCIENCE STUDENTS IN OPTICAL WAVE COURSES

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ABSTRACT

Optical wave courses at the Department of Science discuss waves and optics. The purpose of this study is to describe the problem-solving ability of students in optical wave courses. The method used is quantitative descriptive with one group pre-test post-test design. Method of data collection involves a test given to students before and after the student worksheet was provided in the course of optical waves. This study showed an increase in scores experienced by as many as 15 students. This shows that the problem-solving ability of students has increased.

Keywords: problem-solving ability; waves and optics; student worksheet

INTRODUCTION

Science learning has three important dimensions that must be developed namely basic concepts and knowledge of science, process skills, and scientific attitudes so that science learning in schools can apply scientific methods by familiarizing students doing scientific work (Rahayu et al., 2012). The basic concept and knowledge of science is the most fundamental in learning and teaching science. While process skills occur naturally by using logic to describe the steps in the thinking process to find out the answers to the questions that occur in the environment. Scientific process skills are not only used to solve problems related to science but can be applied in other situations in everyday life. This process skill requires critical thinking skills and problem-solving skills. Skills of this science process include observing, counting, classifying, inferencing, predicting, conducting experiments, and communicating. Thus it is important for prospective science teachers to master the skills of the science process, in this case the problem-solving ability to implement optimal science learning in the classroom.

There are several educational philosophies that can be used by science teachers to optimize students' achievement in science learning. One of them is using a problem-solving approach that implements inquiry learning in it (Hake, 1998). Teachers' duties and roles are not only as information givers, but also as a driver of learning so that students can construct their own knowledge through various activities that demand the active role of the students. This is in contrast to conventional learning which implement teaching-centered learning activities, where the teacher only explains the material, gives examples of problems, then gives the exercise of a question which is usually similar to the example of a given question. The provision of complex and contextual issues will assist students in training their physics problem solving abilities (Sujarwanto et al., 2014). Until now, efforts made to improve the

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quality of education still have not shown optimal results, especially in the course of Optical Wave. It is because the lecturing process only gives lectures and discussions. While students are working on problem-solving problems, they faced difficulties so that they obtained low score.

Learning should provide a learning experience for students through scientific work. Scientific work is a way of solving problems with a series of sequential or systematic activities (Wasis & Irianto, 2008). Activities in scientific work require the use of the ability of the process of science, including: observing, classifying, communicating, measuring, predicting or forecasting, and concluding. However, the optical wave lecture that has been implemented in the IPA Department is still very limited by only providing Student Worksheet (LKM) for the refraction and reflection material. This is not in accordance with the coverage of optical wave materials which include waves, sounds, and optics. In addition, the existing student worksheet model in this lecture is a form of student worksheet that facilitates students in conducting experiments, but limits the ability of students in finding problem solving independently.

Problem-based learning begins from everyday authentic problems from real and meaningful life (Herawati et al., 2010). The problems of science learning (including physics, biology, and chemistry) are related to three aspects namely, creativity, teaching materials, and science process skill (Wenno, 2010). The problems of science are ideas which play important roles in building the capacity of students' problem-solving skill and make science teaching become more joyful and it is able to motivate students to have more achievement (Arimbawa et al., 2013). Problem-solving skill is not only used to solve science problems in the form of mathematical forms but also it is used to solve problems in sorrounding environments (Hertiavi et al., 2010). Some experts stated that problem-based learning helps students improve thinking skill, problem-solving skill, and intelectual skill. It also helps them improve cooperating skill and their students' social attitude (Susilo, 2012). The learning model using real problems found in surrounding environment can be used as the basic to gain knowledge and concepts through criticla thinking skill and problem solving skill (Fakhriyha, 2014). Thinking means using analytical, creative, and practical ability. That intelligence is needed in everyday life. High-level thinking skill like metacognitive skill is a part from high-level thinking skill (Widodo & Kadarwati, 2013).

Five stages of solving problems according to Krulik and Rudnick (Carson, 2007) are as follows, 1) Reading. The activities undertaken by this stage are to record keywords, ask other students what is being asked on the problem, or restate the problem to a more easily understood language. 2) Exploring by including searching patterns to determine the concept or principle of the problem. At this stage, it identifies a given problem, presenting the problem into an easy-to-understand way. The question used at this stage is, "what kind of problem is it" ?. This stage is usually done by drawing activities or creating tables. 3) Choosing or selecting a strategy. At this stage, drawing conclusions or hypothesize abot how to solve the problems encountered based on what has been obtained in the first two stages. 4) Solving the problem. At this stage all the calculating skills are performed to find an answer. 5) Reviewing and discussing (reviewing and extending). At this point, the students double check the answer and see the variation of how to solve the problem.

There are four stages of problem solving skills according to Selcuk et al. (2008) 1) understanding the problem, 2) planning the completion, 3) implementing problem solving based on the plan and 4) re-checking (Selçuk et al., 2008). Problem-solving is a process to find a combination of a number of rules that can be applied in an effort to cope with the new situation. Troubleshooting is the process of getting a set of rules at a higher level. If a person has gained a combination of devices that are proven to be operable in accordance with the situation at hand, he is not only able to solve a problem but also succeed in finding something new that is a set of procedures or strategies that allow one to increase self-reliance in thinking (Gagne, 1985). Based on the above description, a research was onducted with the title "Problem Solving Ability Student IPA on Optical Wave Course". Problems to be answered in the research is how to improve students problem solving abilities in the discussion of waves and optics after the implementation of the student worksheet? The objective of the research is to describe the improvement of problem solving ability of IPA students in the diacussion of wave and optics after the implementation of student worksheet.

METHODS

This type of research is descriptive quantitative. The subjects of the study were students of IPA class of 2013. The research design is one group pre-test post-test.

O_1----------→ X ----------→O_2

(Sugiyono, 2013)

Information:
O_1 = score of *pre-test* (before treatment)
O_2 = score of *postest* (after treatment)
X = treatment with the implementation of learning with the student worksheet to train problem-solving skills

The research instrument is a test sheet. Methods of data collection are tests given to students before and after the student worksheet. The test is given in the optical wave course. The purpose of the test method is to determine the problem-solving ability before and after using the student worksheet. The test of problem solving ability is adjusted to the achievement of the component of training problem solving abilities including 1) understanding the problem of writing the problem formulation, 2) planning the completion of preparing the hypothesis, determining the variables and designing the experiment 3) implementing the problem-solving skill based on the plan which include collecting data, analyzing, and concluding, 4) rechecking the results obtained.

The standard of success of each student is seen from the mastery of learning objectives.

$$\text{Score} = \frac{\textit{Score Obtained}}{\textit{Maximum Score}} \times 100$$

The results of the analysis of students' problem-solving capability will be used to determine the feasibility of the student worksheet developed by using the following interpretations:

Table 1. Criteria of Score Interpretation of Problem-Solving Achievement

Percentage	Criteria
20 % - 40 %	Bad
41 % - 60 %	Medium
61 % - 80%	Good
81 % - 100 %	Very Good

(Riduwan, 2010)

To find out the problem-solving capability, the following formula is used:

$$g = \frac{(post-test)-(pre-test)}{4-(pre-test)}$$

RESULTS AND DISCUSSION

The result of problem solving capability is analyzed using gain score that can be seen in Table 2.

Table 2. Achievement of Problem-Solving Ability based on Gain Score Analysis

SRN	*Pre-test*	*Post-test*	Gain Score
13030654041	10	61	0,57
13030654042	7	82	0,81
13030654043	17	84	0,81
13030654046	13	60	0,54
13030654047	14	83	0,80
13030654049	0	92	0,92
13030654050	56	83	0,61
13030654051	0	73	0,73
13030654052	7	92	0,91
13030654053	13	70	0,66
13030654054	14	61	0,55
13030654055	19	84	0,80
13030654056	24	88	0,84
13030654057	10	46	0,40
13030654058	7	61	0,58

Table 2 shows that students are improving. The diagram below shows the gain score which includes high, medium and low criteria.

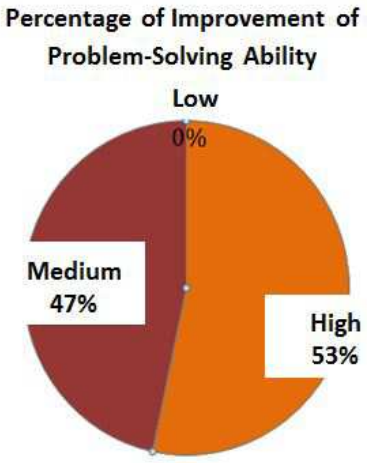

Figure 1. Percentage of Improvement of Problem-Solving Ability

This shows that the improvement of students problem-solving skills are experienced by 15 students. It indicates the feasibility of this

student worksheetas seen from the high criterion percentage (53%), moderate (47%) and low (0%). Factors that cause students with various criteria are because students have different levels of intelligence compared with other students. Moreover, while learning, they have difficulty in implementing problem solving in the plan. This is based on the result of the test done by the students (pretest and post-test) which showed that the problems in the level of analysis cannot be solved by the students well. In order to perform the process analysis well, first the student must have the ability in interpreting the data well. Achievement of problem solving component of pre-test result is presented as follows.

Table 3. Percentage of Components of Pretest on Problem-Solving Ability

Components of Problem-Solving Ability	Percentage (%)
Understanding Problems	33,33
Planning Solution	6,67
Executing the solution based on planning	0
Rechecking	0

Post-test results of the components of problem solving abilities are presented as follows:

Table 4. Percentage of Problem-Solving Components

Components of Problem-Solving Ability	Percentage (%)
Understanding Problems	100,00
Planning Solution	93,33
Executing the solution based on planning	73,33
Rechecking	66,67

In Table 3 and Table 4, the difference in achievement of components of problem-solving capability shows that students in understanding the problem achieved 100%. It reveals that students can write the problem formulation appropriately. Planning completion scored 93.33% which revelas that the students can almost all compile hypotheses, determine variables and design experiments. Components stating that students are able to implement problem-solving based on plan (collecting data, analyze and conclude) scored 73,33%, because there are students making mistake in making table and graph. The last component is rechecking seen from the results of students' work and writing amount and unit exactly. The cpmonent scored 66.67%. A Part of the students forgot in writing the unit in completing the work. From the observation of student activity in doing the student worksheet, students cannot optimally do the assigment. The way to package good material is in the form of an student worksheet constructed by constructivist principles (Prastowo, 2011).

Mason & Singh (2011) stated that someone who has a high ability in problem solving is able to recognize the concept of the problem. The theory of constructivism by Vigotsky said that by conducting a constructivism process by finding and building the concept of knowledge they have learned, we can improve students' understanding of a concept to be learned (Nursalim, 2007). Based on the theory, problem-solving student worksheets can condition students to use information or knowledge that has been studied to understand new concepts The results of research show that students find it easier in understanding the Optical Wave course after being treated by student worksheet problem-solving. It is shown by the existence of significant difference between pre-test result with post-test. In addition to the above theory, the results of this study are also supported by Sudirman (2000) who said that, the purpose of applying the problem solving method is to obtain students 'cognitive abilities and cognitive skills so that students' ability in mastering concepts, principles and generalizations improves.

CONCLUSION

The study concluded that the increase of score is experienced by eight students. The improvement includes high criterion (53%), 7 students are included in medium criterion (47%), and no student is included in low criterion (0%). This suggests that problem-solving abilities has increased by 100% after a problem-solving student worksheet.

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