BioEdu
Berkala Ilmiah Pendidikan Biologi
Vol. 10 No. 1 Tahun 2021 Hal: 221-228
https://ejournal.unesa.ac.id/index.php/bioedu

THE ABILITY OF STUDENT'S PROBLEM SOLVING AT SENIOR HIGH SCHOOL GRADE X BASED ON PROBLEM BASED LEARNING

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Abstract

Problem based learning that involve student to solve authentic problem need to be applied for understanding its role in training students' problem solving ability. This research aimed to (1) describe the implementation of problem based learning, (2) describe mastery of student's problem solving ability who are taught problem based learning and (3) describe student's responses about problem based learning. This research was a pre-experimental using one-group pretest-posttest design. The research sample which selected using purposive sampling were X IPA 6 of MAN Sidoarjo as a experiment class. Data was collected by observation, test and questionnaire. Data were analyzed based on learning implementation, the mastery level of student's problem solving ability, and student responses. Results showed that problem based learning carried out very good (in the percentage 97.5%). The student's mastery level of problem solving ability increased with a percentage of 80% after applying problem based learning. Students was positively response to the problem based learning (in the percentage of 86%).

Keywords: Problem based learning, Problem solving ability

INTRODUCTION

Education can improve the quality of human resources based on the process of learning in schools. Learning becomes very important to develop the potential of student, because it has a purpose, controlled and deliberate effort, so that student can learn and change themselves permanently (Miarso, 2004). According to Rusmono (2012) students can get knowledge and understanding as learning experiences because during learning activities, teacher can guide, direct and help student.

In the 21st century there has been a change in the learning paradigm. Learning activities must be adapted of this century. According to Partnership for 21st Century Skills Institute, problem solving skill is one of the skill needed in the 21st century. Trilling and Hood (1999) also state that in this century, there are 7 types of skill that serve as student's learning outcomes in secondary schools and problem solving ability is part of those. One of the efforts to deal with these guidelines is the learning material must be more authentic and student collaborate using various available information resources. At learning activities, students must be trained problem solving skill because it is very important. According to Cahyani and Setyawati (2016) learning that train problem solving skill can prepare mentally students be better to deal with authentic problems because student is trained to deal problem in learning continually. Student who is trained solve problems can also help themselve to survive productively in the current era of globalization (Juliyanto, 2017).

Government has made concrete efforts to train problem solving skill to student. The concrete effort is to change learning pattern that more emphasize student's ability to find knowledge from several sources, formulate problems, analytical thinking and teamwork, and collaborate in solving problems (Litbang Kemendikbud, 2013) . However, student's problem solving ability in Indonesia is still very low. According to Wahyudin, et al (2017) there has been a gap in education in the society . This can occur due to mismatch between the quality of education output with the required workforce qualifications.

Based on the results of interviews with biology teachers at MAN Sidoarjo stated that when learning only focus on the content of the material. Teacher more often has used the conventional method assisted by power point to tranfer the material and students tend to be more passive because they only have listened material presented. In addition, some teacher have also used student-centered learning models to improve student's competencies who are billed in the 2013 curriculum by providing LKPD to find their own knowledge about learning material. However, LKPD only contains theory and it does not train student to solve problem related to learning material.

Problem solving skill is activity that provide a challenge for students to solve a problem by involving

the knowledge that they have with the new knowledge that they get (Hamiyah and Jauhar, 2014). The application of scientific methods is needed to solve problems rationally, straightforwardly, and completely (Kusstianti et al., 2014). Active learning that practice problem solving skill is very necessary for biology that using steps of scientific method through experiments to find a proof of a problem that must be solved (Widiastuti, 2016).

According to Sumartini (2016) to train student's problem solving skill, it needs to be supported by an appropriate learning model. Problem-based learning is a learning model that involves student to solve a problem based on step of scientific method, so that student can learn knowledge that related to the problem while having the skill to solve problem systematically and planned (Ngalimun, 2017).

Arends (2008) states that the problem-based learning has a characteristic is to provide a variety of authentic and meaningful problem for students. Authentic problem that is given to students will stimulate student to solve these problems by related the knowledge that they have with the application in daily life (Tivani and Paidi, 2016).

In the subject of biology, there is one material, namely ecology that the topic can be associated with the phenomenon of problem in the environment, especially on the interaction between living things and their environment. In accordance with the statement of Agustini, et al (2015) ecology is one of the materials related to daily life. So, this material can be used with problem-based learning that has characteristic of presenting authentic problems in everyday life then involving student to solve these problems.

Based on the description that has been described, the researcher wants to conduct a study of "The Ability of Student's Problem Solving at Senior High School Grade X Based on Problem Based Learning in Ecology".

METHOD

This study was a pre-experimental study using the design of One-Group Pretest-Posttest Design. Determination of the sample used a purposive sampling technique. Using this technique because there were a superior class, so researchers took the appropriate class at an equivalent level. Determination of the class that was used by researchers was helped by deputy head of curriculum and obtained class X IPA 5 and class X IPA 6. Those two classes have different schedule so that one class cannot be used as a comparison class. So that, only one class was taken by using random assignment and obtaining class X IPA 6.

Learning activities were carried out using validated tools, including RPP, LKPD, and the questions about the pretest and posttest. The learning devices are adjusted with problem based learning. Before the treatment the class was given the initial test (pretest) as the initial measurement, then the class was treated using problem based learning. After the treatment, the class was given the final test (posttest) as the final measurement. The results of the pretest and posttest were used to describe the mastery level of student's problem solving ability.

The following figure is an overview of experimental research designs with The One Grup Pretest – Posttest Design.

O_1 X O_2

Information :
O1 : Pretest
X : Problem based learning's treatment
O2 : Posttest

Figure 1. Diagram of The One Grup Pretest – Posttest Design (Adapted from Fraenkel dan Wallen 2009:267)

In this study, indicators' of problem solving ability were identify problems, formulate problems, determine hypotheses, designand arrangge experimental or observational procedures to determine how to solve problems, analyze data, make conclusions and determine the appropriate way in of solutions of problem. Research instruments were observation sheet, problem solving test and student response sheet.

Data collection techniques were observation, test and questionnaire methods. The data was analyzed based on learning implementation, the mastery level of student's problem solving ability, and student responses Problem based learning implementation was analyzed by using Guttman scale assessment criteria (Yes/No), then calculated the percentage and interpreted using categories as in Table 1.

Table 1. The category levels of learning implementation

Percentage (%)	Category
0 – 20	Very poor
21 – 40	Poor
41 – 60	Sufficient
61 – 80	Good
81 – 100	Very good

(Sudaryono, 2017)

Data on students' problem solving ability was obtained from the results of the pretest and posttest. The ability of students' problem solving was measured by individual mastery and classical mastery. The mastery level of student's problem solving ability assessed using pretest and posttest scores of cognitive aspect based on minimum standard from the school, that is 75. Whereas a class was mastery if 75% of students reached a value of ≥ 75.

The student response was analyzed using Guttman scale assessment criteria (Yes/No), then calculated the percentage and interpreted using categories as in Table 2.

Table 2 The category levels of student's responses

Percentage (%)	Category
0 – 20	Very poor
21 – 40	Poor
41 – 60	Sufficient
61 – 80	Good
81 – 100	Very good

(Sudaryono, 2017)

RESULTS AND DISCUSSION

The research about the ability of student's problem solving based on problem based learning in ecology had been conducted in class X IPA 6 MAN Sidoarjo with 30 students. Student's problem solving ability was analyzed based on learning implementation, the mastery level of student's problem solving ability, and student responses.

The implementation of problem-based learning was observed by three observers using the observation sheet of the implementation of learning, the steps of which were adjusted to the steps in problem-based learning.

Table 3. The implementation of problem based learning

Learning step	Description	First meeting			Second meeting			Third meeting		
		P1	P2	P3	P1	P2	P3	P1	P2	P3
Phase 2 : Organizing students to learn	Students were directed to read the authentic problems in the LKPD	√	√	√	√	√	√	√	√	√
	Students identified problems in LKPD	√	√	√	√	√	√	√	√	√
Phase 3 : Guide individual and group investigations	The teacher guided students to conduct an investigation by following the steps contained in the LKPD, including: Students formulated the problem	√	√	√	√	√	√	√	√	√
	Students determined the hypothesis	√	√	√	√	√	√	√	√	√
	Students arranged design and procedure experimental	√	√	√	√	√	√	√	√	√
	Students conducted experiment	√	√	√	√	√	√	√	√	√
	Students analyzed the experimental data and made conclusions	√	√	√	√	√	√	√	√	√
	Students determined the solution of problem	√	√	√	√	√	√	√	√	√

*Note : (√) = Done, (-) = Hadn't done
P1 : Siti Mahmudah, S.Pd. (Biology teacher in MAN Sidoarjo)
P2 : Husfina Lailiyatus S. (Student in Biology Education)
P3 : Paramastri Zaindara D. (Student in Biology Education)

Based on Table 3, problem-based learning activities at the problem orientation and guiding individual and group investigations phase whose steps lead to indicators of the problem solving ability have done at the first, second and third meeting. This showed that when learning activities students have taught and trained to solve problems.

The result of student's pretest and posttest were compared with the KKM that has been determined by the school, that is 75 to determine the mastery level of students' problem solving ability. The mastery level of student's problem solving ability before and after being taught problem-based learning can be seen based on Figure 2.

Based on the result of pretest, the mastery level of student's problem solving ability was 0%, which means that all students have not mastered problem solving ability at the beginning of learning before teacher taught problem-based learning. While based on the result of posttest, the mastery level of student's problem solving ability was 80%, which means that 24 students have mastered problem solving ability after teacher taught problem-based learning and 6 students have not yet mastered. So that the mastery level of student's

problem solving ability increased after applying problem-based learning.

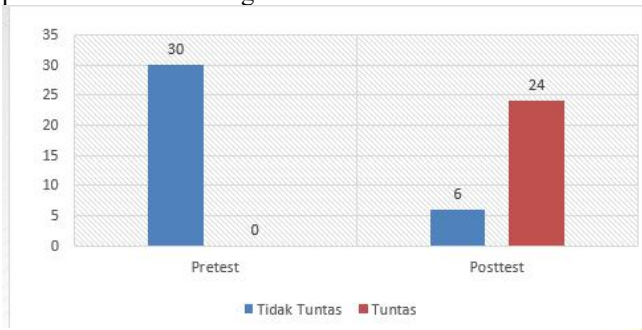

Figure 2. The ability of student's problem solving before and after problem based learning's treatment

After analyzing student's mastery of problem solving ability based on the results of the pretest and posttest, then analyzing student's problem solving ability based on each indicator (Table 4).

Table 4. Percentage student's problem solving ability each indicator

Indicators	Percentage (%)	
	Pretest	Posttest
4.10.1 Identify problems	93	100
4.10.2 Formulate problems	0	80
4.10.3 Determine hypotheses	0	80
4.10.4 Design and arrangge experimental or observational procedures to determine how to solve problems	0	87
4.10.5 Analyze data	7	90
4.10.6 Make conclusions	47	100
4.10.7 Determine the appropriate way in of solutions of the problem	63	100

In Table 4. It was known that in each indicator increased after applying problem-based learning. Identify problems from 93% increased to 100%, formulate problems from 0% increased to 80%, determine hypotheses from 0% increased to 80%, design and arrangge experimental or observational procedures to determine how to solve problems from 0% increased to 87%, analyze data from 7% increased to 90%, make conclusions from 47% increased to 100% and determine the appropriate way in of solution of the problem from 63% increased to 100%.

Student's responses was the impression of students during the learning process. Student responses data were obtained from a questionnaire that was distributed to all students in X IPA 6 which had been taught problem-based learning. Most students (86%) gave a positive response to learning using problem based learning for enhancing problem solving ability. (Table 5).

Tabel 5. Percentage of student's responses toward problem based learning

No	Criteria	Percentage (%)
1	Problem based learning was interesting	93
2	Problem based learning made students easier to identify the ecosystem component	90
3	Problem based learning made students easier to analyze interactions between components in ecosystem	93
4	Problem based learning made students easier to find trophic level of an organism based on its role in an ecosystem	87
5	Problem based learning made students easier to analyze carbon cycle	57
6	Problem based learning made students easier to identify problem	97
7	Problem based learning made students easier to formulate problem	67
8	Problem based learning made students easier to determine hypothesis	70
9	Problem based learning made students easier to design and arrangge experimental or observational procedures to determine how to solve problems	97
10	Problem based learning made students easier to analyze data	93
11	Problem based learning made students easier to make conclusion	93
12	Problem based learning made students easier to determine the appropriate way in of solution of the problem	93
13	Problem based learning made students easier to work in group	90
14	Problem based learning made students to be more active when learning	90
Total Average (%)		86

The result of pretest before applying problem-based learning showed that students have not mastered problem solving ability. Problem based learning is basically learning to use scientific methods in order to solve problems rationally, straightforwardly, and completely (Kusstianti, et al., 2014). Using scientific methods at the same time also train students to solve problems because of indicators of problem solving ability in accordance with the scientific method's step.

Students can not solve problem because they didn't use scientific methods optimally when science learning. In accordance with the statement of Shofiyah

(2016) which states that some schools, especially in schools that has not natural science laboratory facilities completely, when science learning has not been done optimally because teacher still teach by conventional model, so that teacher explain science just as a product and students must memorize factual information from teacher. Implementation of the scientific method that is not optimal will affect the initial ability of students to solve problems. This can occur because the way the packaging of learning experiences designed by the teacher is very influential on the meaningful experience for students (Listyawati, 2012).

According to Handayani and Sopandi (2016) the prior knowledge of students will affect the success of students in solving problems to help students construct knowledge independently through the experience gained when trying to solve problems. Thus, students who do not have the prior knowledge to solve problems will have difficulty resolving problems when facing a problem.

However, based on the percentage of student's problem solving ability each indicator showed that 93% of students can solve problems on indicators identify problems. From these results it can be seen that before applying problem-based learning, most students have been able to analyze a phenomenon of problems in daily life. In contrast to the other two indicators were formulating problem and determining hypothesis. In both indicators, none of the students completed it. According to Winarno (2013) the good formulate problem is the relationship between the research variables.

Before applying problem-based learning, students cannot determine the experiment variables because students did not have prior knowledge about the types of experiment variables. So that students was difficult to formulate the problem. According to Hevriansyah and Megawanti (2016) prior knowledge is a set of knowledge that is already possessed by students. Students who do not have prior knowledge about a material do not know the concept of the material. Students who is not mastering a concept will be difficult to solve problems related to the concept (Islam, et al., 2019).

At the time of learning activities students were divided into groups that were determined by the teacher. Work & Mauffette (2018) state that in a learning environment a problem-based learning model, students in large groups are generally divided into small groups consisting of 6-14 groups. Students are divided into several groups heterogeneously according to their respective abilities, so there is a spread of the level of student ability in each group (Arief et al., 2016). According to Amir (2010) the formation of groups in problem-based learning models aims to make students work together to find solutions to a given problem.

When problem-based learning activities, students were trained to solve problems in accordance with indicators of the problem solving ability including identify problems, formulate problems, determine hypotheses, design and arrangge experimental or observational procedures to determine how to solve problems, analyze data, make conclusions and determine the appropriate way in of solutions of problem. Indicators of the problem solving ability can be trained to students during learning activities because those indicators is accordance with problem-based learning syntax.

According to Nur (2011) on the syntax of problem-based learning, including the phase of orienting problem to students, teacher presents an authentic problem then students identify problem. In phase of guiding individual and group investigations, teacher encourages students to collect appropriate information, conduct experiments, and look for explanations and solutions to the problems being investigated (Arends, 2011). In the investigation phase, teacher facilitates students (guiding if needed) in group when formulating problems and hypotheses, planning experiments to test hypotheses, carrying out investigations, recording data, analyzing data and making conclusions (Suyono, 2007).

Based on observations of problem based learning implementation, when the phase of training students to solve problems in accordance with indicators of problem solving ability contained in the problem orientation phase and guide individual and group investigations have done at the first meeting, second meeting and third meeting. Thus, when problem-based learning activities students have been told and trained to solve problems in accordance with indicators of problem solving ability.

Then a post-test was conducted to determine the master level of student's problem solving ability after applying problem-based learning. Based on the result of posttest showed that 80% of students achieved mastery level of student's problems solving ability. The percentage of mastery level of student's problems solving ability increased from 0% to 80%. 24 students have mastered problem solving ability and 6 students have not yet mastered. The results of students' problem solving ability percentage in each indicator also increased.

According to behaviorism learning theory, students will respond when given a stimulus and when a stimulus is given repeatedly can cause changes in learning outcomes (Nahar, 2016). So when students are trained to solve problems changes in learning outcomes can not be able to solve problems. There are differences in the ability to solve problems among students because the level of understanding of each student is different. This is in accordance with the statement Kubat (2018) which states that every student has a difference, one of which is intelligence and the ability to think.

In addition, the application of problem-based learning also aims train students to solve problems. Ngalimun (2017) states that problem-based learning involves students to solve a problem through the stages of the scientific method so that students can learn knowledge related to the problem while having the skills to solve problems systematically and planned. Problem-

based learning is designed to help students solve problems effectively (Padmavathy & Mareesh, 2013).

Problem-based learning's problem is open problems so that students and teachers have the opportunity to develop the possibility of problem solving (Sanjaya, 2011). This can enable students to be more active and expand their knowledge by using various sources of information from textbooks and by discussing with peers so as to enable students to integrate knowledge across disciplines and various approaches to problem solving (Beachey, 2007). Problem-based learning begins by proposing authentic problems as a context that will encourage students to gather information and data to solve problems, think critically and gain knowledge and learn to make decisions (Bashith and Amin, 2017).

When the learning process , students learn to discuss discussing the resolution of problems that exist in everyday life by analyzing the problem first then providing a solution to the problem (Ramanhilho, 2016). So that the application of problem-based learning can improve students' problem solving abilities (Kadir et al., 2016). Yadav, et al. (2011) also states that problem-based learning can direct students to have the ability to solve higher problems and increase students' factual knowledge.

The phase of students show their work in the group has not been implementation because of time constraints and it can be replaced with discussions classically by the teacher or an exhibition can be held at the last meeting specifically for students to showcase their work. Open-ended problems in problem-based learning require more time for students to conduct research, discuss and find various sources of information to solve problems (Duch et al., 2001).

In addition, teacher cannot regulate conditions of learning when experiment or observation, so that the time used was longer at that stage. According to Agus (2006) to achieve learning objectives, teachers must be able to regulate and control learning conditions. Structuring the learning environment can also affect the level of student involvement and participation in the learning process (Winaputra, 2003). Silalahi (2008) also states that classroom climate (environment) influences learning motivation. So that the creation of a conducive learning atmosphere can determine the success of the teaching and learning process (Sari, 2013).

Student responses were measured using a questionnaire response sheet. Students provide responses related to the ease or difficulty when working on the posttest in accordance with the indicators tested after the implementation of problem-based learning activities. Based on students' response data shows that the percentage of positive responses of students in accordance with the percentage of achievement in each indicator.

As the indicator of analyze the process that occurs in the carbon cycle showed that only 65% of students have been mastered. The achievement was same with student's responses in these indicator. Only 57% of students who respond to these indicators were also easy. In addition, the indicators of analyzing data, based on the achievement of the indicators show that 90% of student have mastered and students who respond to these indicators easily also 93%. This shows that students can evaluate and believe in their abilities. In accordance with the statement of Akinoglu and Ruhan (2007) which states that the problem-based learning model can increase self-confidence and can raise the ability of students to express themselves.

Based on Table 5, the average positive response of students to problem based learning was 86%. Learning was more fun because students actively conducted investigations to solve problems rather than konvensional methods that make students passive. This is in accordance with the statement of Mintasih (2016) which states that a fun learning strategy can be applied appropriately if educators understand the needs and desires of students. A fun, flexible and inspiring learning atmosphere can make learning activities more meaningful and the activities and creativity undertaken by students can be optimally achieved (Ruhimat, 2009). In addition, enjoyable learning can also increase students' learning motivation (Sanjaya, 2011). According to Nurmala, et al (2014) learning motivation will encourage students' learning enthusiasm, if the motivation to learn is high then the desire to learn is also high, so that it can affect learning outcomes.

CONCLUSSIONS

Problem-based learning based on the implementation of the Learning Implementation Plan (RPP) was categorized to be implemented very well.

Students who have been taught problem-based learning can achieve mastery level of problem solving ability. Students who have mastered problem solving ability has increased.

Problem-based learning got a very good response from students. Students were more motivated in learning because learning was fun.

SUGGESTION

We manage the duration of study well, especially during practical work. This is done so that all learning activities take place effectively. We will use interesting learning media so that learning is not monotonous. At the last meeting, we will also make a special exhibition for students so students present their work on each topic.

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