

The Implementation of Problem Based Learning Model on Science Problem Solving Ability of Elementary School Students

Rahmani^{1*}, Mahyana²

^{1,2}Faculty of Teacher Training and Education, Universitas Serambi Mekkah, Aceh, Indonesia

*Corresponding Author: rahmani@serambimekkah.ac.id

Abstract

This study aims to describe students' science problem solving abilities after the application of the Problem Based Learning model. The hypothesis formulated in this research is the implementation of Problem Based Learning (PBL) learning model can improve the science problem solving ability of elementary school students. The approach used in this research is a quantitative approach. The type of research used in this study is a quasi-experimental research. The research design used in this study is one group pretest posttest design. The population of this study was all high-class students at SD Negeri 5 Banda Aceh for the 2020/2021 academic year, totaling 170 students. The sampling technique used was random sampling. Based on the results of the lottery, the samples used were students of class IV-B, totaling 16 boys and 10 girls. Data collection techniques in this study used tests in the form of pretest and posttest. Data analysis technique used was N-Gain. Based on the data analysis, the average pretest and posttest values were 35.54 and 73, respectively, with an N-Gain of 0.59 in the "medium" category, indicating that the implementation of Problem Based Learning (PBL) learning models can improve the science problem solving abilities of elementary school students.

Keywords: *Implementation, Problem based learning model and problem solving ability.*

1. Introduction

Problem solving ability is one of the essential abilities that students must have because in everyday life, everyone is constantly faced with various problems that must be solved and require creativity to be able to find solutions to the problems they face (Permatasari, 2014). Problem solving skills train students to find various concepts holistic, meaningful, authentic and applicable (Hariawan, 2014). Gok and Silay (2010) stated that problem solving ability is seen as very fundamental in science learning. Science (IPA) is a branch of science that studies the regularities of nature, mastering knowledge, facts, concepts, principles, discovery processes and scientific attitudes (Gunawan et al, 2015). Learning science does not only understand concepts, but emphasizes students' thinking patterns to be able to master and solve problems critically, logically, carefully and thoroughly (Darwanti, 2013). Problem solving ability is a very important part of science learning. Problem solving activities require students to find their own concepts in learning so that the learning process is more meaningful.

Mariawan (2013) also states that problem solving ability is an important aspect of science learning, because problem solving is used to teach students to apply scientific knowledge and skills acquired in learning. Problem solving skills provide direct experience to students to increase students' proficiency in constructing, understanding and applying concepts that students have learned. Based on this issue, if in the science learning process, students are accustomed to developing higher-order thinking skills, so that the students' science problem solving abilities will be better.

The reality that occurs in the field is that students still have difficulty determining and solving the problems they experience related to science learning materials. This is because there are still many students who only memorize concepts and are less able to use the ideas if they find problems in their lives related to the concepts they have, even students are less able to determine the issues and formulate them (Trianto, 2009). In addition, the low problem-

solving ability of students is also evidenced by the low scores obtained by Indonesian students in taking the TIMSS (Trends International Mathematics and Science) test. Based on the results of the TIMSS research which measures the level of student knowledge those are from just knowing facts, concepts and using them to solve simple problems to problems that require high reasoning.

The results of the TIMSS research in 2011, the score obtained by Indonesia is 406 which is the smallest score number five, while in 2015 Indonesia received a score of 397 which is the smallest number four of 64 countries. The score obtained puts Indonesia in the Low Science Benchmark predicate (Martin., et al, 2015). Based on the predicate obtained by Indonesia in the 2011 and 2015 TIMSS, Indonesian students only had some basic knowledge of biology, chemistry, physics and science. Students had not demonstrate and convey knowledge of biology, chemistry, physics and science in various contexts. Students were also less able to communicate and explain concepts related to biology, chemistry, physics and science in everyday life both practically, abstractly and experimentally.

The low problem solving ability of students in science lessons is caused by many factors. Factors that can trigger low student problem solving abilities might come from within students (internal) and might come from the environment (external). Internal factors that can affect students' problem solving abilities such as attitudes, talents, interests and self-motivation of students are still lacking, while external factors that can cause students' low problem solving abilities are the role of educators (teachers).

The teacher's role that can affect students' problem solving abilities is the teacher's inaccuracy in choosing the learning model used during the learning process in the classroom. The learning model that teachers often use during learning is the STAD type cooperative learning model. The STAD type cooperative learning model is a learning model that has been implemented student centered (Harjono in Amalia, 2016). The weaknesses of the STAD type cooperative learning model are that it takes longer for students to reach the curriculum, requires special abilities of teachers so that not all teachers can do cooperative learning, and demands certain characteristics from students, such as cooperative nature (Budairi in Solihah, 2016). This is in accordance with the results of research conducted by Chrisna and Surya (2017) which states that the STAD type cooperative learning model has weaknesses in improving students' problem solving abilities.

The solution to follow up on this problem is to apply a learning model that is able to actively involve students and contribute to the learning process in the classroom so that students' science problem solving abilities are further improved and the learning process is more meaningful. One of the innovative models that can improve students' problem solving skills is the problem based learning (PBL) model. The PBL model has five components: student orientation to problems, organizing students to learn, guiding investigating individuals or groups, developing and presenting work and analyzing and evaluating problem solving processes. The advantage of the PBL model is that it is one of the models that can bridge the gap between students' daily reality and what happens in the classroom (Delisle in Upayoga, 2013). The PBL model can also generate interest in learning and build students' intellectual abilities. Hastin (in Astika, 2013) revealed that PBL can improve students' understanding of the material being studied, problem-solving skills, and skills in applying concepts. Wheeler (in Astika, 2013) suggests that PBL can train students' higher-order thinking skills, with the application of the PBL model, students' memory of learning becomes more permanent because students find the answers to the problems they have.

Based on the background, the researcher desires to implement PBL in Theme 8 class IV-B till this research is entitled "Implementation of Problem Based Learning Models on Science Problem Solving Ability of Elementary School Students". As for the formulation of the problem in this study, how is the problem-solving ability of elementary school students'

science through Problem Based Learning? The objective to be achieved in this study is describing the ability to solve science problems of elementary school students after the implementation of the Problem Based Learning model. The hypothesis formulated in this research is the implementation of Problem Based Learning (PBL) learning model can improve the science problem solving ability of elementary school students.

2. Method

The approach used in this research is a quantitative approach. Quantitative approach is used to see students' science problem solving ability. The type of the research in this study was a quasi-experimental research; the research design used in this study was a one group pretest posttest design. This research was conducted at SD Negeri 5 Banda Aceh, Aceh province, which was carried out in the second semester from April to June of the 2020/2021 Academic Year.

The research population in this study was all high-class students at SD Negeri 5 Banda Aceh for the 2020/2021 academic year, totaling 170 students. The sampling technique used was random sampling. Based on the results of the lottery, the samples used were students of class IV-B, totaling 16 boys and 10 girls. The data in this study were collected using tests in the form of pretest and posttest to measure students' science problem solving abilities. Furthermore, the data on the science problem solving ability of grade IV-B students before and after the use of PBL and the magnitude of the increase was determined using the gain index (Meltzer, 2002) as follows:

$$\langle g \rangle = \frac{\text{posttestscore} - \text{pretestscore}}{\text{maximumscore} - \text{pretestscore}}$$

The gain index $\langle g \rangle$ obtained from the calculation results with the above formula is interpreted as presented in Table 1 (Meltzer, 2002) as follows:

Table 1. N-Gain Criteria

Gain Index	Interpretation
$g > 0.70$	High
$0.30 < g < 0.70$	Medium
$g \leq 0.30$	Low

3. Results and Discussions

The results of the students' pretest and posttest were analyzed using the N-Gain test to determine the improvement of each individual's problem solving ability and described in Table 2 below:

Table 2. N-Gain Analysis Test Result

No	Students Name	Pretest Score	Posttest Score	N-Gain	Category
1	Student 1	40	73	0,55	Medium
2	Student 2	33	87	0,81	High
3	Student 3	27	87	0,82	High
4	Student 4	33	60	0,40	Medium
5	Student 5	27	80	0,73	High
6	Student 6	27	73	0,63	Medium
7	Student 7	47	87	0,75	High
8	Student 8	47	80	0,62	Medium

9	Student 9	27	67	0,55	Medium
10	Student 10	47	73	0,49	Medium
11	Student 11	33	53	0,30	Low
12	Student 12	47	73	0,49	Medium
13	Student 13	20	60	0,50	Medium
14	Student 14	47	87	0,75	High
15	Student 15	33	53	0,30	Low
16	Student 16	27	87	0,82	High
17	Student 17	33	40	0,10	Low
18	Student 18	27	73	0,63	Medium
19	Student 19	27	73	0,63	Medium
20	Student 20	47	73	0,49	Medium
21	Student 21	47	93	0,87	High
22	Student 22	47	93	0,87	High
23	Student 23	20	73	0,66	Medium
24	Student 24	27	47	0,27	Low
25	Student 25	47	87	0,75	High
26	Student 26	40	67	0,45	Medium
Average Score		35,54	73	0,59	Medium

The increase in the N-Gain category of each student varies because the results of the pretest and posttest obtained are also different. There are 4 students who get an increase in the "low" category, 13 students get an increase in the "medium" category, and 9 students get an increase in the "high" category. The average pretest and posttest values obtained were 35.54 and 73, respectively. While the increase of average N-Gain was 0.59 in the "medium" category.

In table 2, the improvement of problem solving ability after learning can be seen based on the pretest and posttest scores obtained. Overall, 26 students experienced an increase in their problem-solving ability in various categories. This is because the cognitive abilities of each individual are different so that students need time, guidance and direction to master the concept and cause different N-Gain gains for each student (Triyuni, 2016).

For students with an increase in solving ability in the high category, it was found that initially the pretest score was still low, but with continuous problem solving skills training, the final assessment in the form of a posttest increased in value to exceed the KKM. This is in accordance with the opinion of Slavin (2011) which states that the important role, repetition, and exercises taught in learning have a high probability of being retained in long-term memory.

The improvement in problem-solving abilities in the medium category obtained by some students in one class is still not evenly distributed when viewed from the completeness of the KKM. Although the increase is in the moderate category, there were still students who have not reached the minimum KKM limit of 70. In addition, there were some students who experience an increase in problem-solving skills in the low category. There are several factors that influence this, namely in the form of attitudes towards learning, learning motivation, learning concentration, time available for learning, and saving learning gains (Hamiyah, 2014).

Based on the N-Gain test, it can be concluded that the problem-solving ability increased in all students with an average N-Gain score of 0.59 and was categorized as moderate. The pretest and posttest scores obtained by students were 35.54 and 73, respectively. If viewed from the school's KKM score of 70, the average posttest score obtained was complete. Students are able to understand facts and concepts in science learning

and are able to increase student activities and learning outcomes through problem solving steps (Trna, Josef et. al., 2012). The orientation of social skills such as problem solving is important in science learning. Attitude is one aspect that cannot be ignored in science learning. Attitude aspects need to be instilled in the mind so that students become superior human resources, enabling them to adapt in intellectual, emotional, and spiritual aspects, and enabling them to increase their intellectual potential optimally and evenly (Widowati, 2017).

The improvement of problem solving ability can be seen from the completeness of each indicator of problem solving ability which is presented in Table 3 below:

Tabel 3.Improvement of Every Indicator of Problem Solving Ability

Indikator	Pretest Percentage	Posttest Percentage	Gain	N-Gain Percentage	Category
Understanding the problem	33,65	73,08	39,43	0,59	Medium
Developing a problem-solving plan	34,62	71,15	36,53	0,56	Medium
Implementing a problem solving plan	30,77	72,12	41,35	0,60	Medium
Re-examining the results obtained.	44,87	76,92	32,05	0,58	Medium

In this study, there were 4 indicators of problem-solving skills that were trained including understanding the problem, developing a problem-solving plan, implementing a problem-solving plan, and re-examining the results obtained. After being trained in problem-solving skills, there was an increase in the moderate category for each indicator, both in the indicators of understanding the problem, compiling a problem-solving plan, implementing a problem-solving plan and re-examining the results obtained.

In table 3, the indicator of understanding the problem has increased in the medium category. Based on the 4 problem-solving indicators that were measured, the indicator of understanding the problem obtained an increase in the medium category. However, in this indicator students were still not used to carrying out learning activities using problem solving procedures. In addition, the indicator of understanding the problem is the first procedure in problem solving; the teacher needs to explain in more detail so that a strong foundation of thinking is built so that students are able to pass the next stage more easily. This causes the teacher to take a long time to pass the indicators to understand the problem.

In the indicator of developing a problem-solving plan, there was an increase in the medium category by obtaining the results of the pretest percentage of 34.62% and posttest of 71.15%. Based on the 4 problem solving indicators that were measured, the indicators for developing a problem solving plan obtained an increase with the smallest value with an N-Gain of 0.56. This is because students do not understand and have not been trained in the steps to develop a problem-solving plan. In learning the teacher needs to guide students in making plans, this is done repeatedly so that experiences are formed in the minds of students. The teacher provides guidance to students during the early stages of learning in the form of instructions, motivations, warnings, describing the problem into solving steps, giving examples, and other actions that aim to make students learn independently, then the guidance is reduced gradually and students are given the opportunity to carry out greater responsibilities after they can do it (Slavin, 2011).

The indicator of implementing the problem solving plan obtained an increase in the medium category. Based on the 4 problem-solving indicators measured, the indicator of implementing the problem-solving plan obtained an increase with the highest N-Gain value of 0.60. This is in line with the results of observations of problem solving abilities in the learning process which show very good criteria. Student activities also show that students are very enthusiastic in trying every new thing for them and students also do not hesitate to ask questions if they feel that there is material that has not been understood during science learning. Good student activities in learning support students to build their knowledge and help thinking to be more logical. This is in accordance with Piaget's opinion which views that most of a child's cognitive development depends on how actively children build understanding through experience and interaction with their environment (Nur, 2008). In addition, in carrying out an investigation, students will gain experience so that they can find the concept of learning through themselves (Al-Tabany, 2014).

The indicator of re-examining the results obtained has increased in the medium category. This is in accordance with the results of the observation of problem-solving abilities in the learning process by applying the PBL model. Learning is carried out as interesting as possible so that students are enthusiastic and not easily bored, students also take part in learning activities according to the steps guided by the teacher, but the ability of students to re-examine the results obtained is still lacking. This is because students are not accustomed to applying problem-solving indicators to solve a given phenomenon/problem. Problem solving skills are needed to train students to get used to dealing with various problems in their increasingly complex lives. Due to this, problem solving skills need to be continuously trained so that students are able to solve the problems they will face in the future (Fadillah, 2009). Problem solving skills can be trained through the habit of giving students problems that cannot be immediately imagined, but require deep thinking to find a way out of these problems (Rosmawati, 2012). Problem solving activities in learning encourage creative thinking by directing students to develop new scientific knowledge by helping them find relationships between variables and generate scientific ideas in relation to a concept and a number of solutions to certain problems (Mukhopadhyay, 2013).

Problem solving skills should be taught to students from an early age. Problem solving is a series of learning activities centered on procedures for solving problems faced scientifically (Komariah, 2011). Problem solving will improve students' ability to reorganize their previous scientific knowledge and help to incorporate students' knowledge efficiently into long-term memory (Cheng, 2017). Students' scientific understanding is supported through expanding habitual thoughts and using problem solving abilities. Students make connections with their new knowledge by using prior knowledge (Maxwell, 2015). The importance of developing problem-solving skills can be achieved by being integrated in all subjects and explicitly allocating time if the time provided is still lacking (Rufaida, 2013). The task and role of the teacher is not only as a provider of information, but also as a driver in learning so that students can construct knowledge through activities that guide their active role (Nurita, 2017).

4. Conclusions

Conclusions can be put forward based on the results of research data and discussions that are described based on the results of the average pretest and posttest scores of 35.54 and 73, respectively, with an N-Gain of 0.59 in the "medium" category, thus indicating that the implementation of the learning model Problem Based Learning (PBL) can improve the science problem solving ability of elementary school students.

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