The effect of learning methods and self regulation on problem-solving ability of mathematics in elementary school

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Abstract: This study aims to determine the effect of learning methods and self-regulation on the ability of solving mathematical problems in primary schools. This research was conducted by grade V students of Mempawah District, West Kalimantan Province, Indonesia. Research sampling technique using cluster random sampling. The data were collected through the test and analyzed using two-way analysis of Variance (ANOVA) with the treatment design by level 2 x 2. The result of the research showed that students' math problem-solving skills were taught using higher learning method than the students taught using an expository method. the influence of interaction between learning method and self-regulation to the ability of problem-solving mathematically.

1. Introduction
Mathematical science is the basic science that supports other science in its application, therefore, understanding mathematics correctly will have implications for the ability in considering some science related to mathematics [1], [2]. One of the goals of learning mathematics for students is that he has the ability or skills in solving problems or math problems, as a means for him to hone logical, logical, critical, and creative reasoning. Therefore, problem-solving skills become the focus of mathematics learning at all levels, especially in primary school [3], [4].

One of the factors that can influence the ability to solve mathematical problems is the attitude of self-regulating in learning mathematics. According to Juter students' positive attitudes toward mathematics affect the ability of students to solve mathematical problems successfully. Other factors that influence the ability to solve mathematical problems is related to the ability of self-regulating [5]–[7][8]. The ability of self-regulation is also called the term regulation self–has an impact on students to achieve learning objectives [9] [7], according to Zimmerman [10], said that self-regulation in learning as the basis of the success of learning, solving problems and academic success in general. In addition, self-regulation is also one important factor in shaping students' attitudes toward mathematics learning.

In addition to the ability of students in managing their success in learning, mathematics is also supported by the application of appropriate learning methods. The appropriate learning method is student-centered learning [11], [12]. The role of teachers in learning activities is as a facilitator in which, teachers facilitate the process of learning in the classroom. Innovative learning with student-centered
methods has a diversity of learning methods that demand the active participation of students. This method revolves around giving lectures, questions and answers, discussions, and assignments [13], [14].

This research will test four hypothesis that is (1) to know whether there is difference of problem-solving ability of mathematics between student studying by using method of Learning Method While Playing and student learning by using Expository Method. (2) to know whether there is influence of interaction between learning method and self-regulation learning towards math problem-solving skills. (3) knowing groups of students who have high self-regulation, students' math problem-solving skills that learn to use Learning Method While Playing is higher than students who learn to use Expository Method. (3) knowing groups of students who have low self-regulation, the ability of problem-solving of students who learn to learn using Learning Method While Playing lower than students who learn to use Method Ekspositori.

2. Literature Review

2.1. Learning Methods While Playing

The method of learning while playing by barr [15] becomes an indispensable activity in everyday human life, playing is a major activity that develops along with talking, physical growth, and connecting with others. Playing cannot be separated from children, because in addition to meeting the needs of play can also increase or enrich the experience of children. with the wishes of children playing, parents or educators can use it for students can interact well with others as well as for physical growth, through play activities students can develop the potential it has [16].

Briggs and Davis [17] define play as a creative activity for children that allows them to explore their surroundings and make the world around them make sense to them. This opinion explains that learning by exploring the surrounding environment makes it easy for children to absorb the material provided. Children will be sensitive to the environment where students often interact with the learning process while playing. The experience that can be through the process of playing also develops student piker patterns become more mature.

2.2. Expository Method

The expository teaching method is a teaching method that emphasizes the process of verbal material delivery from a teacher to a group of students with the intention that students can master the subject matter optimally. This means that the role of teachers is still dominant in the learning process. However, it does not mean passive students in receiving the submitted material. There is a question and answer process between teacher and student, then continued by taking notes [18].

The expository method (story) is the way of delivering the subject matter of a teacher to the students in the class by speaking at the beginning of the lesson, explaining the material and sample questions with questions and answers [19]. This means that the main teacher activity is explained and the students listen or record what the teacher says. This process is more time-saving because the teacher conveys the material optimally. When students have not understood the certain material, students can directly ask the teacher without waiting until the end of the teacher concludes the materi [20]

3. Method

This study aims to determine the effect of learning methods and self-regulation of the ability to solve mathematical problems. This research was conducted in elementary school students of grade V district under the province of West Kalimantan, Indonesia. Research sampling technique using cluster random sampling. Data collection was carried out through tests and analyzed using two-way Variance Analysis (ANOVA) with a design of 2 x 2 level treatments. The instruments used in this study were questionnaires and tests. For the instrument of mathematical problem-solving ability using an instrument developed by Fahrudin.

4. Results and Discussion

The results of the calculation of ANOVA Two Way, namely:
Tabel 1. ANOVA Two Paths of Mathematical Solving Ability

| Source Varians | db | J Square | RJK | Fh=Rk/RkD | F\text{table} | 5% | 1% |
|----------------|----|----------|-----|-----------|---------------|-----|-----|
| Between A      | 1  | 2070.25  | 2070.25 | 55.069    | 4.20          | 7.64|
| Between B      | 1  | 529.00   | 529.00  | 14.071    | 4.20          | 7.64|
| Interaction    | 1  | 6440.06  | 6440.06 | 171.307   | 4.20          | 7.64|
| In             | 60 | 2255.63  | 37.59  |           |               |     |
| Total reduction| 63 | 11294.94 |        |           |               |     |

Based on the count of two-way ANOVA calculations in the Table above we can conclude the test results from the first hypothesis and the second hypothesis as follows:

4.1. The first hypothesis is to find out whether there are differences in problem-solving skills of mathematics between students who learn by using the method of Learning Method While Playing and students who learn by using the Method of Expository. The null hypothesis (H₀) which states that the problem-solving ability of mathematics between groups of students who learn by learning method while playing is not different from expository method, is rejected because F-count > F-table (α 0.05) is 55.069 > 4.20 or F-count > F-table (α 0.01) That is 55.069 > 7.64. This means that the problem-solving ability of mathematics students who learn with learning methods while playing better than the students who learn with expository methods.

In this study found that there are differences in the ability of problem-solving mathematics between students who learn by using the Method of Learning While Playing and students who learn by using the Expository Method. Math problem-solving skills of students who learn by the method of Learning Method While Playing is higher than Expository Method. Briggs and Davis [17] define play as a creative activity for children that allows them to explore their surroundings and make the world around them make sense to them. This opinion explains that learning by exploring the surrounding environment makes it easy for children to absorb the material provided.

4.2. The second Hypothesis is to find out whether there is an interaction effect between learning methods and self-regulation learning to the ability of problem-solving mathematics. Hypothesis zero (H₀) which states that there is interaction between learning methods with self-regulation students rejected, because F-count > F-table (α 0.05) that is 171.307 > 4.20 or F-count > F-table (α 0.01) that is 171.307 > 7.64 so it can be concluded that there is a significant interaction between the method of learning with student self-regulation. to the ability to solve mathematical problems. The following forms of interaction between learning methods with self-regulation of students to the ability of math problem solving can be seen in the following figure:

Figure 1. Graph of Interaction between Learning Method and Self-regulation

Based on the picture of the interaction between the method of learning and self-regulation is known that the ability of problem-solving mathematics of students who learn with learning method of play
while higher than students who learn by the expository method. In the group of students who have high regulation and learning by learning method while playing the problem-solving ability of mathematics is higher than students who learn by the expository method. As for the group of students who have low self-regulation and learning with learning methods while playing problem-solving skills mathematics lower than students who learn with expository methods. The existence of the average mathematical problem-solving ability in each of these treatment groups makes the interaction effect.

Tested significantly the interaction between learning methods to the ability to solve mathematical problems in terms of self-regulation of students, the next is to conduct further tests. Since the number of subjects in the cell (group) is the same, the further test used is the Tukey test. This analysis is used to test the difference of absolute mean values of two groups paired by comparing the critical value of Tukey number can be tested the hypothesis can be seen in the following table:

| Compared groups | Average Difference | Table Prices | Conclusion |
|-----------------|--------------------|--------------|------------|
| A1B1 - A2B1     | 20.51              | 4.04         | Significant |
| A1B2 - A2B2     | 5.67               | 4.04         | Significant |

4.3. The third Hypothesis, to know the group of students who have high self-regulation, the ability problem-solving mathematics students who learn to use Learning Methods While Playing higher than students who learn to use the Method of Expository

Testing the third hypothesis \((A1_B1 > A2_B1)\), \(t\) arithmetic for groups A1B1 and A2B1 greater than \(t\) table or 20.51 > 4.04 at \(\alpha = 0.05\). It means \(H_0\) is rejected and accepts \(H_1\). Thus the third hypothesis which states that the ability to solve mathematical problems for students who have high regulation and learn to use methods of learning methods while playing better than the students who learn to use the Expository Method, received significantly.

Testing of the third hypothesis shows that the ability to solve mathematical problems for students who have high self-regulation who learn to use methods of learning methods while playing higher than students who learn to use expository methods significantly. Self-regulation has an important role to play in encouraging learning. A person who has a high self-regulation will perform activities optimally otherwise if someone has low regulation will perform activities less than optimal. Therefore, students who have the highest high regulation are suitable to use a learning method while playing [21].

4.4. The fourth hypothesis to know the group of students who have low self-regulation, the ability solving problems of students who learn to learn using Learning Methods While Playing is lower than students who learn to use the Method of Expository

Testing of the fourth hypothesis \((A1B2 < A2B2)\), \(t\) arithmetic for group A1B2 and A2B2 is smaller than \(t\) - table or 5.67 > 4.04 at \(\alpha = 0.05\). Meaning \(H_0\) is rejected and \(H_1\) accepted. Thus the fourth hypothesis which states that the learning outcomes of mathematical problem-solving skills for students who have low regulation and learn to use learning methods while playing lower than students who learn to use expository methods, received significantly.

Testing the fourth hypothesis shows that students who have low self-regulation, This is because students who have low self-regulation they do not have the desire and a strong impetus in solving problems that are facing, and less interested in a challenge. The use of expository methods is a method in which there are lectures and discussions. While the method of playing while learning more about the practice in which there is a challenge to solve which students who have low self-regulation learning less like a challenge [22].

5. Conclusion
Learning methods and self-regulation of students to the ability of thinking. This means that the use of learning methods while playing and expository methods have an effective effect on the ability of
problem solving depends on the level of student self-regulation. So every student has different levels of regulation. Improved math-problem-solving skills of a student who has high self-regulation they are more likely to be successful in learning challenges.

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