PROBLEM SOLVING PROCESS BASED ON THE NEWMAN PROCEDURE IN AN EFFORT TO INCREASE STUDENTS' REVERSIBLE THINKING

Fatima

1Tarbiyah Faculty Mathematics Education
IAIN Parepare
E-mail: fatimahsunusi1@gmail.com

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ABSTRACT

Students' low Reversible Thinking and mathematical problem solving abilities, especially in working on mathematical problems in the form of stories. This research aims to determine and describe the increase in Reversible Thinking and problem solving abilities in mathematics problems in the form of stories after implementing the Newman Procedure in the learning and problem solving process. This type of research is the Kemmis and Taggart model of Class Action Research (PTK) which consists of 4 stages, namely planning, implementation, observation and reflection. This research was conducted in two cycles. Data collection techniques in this research are observation, tests, and documentation. The data analysis technique used is qualitative analysis to describe research results through observation and quantitative analysis techniques to analyze test assessment scores. The results of this research show an increase in students' reversible thinking abilities seen from changes in attitudes and behavior, seen from the ability to read questions quickly and clearly, able to understand the information contained in the reading, easy to transform information into mathematical language, confident to work on questions and able to take responsibility for the answers obtained.

Keywords: Solution to problem; Newman Procedure; Reversible Thinking

INTRODUCTION

Alternative education is a learning system that is not always identical to school or formal education. Mathematics has an important role in the development of education. As a basic science, mathematics can be widely applied in various areas of life. Mathematics is part of the education system which has a very important role in the development of science, thus making mathematics a basic science studied by students from elementary school (SD) to tertiary level (Perti). Mathematics is a subject that must be studied at every level of education, this is what makes mathematics a subject that must be understood and mastered by students at every level of education. In reality, mathematics learning in schools aims to instill problem-solving skills and abilities in students, including the ability to understand concepts, design mathematical models, solve models, and interpret the necessary solutions. One of the goals of mathematics learning is to improve problem-solving abilities. Mathematics skills can be developed by training oneself to solve problems related to mathematics in everyday life which can be presented in the form of mathematics story problems. Story problems are problems related to problems in everyday life in the form of stories. Story problems can also help students to practice and think deductively and can improve students' understanding of mathematical concepts.
In solving mathematics problems, several thoughts and skills are needed, including: Ability to understand the problem, Ability to analyze, Ability to read comprehension, Ability to calculate, Ability to conclude, and Ability to think critically.

According to Newman, there are five mistakes that students make when working on mathematics problems: (1) reading errors, which occur because students misread the problem or read it incorrectly, so that they have difficulty or cannot solve the problem; (2) errors in understanding, which occur because students lack or do not understand the concepts contained in the questions, so they cannot solve the problem, errors in understanding occur because students do not understand the concepts contained in the questions; (3) transformation errors, which are caused by students not correctly converting the information in the problem into mathematical form; (4) process skills errors, which occur because students do not perform calculations correctly; (5) errors in writing answers, which occur because students are less careful or inaccurate in writing the final results.

According to Titi Satiti in her research, she revealed that students try to implement the Newman Procedure when working on mathematics problems. However, due to lack of familiarity, it often happens that steps are not carried out, and the results of Marta Sila's research found that almost all types of errors were made by the subjects, including errors in (1) reading (2) understanding (3) transforming (4) doing questions and ( 5) write down the answers, in different quantities. And in research conducted by Ilham Minggi which shows that based on the Newman Procedure error criteria, errors that occur in the problem solving process are not being able to write down what is known and what is asked, not being able to create mathematical models correctly, not being able to use procedures, making mistakes in uses arithmetic operations and is unable to conclude the final result.

METHOD

The research method that will be used is Classroom Action Research (PTK), which is an investigation that focuses on certain actions that are continuously evaluated and reflected on to improve their quality towards more optimal achievements. The action research model in question describes four steps, namely Plan, Action, Observation and Reflection. This classroom action research procedure was carried out in two cycles and four stages. The subjects in this research were students in class The sampling technique used was proportional sampling. The data collection techniques used are observation, tests and documentation. The data analysis technique used is qualitative analysis to describe research results through observation and quantitative analysis techniques to analyze test assessment scores. The indicators for the success of this research are based on Reversible Thinking and problem solving abilities that meet the target of an average KKM score of ≥ 76 with a percentage of students completing in one class ≥ 80%.

RESULTS AND DISCUSSION

Results

This classroom action research consists of 2 cycles, with each cycle consisting of 2 meetings. In each cycle, the first two meetings are used to provide theory or material, and in the second meeting an evaluation test is carried out. Cycle I begins with a meeting on Monday 15 January 2024, followed by a second meeting on Friday 19 January 2024, and the cycle I evaluation test is carried out on the same day. Cycle II begins with a meeting on Monday 22 January 2024, followed by a second meeting on Friday 26 January 2024, and the cycle II evaluation test is also carried out on the same day. In carrying out learning actions, the researcher acts as a teacher, while the Mathematics subject teacher for class XI.B, namely Hamzah, S.Pd., acts as an observer.

The results of cycle 1 field notes showed that there were still many students who did not understand the steps in working on the questions, due to a lack of focus and being in a hurry. Apart from that, the unequal distribution of group members based on cognitive abilities also makes it difficult for other
groups to solve problems. Another difficulty arises from the lack of regularity in group division, where students have difficulty finding their group members and arranging chairs and tables, which causes time to be wasted.

From the implementation of the second cycle of learning, it shows that it turns out that the Newman Procedure problem solving strategy in solving problems related to geometric transformation material, in the process of implementing the action has shown an improvement that has reached the good category and students are complete in learning, so the research is sufficient for the second cycle only. The following are several things that are taken into consideration for this research, it is sufficient to carry out it in 2 cycles:

1) It can be seen that there is an increase in active students in the class
2) From the research results, students' problem solving abilities have greatly improved
3) Students have started to be orderly and appear active in discussion activities
4) No learning stages in the RPP have been skipped.

Based on the results obtained from the actions carried out in cycle II, it can be explained that the application of the Newman Procedure strategy is very good because it can improve students' reversible thinking and mathematical problem solving abilities. From the implementation of cycle II learning, it shows that it turns out the Newman Procedure problem solving strategy In solving problems related to geometric transformation material, the process of implementing the action has shown improvement which has reached the good category and students are complete in learning, so research is sufficient for cycle II only.

<table>
<thead>
<tr>
<th>Observed aspects</th>
<th>Pre-action</th>
<th>Cycle I</th>
<th>Cycle II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class grade average</td>
<td>49.2</td>
<td>72.8</td>
<td>84.8</td>
</tr>
<tr>
<td>The highest score</td>
<td>80</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Lowest value</td>
<td>20</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Students who have KKM≥76</td>
<td>3</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>Students who do not have KKM &lt;76</td>
<td>22</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Percentage of students who have KKM≥76</td>
<td>12%</td>
<td>48%</td>
<td>88%</td>
</tr>
<tr>
<td>Percentage of students who do not have KKM &lt;76</td>
<td>88%</td>
<td>52%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Based on the research results, it was found that students' reversible thinking and mathematical problem solving abilities in geometric transformation material by applying the Newman Procedure problem solving strategy had increased. To see the increase in mathematical problem solving abilities based on indicators, you can see the following table:
Table 2. Increased Reversible Thinking ability

<table>
<thead>
<tr>
<th>Observed aspects</th>
<th>Percentage</th>
<th>Cycle I</th>
<th>Cycle II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
<td>P2</td>
<td>P1</td>
</tr>
<tr>
<td>Read</td>
<td>60%</td>
<td>76%</td>
<td>88%</td>
</tr>
<tr>
<td>Understand</td>
<td>58%</td>
<td>86%</td>
<td>92%</td>
</tr>
<tr>
<td>Transforming</td>
<td>78%</td>
<td>88%</td>
<td>92%</td>
</tr>
<tr>
<td>Doing the questions</td>
<td>86%</td>
<td>92%</td>
<td>96%</td>
</tr>
<tr>
<td>Write down the answer</td>
<td>64%</td>
<td>70%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Graph 1. Increased Reversible Thinking ability

Based on the graph above, the percentage of Reversible thinking and mathematical problem solving abilities at each meeting in each cycle seen from the problem solving ability indicators continues to increase due to good learning implementation. The results show an increase in Reversible Thinking abilities in students seen from the first indicator, namely reading quickly and clearly at the first meeting in cycle I, 60%, increasing at the second meeting in cycle II to 90%, then in the second indicator, namely understanding the problem at the first meeting in cycle I, 58% increased at the second meeting of cycle II to 94%, then at the third indicator, namely transforming information received into mathematical language at the first meeting of cycle I, 78% increased at the second meeting of cycle II to 94%, then at the fourth indicator, namely working on questions at the first meeting cycle I, 86% increased at the second meeting of cycle II to 100% and for the last indicator, namely writing answers at the first meeting of cycle I, 64% increased at the second meeting of cycle II to 90%.

Discussion

The application of the Newman Procedure strategy in geometric transformation material in class XI.B at SMAN 7 Pinrang can improve students' Reversible thinking and mathematical problem solving abilities. In the implementation of learning from cycle I to cycle II, the implementation of the Newman Procedure strategy steps has increasingly improved in working on questions in the form of story questions. The steps of the Newman Procedure are reading, understanding the problem,
transforming, working on questions, and writing answers. At the beginning of the learning implementation, there were still many students who were a little confused because the Newman Procedure strategy was implemented. But as time goes by, they start to get used to applying this strategy when working on questions. This is evidenced by the increase in the average score, percentage of learning completeness, and percentage of reversible thinking and mathematical problem solving abilities in each cycle. This increase was supported by the steps put forward by Anne Newman.

From the data above, it is proven that the application of the Newman Procedure in the learning process and working on questions can improve students' ability to solve mathematical problems in the form of story problems and Reversible Thinking abilities. This is in accordance with research by Aneu Pebrianti and Dadang Juandi which shows that problem solving abilities and Reversible Thinking abilities have a close relationship because they both involve critical thinking, flexibility of thinking, and the ability to overcome challenges. Reversible thinking is an important aspect in helping improve students' problem-solving abilities. This is also supported by the results of Siti Fatimatus Solihah's research which states that Reversible Mathematical Thinking Ability can help in strengthening students' mathematical problem solving abilities, because it involves the ability to think in reverse and reflect on the steps taken in solving mathematical problems. Several studies have shown that the application of methods such as the Newman Procedure, which involves analyzing student errors, can improve student learning outcomes in solving mathematical problems, especially in mathematical story problems.

CONCLUSIONS AND SUGGESTIONS

Based on the research results obtained by researchers, it can be concluded as follows:

1. The application of Newman's Procedure theory in the learning process and problem solving has 5 stages, namely 1) reading, students get used to reading quickly and clearly; 2) understand, students understand what information is given in the problem and what is the purpose of the problem given; 3) transform, students are asked to change the information they understand; 4) working on questions, students work on questions using relevant concepts or formulas; 5) write down the answers, students check again the steps they have taken when working on the questions by paying attention to the information they obtained previously so that the results obtained are in accordance with the question request.

2. The application of Newman's Procedure Theory in the learning process and working on questions in the form of story questions shows an increase in students' Reversible Thinking abilities. The improvements obtained from the development of students' reversible thinking abilities are starting from students who at first could only read quickly and unclearly can now read quickly and clearly, students who initially found it difficult to understand the meaning of the question, difficult to understand the information contained in the problem, finally they want to hone their critical thinking, students who initially had difficulty in transforming the information contained in the problem, finally easily converted the information into mathematical language, students who initially had no confidence in working on the problem and were pessimistic write down the final answer you get, finally have the courage to take responsibility for the results obtained. So it can be concluded that the results of the research found by researchers regarding the application of Newman's Procedure theory to improve students' problem solving abilities and Reversible Thinking abilities are based on changes in attitudes and learning outcome values which can be seen in the test results.

Based on the research results, the following suggestions can be stated:

1. Students are expected to be more motivated to work on story problems which can improve their Reversible Thinking abilities and analyze them using Newman's Procedure theory when working
on them.

2. Teachers should pay attention to the development of students' problem-solving abilities by providing problems of a multi-level nature, so that students can find out the extent of their problem-solving abilities and Reversible Thinking abilities.

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