The Influence of Working Backward Problem Solving Strategy Towards Mathematical Reasoning Ability in Terms of Students’ Emotional Intelligence

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Abstract. The study aimed to know the description of student’s mathematical reasoning ability and student’s emotional intelligence, to find out whether there were differences in the mathematical reasoning ability between students who used and those who did not use working backward problem solving strategy, identify whether there were differences in mathematical reasoning ability between students who used and those who did not use working backward problem solving strategy in terms of the emotional intelligence, and to find out whether there was an influence of interaction on the working backward problem solving strategy towards the mathematical reasoning ability in terms of the emotional intelligence of the students of grade VIII of MTsN 1 Makassar. The study used the quantitative approach with 3x2 factorial design. The population of the study were the students of grade VIII of MTsN 1 Makassar consisting of 440 students with 80 students as the samples (2 classes). The data analysis technique used was descriptive statistical and inferential statistical analysis. The findings of the study showed that (1) the mathematical reasoning ability of the students who used and those who did not use the working backward problem solving strategy were in the high category, meanwhile the students’ emotional intelligence was in the medium category, (2)there were differences in the mathematical reasoning abilities between students who used and those who did not use working backward problem solving strategy, (3)there were differences in mathematical reasoning ability between students who used and those who did not use working backward problem solving strategy in terms of student’s emotional intelligence, and (4)there was no interaction effect of working backward problem solving strategy towards the mathematical reasoning ability in terms of the emotional intelligence of the students of grade VIII of MTsN 1 Makassar

1. Introduction
Education has a very important role for human life because education is one of the modals to achieve success in the world and the hereafter. As Allah SWT has given advantage to human that is not given to other creature, the mind. Only intelligent people (thinking) are able to receive a lesson. Education includes several things such as academic education. Mathematics education is one of the fields studied in academic education. [1] argues that mathematics has the meaning of knowledge obtained by reasoning (thinking) which emphasizes more activities in ratio rather than emphasizing the result of observation or experimental result.
The objectives of learning mathematics in school according to the Ministry of National Education (2004) are: (1) training how to reason and to think in drawing conclusion, (2) developing creative activities that involve imagination, curiosity, make prediction and guess, and also attempt, (3) developing the ability to solve problem, and (4) developing the ability to convey information and communicate ideas [2]. Based on these objectives, it can be seen that one of the very important abilities developed in learning mathematics is reasoning ability because reasoning ability is an aspect that affects student achievement.

[3] Stating that the reasoning ability contained in Minister of National Education Regulation No.22 year 2006 concerning Content Standard (SI) is one of the competencies that must be owned and developed. Reasoning is defined as the line of thought that is adopted to produce assertions and reach conclusions when solving tasks [4]. Reasoning is a process or activity of thinking to draw a conclusion or make a correct statement based on several statements which the truth has been assumed previously. The mathematical reasoning is a process of reaching logical conclusion based on fact and relevant source[3].

Based on the results of an interview with Mr. Rosli, S.Ag, a grade VIII mathematics teacher in MTs Negeri 1 Makassar, the researcher received information that student's mathematical reasoning abilities were still lacking, namely student's ability to manipulate mathematics and find pattern of problem solving were still low. The researcher also observed students directly when the students given a story problem, precisely a problem solving problem, only a few students were able to find solution to the questions given, and even then require guidance from the teacher. Other students are confused about where to start to find solution to the question. This is because the learning activity is centered on the teacher, while students are accustomed to only listening to the explanation of the material presented by the teacher and then doing the practice questions like what the teacher has demonstrated before. During the assessment, students are very weak in finding pattern of solving mathematical problem. This is why students are not accustomed to working on non-routine problem to practice their reasoning abilities where the non-routine problem itself requires a further level of reasoning. They are very weak in finding solution toward the problem related to problem solving that requires mathematical reasoning.

Based on the interview with student, some students considered mathematics as a difficult subject so the lack of motivation from within students causes students to be passive in class. When students find it difficult to find pattern of solving the mathematical problems, the students felt anxiety. This emotional state will affect the reasoning ability in solving these problems. As expressed [5] in his research which said that the ability of mathematical reasoning of students of Class X Natural Science 2 was low. This is indicated by the result of observation and interview conducted with mathematics teacher. Mathematics teacher revealed that in the process of learning mathematics, students did not respond the learning material delivered by the teacher. Students tended to be quiet and not gave the answer when the teacher asked question.

To achieve a good level of reasoning ability, the only way is not only to use various models or learning strategies. But there are some things that can be used as the parameter in order to observe the ability of reasoning namely by looking at aspects of intelligence possessed by students. One of them is looking at the level of emotional intelligence. In essence, each student has a different level of emotional intelligence. Emotional intelligence is an important factor that influences learning outcome. If emotional intelligence is good, it will greatly improve learning outcome. High academic ability supported by good emotional intelligence, will open a lot of success for students [6]. Students with
high emotional intelligence have good thinking abilities, the ability to give argument appropriately and the ability to draw good conclusion [7]. Related to mathematical problem solving, someone who has high emotional intelligence certainly knows how to think critically to solve the problem.

Seeing the reality and some of the problems described, a solution is needed to develop or to improve student's reasoning abilities. The solution provided is to apply mathematical problem solving strategies. One of them is a working backward strategy, because this strategy emphasizes the power of creativity while developing it requires several aspects of thinking, one of them is reasoning. Each strategy has special characteristic in solving mathematical problem. Working backward is a short-sighted Heuristic method. With the use of this strategy, the search for finding a solution starts with a goal and then works backwards towards what is already known. Sometimes, a lot of manipulation in other mathematical problems that are difficult to do by moving forward is to start from the data to the result, but it is very easy to do after we try to move from behind (starting from the result to the data) [8]. This strategy can train student's reasoning abilities, namely how to think to solve mathematical problem.

This is reinforced by the various results of previous studies, including research conducted by [9] with the title "The Effect of the Working Backward Strategy in Mathematical Problem Solving on the Reasoning Ability of the State Junior High School Students in Jambi City". The result of this research is the mathematical reasoning ability of students taught with a working backward strategy higher than the mathematical reasoning ability of students taught with conventional learning expository method. The result of this study shows that the working backward strategy is very influential in improving student's reasoning ability.

2. Methodology
The approach of this research is quantitative research with the type of factorial experimental research. The research design used was a 3 x 2 factorial design. The population in this study were all eighth grade students of MTs Negeri 1 Makassar in academic year 2018/2019 consisting of 11 classes with 440 students. The sampling technique in this study was purposive sampling. The class selected as a sample was class VIII.2 as the experimental class and class VIII.3 as the control class. The design is described as shown below:

\[
\begin{array}{ccccccc}
R_1 & O_1 & X_1 Y_1 & O_2 \\
R_1 & O_3 & X_2 Y_1 & O_4 \\
R_1 & O_5 & X_1 Y_2 & O_6 \\
R_1 & O_7 & X_2 Y_2 & O_8 \\
R_1 & O_9 & X_1 Y_3 & O_{10} \\
R_1 & O_{11} & X_2 Y_3 & O_{12} \\
\end{array}
\]

Figure 1. 3 x 2 Factorial Design

Information:
R_1 : experimental class
R_2 : control class
X_1 : treatment is a working backward problem solving strategy
The research instruments used in this study were the test of mathematical reasoning ability and an emotional intelligence questionnaire. The mathematical reasoning ability test takes the form of a description of the problem that contains 5 indicators, namely: (1) submitting an allegation, (2) carrying out mathematical manipulation, (3) compiling evidence, giving reason or proof of the truth of the solution, (4) drawing conclusion from statement, and (5) check the validity of the argument[11]. While the emotional intelligence questionnaire is a list of statements containing 5 aspects, namely: (1) recognizing their own emotion, (2) managing emotion, (3) motivating their selves, (4) recognizing the emotion of others, and (5) building relationship[12].

The data analysis technique used is descriptive statistical analysis and inferential statistical analysis. Descriptive statistics analysis is to describe the condition before and after being treatment given in both classes in term of each dependent variable. Inferential statistical analysis is carried out to draw conclusion based on data that has been obtained during the research process. Inferential statistical analysis used was two-way ANOVA. Hypothesis testing using the ANOVA test with the test criteria is $H_0$ accepted if $F_{\text{count}} < F_{\text{table}}$, and $H_0$ rejected if $F_{\text{count}} > F_{\text{table}}$, which the value $F_{\text{table}}$ is obtained from the F distribution table at the significance level $\alpha = 5\%$ pre-requisite test [9].

## 3. Result and Discussion

Data on student's mathematical reasoning ability were obtained from pre-test and post-test given to the experimental class and the control class. The summary of the results is shown in the following table:

| No | Variable | Experimentation Class | Control Class |
|----|----------|-----------------------|---------------|
|    |          | Pre Test | Post Test | Pre Test | Post Test |
| 1. | Total students (N) | 40 | 40 | 40 | 40 |
| 2. | Average ($\bar{x}$) | 63,15 | 71,52 | 60,33 | 63,87 |
| 3. | Standard Deviation (s) | 7,895 | 7,596 | 9,523 | 7,653 |

Based on the result of data analysis in the table above, it appeared that the average score of mathematical reasoning ability of experimental class students who learned by using working backward problem solving strategy is higher than the average score of mathematical reasoning ability of control class students who did not use working backward problem solving strategy.
Table 2. The Result of Emotional Intelligence Categorization Analysis of Student on Experimentation Class and Control Class

| No. | Category | Total students | Experimentation Class | Control Class |
|-----|----------|----------------|-----------------------|---------------|
| 1.  | High     | 7              | 7                     |               |
| 2.  | Average  | 27             | 28                    |               |
| 3.  | Low      | 6              | 5                     |               |

Based on the result of data analysis in the table above, it can be concluded that the level of emotional intelligence of students in the experimental class and the control class is in moderate category. Before testing the hypothesis, the researcher tested the normality and homogeneity of student's mathematical reasoning ability and emotional intelligence. The result of normality test data in the experimental group and the control group can be seen in the following table.

Table 3. The Summary of Normality Test Result for Student's Mathematical Reasoning Capability

| Group            | Data   | Number of Sample | Asymp.Sig.(2-tailed) | Information |
|------------------|--------|------------------|----------------------|-------------|
| Experimentation Class | Pre Test | 40               | 0,056                | Normal      |
|                   | Post Test | 40               | 0,173                | Normal      |
| Control class     | Pre Test | 40               | 0,053                | Normal      |
|                   | Post Test | 40               | 0,052                | Normal      |

Table 4. The Summary of Test Result for Student's Emotional Intelligence Normality

| Group            | Number of Sample | Asymp.Sig.(2-tailed) | Information |
|------------------|------------------|----------------------|-------------|
| Experimentation Class | 40               | 0,200                | Normal      |
| Control class    | 40               | 0,081                | Normal      |

Based on the result of SPSS processing version 22.0, it can be seen that the value of Asymp.Sig. (2-tailed) obtained in the two sample groups, the experimental class and the control class is greater than the significance level $\alpha = 0.05$, so it can be concluded that the mathematical reasoning ability data and Student's emotional intelligence comes from normally distributed population. The summary of the result of homogeneity test data on mathematical reasoning ability score and emotional intelligence of students for the two sample groups can be seen in the following table.

Table 5. The Summary of Homogeneity Test Result of Mathematical Reasoning Capability and Student Emotional Intelligence

| Data           | Group            | Number of Sample | Sig.  | Information |
|----------------|------------------|------------------|-------|-------------|
| Pre Test       | Experimentation  | 40               | 0,201 | Homogen     |
|                | Control          | 40               |       |             |
| Post Test      | Experimentation  | 40               | 0,704 | Homogen     |
|                | Control          | 40               |       |             |
| Emotional Intelligence | Experimentation | 40               | 0,566 | Homogen     |
|                | Control class    | 40               |       |             |

Based on the processing result of SPSS version 22.0, it can be seen that the value of Sig. in both the sample group of the experimental class and the control class were greater than the significance level $\alpha = 0.05$, so it can be concluded that the data on student's mathematical reasoning ability and emotional intelligence are obtained from population with homogeneous variance.

Prerequisite test has been fulfilled, then hypothesis testing can be done using the ANOVA-test. The first hypothesis can be formulated as follows.
$H_0 =$ There is no difference in mathematical reasoning ability between students who use working backward problem solving strategy and students who do not use working backward problem solving strategy in class VIII of MTs Negeri 1 Makassar

$H_1 =$ There is a difference in mathematical reasoning ability between students who use working backward problem solving strategy and students who do not use working backward problem solving strategy in class VIII of MTs Negeri 1 Makassar City

| Table 6. Hypothesis Testing 1 |
|-----------------------------|
| **F** | **Sig.** | **Information** |
| Between Groups | 20.134 | 0.000 | $H_0$ rejected |

Based on the result of processing SPSS version 22.0, it is obtained the value $F_{count} > F_{table}$, therefore $H_0$ is rejected. Thus, it can be concluded that there was difference in mathematical reasoning ability between students who used working backward problem solving strategy and students who did not use working backward problem solving strategy in class VIII of MTs Negeri 1, Makassar. The second hypothesis can be formulated as follows.

$H_0 =$ There is no difference in mathematical reasoning ability between students who use working backward problem solving strategy and students who do not use working backward problem solving strategy in terms of student's emotional intelligence in class VIII of MTs Negeri 1 Makassar

$H_1 =$ There is difference in mathematical reasoning ability between students who use working backward problem solving strategy and students who do not use working backward problem solving strategy in terms of student's emotional intelligence in class VIII of MTs Negeri 1 Makassar

| Table 7. Hypothesis Test 2 |
|-----------------------------|
| **Source** | **F** | **Sig.** | **Information** |
| Emotional Intelligence | 7.465 | .001 | $H_0$ refused |

Based on the result of processing SPSS version 22.0, it is obtained $F_{count} = 7.465 > F_{table} = 3.97$ and value Sig. $< \alpha = 0.001 < 0.05$, it can be concluded that $H_0$ is rejected which mean there was difference in mathematical reasoning ability between students who used working backward problem solving strategy and students who did not use working backward problem solving strategy in terms of student's emotional intelligence in class VIII of MTs Negeri 1 Makassar. The third hypothesis can be formulated as follows.

$H_0 =$ There is no interaction effect between working backward problem solving strategy in terms of emotional intelligence on the mathematical reasoning ability of Grade VIII students of MTs Negeri 1 Makassar.

$H_1 =$ There is an interaction effect between working backward problem solving strategy in terms of emotional intelligence on the mathematical reasoning ability of eighth grade students of MTs Negeri 1 Makassar

| Table 8. Hypothesis Test 3 |
|-----------------------------|
| **Source** | **F** | **Sig.** | **Information** |
| Class | 21.812 | .000 | - |
| Emotional Intelligence | 7.465 | .001 | - |
| Class * Emotional Intelligence | 2.692 | .074 | $H_0$ accepted |
Based on the table above, it is obtained $F_{\text{count}} = 2.692 < F_{\text{table}} = 3.97$ and value $\text{Sig.} > \alpha = 0.074 > 0.05$, it can be concluded that $H_0$ is accepted which means there was no interaction effect between working backward problem solving strategy on mathematical reasoning ability in terms of emotional intelligence of eighth grade students of MTs Negeri 1 Makassar.

Learning activity is done in the experimental class better than the control class because the working backward strategy contains several steps of completion that can develop student's reasoning ability. After implementing the working backward problem solving strategy in the experimental class, learning was more student-centered, where the teacher was only a facilitator who acted as a guide in teaching and learning activity in the classroom. Students could think systematically because they are trained to understand themselves and use their reasoning in solving math problem solving given, especially questions in form of story. This is because the working backward problem solving strategy contains several steps to solve the problem according to Polya[13]. While learning activity by not using the working backward problem solving strategy in the control class, is more centered on the teacher and students only accepted what is conveyed by the teacher so as not to develop student's reasoning ability.

Mathematics learning also has the goal of shaping someone's personality. Personality means the attitude personality (emotion). This is based on research conducted by James D. Parker with the title "Academic achievement in high school: does emotional intelligence matter" stated that academic success is closely related to the dimension of emotional intelligence [14].

Students who have high emotional intelligence score do not necessarily have high score as well as students who have low intelligence score do not necessarily have low score. Emotional intelligence (EI) is the ability to carry out accurate reasoning focused on emotional and the ability to use emotion knowledge to enhance thought [15]. Emotional intelligence is the ability to make accurate reasoning about emotion and the ability to use emotion and emotional knowledge to enhance thinking.

Emotional intelligence really needs to be owned by students because the ability to control emotion properly will affect their thinking processes positively. Students who have high emotional intelligence will easily solve mathematical problem in accordance with indicators of reasoning ability while students who have low emotional intelligence will experience less interference in solving mathematical problem.

Although some previous research results suggested that working backward problem solving strategy has a positive effect on student's reasoning ability, students who have high emotional intelligence score do not necessarily have high reasoning ability as well as students who have low emotional intelligence score do not necessarily have low reasoning ability also. In conducting research, there are still factors that originate from the students themselves, for example, mostly playing and telling story with their friends so they paid less attention during the learning process. The number of students was too many limited space could also disrupt the concentration of students during the learning process. The reality of these factors during the study was very influential because if the classroom conditions were noisy it meant that the researcher could not implement the learning strategy properly as well as the delivery of the material would not be maximized.

Finally, what Thorndike said in his theory that "Law of exercise (ie the more often a behavior is repeated / trained (used) the stronger the association" cannot be realized during the course of the study. The result obtained is not as expected, it was due to the condition of the class that did not support the learning process going well and the problem of time limitation became obstacle. From the result of the
analysis, the third hypothesis in this study cannot be proven. The analysis showed that there was no interaction effect between working backward problem solving strategy on mathematical reasoning ability in terms of student's emotional intelligence. It showed that the effect of working backward strategy on reasoning ability did not depend on the level of emotional intelligence of student. Student emotional intelligence cannot be used as the parameter, as the only factor that can affect student's reasoning ability.

4. Conclusion
The average score of mathematical reasoning ability of experimental class student who learnt by using working backward problem solving strategy was higher than the average score of mathematical reasoning ability of control class students who did not use working backward problem solving strategy.

Based on the result of the analysis, because \( F \text{ count} = 20.134 > F \text{ table} = 3.97 \) and the value \( \text{Sig.} < \alpha = 0.000 < 0.05 \) then it can be concluded that \( H_0 \) is refused \( H_1 \) is accepted which there was a difference in mathematical reasoning ability between students who used the working backward problem solving strategy and students who did not use the working backward problem solving strategy in class VIII of MTs Negeri 1 Makassar.

Based on the result of the analysis, because \( F \text{ count} = 7.465 > F \text{ table} = 3.97 \) and the \( \text{Sig.} < \alpha = 0.001 < 0.05 \) then it can be concluded that \( H_0 \) is refused \( H_1 \) is accepted which there was difference in mathematical reasoning ability between students who used working backward problem solving strategy and students who did not use working backward problem solving strategy in terms of student's emotional intelligence in class VIII of MTs Negeri 1 Makassar.

Based on the result of the analysis, because \( F \text{ count} = 2.692 < F \text{ table} = 3.97 \) and the \( \text{Sig.} < \alpha = 0.074 > 0 \), then it can be concluded that \( H_0 \) is accepted, namely there was no interaction effect between working backward problem solving strategy on mathematical reasoning ability in terms of emotional intelligence of VIII grade students of MTs Negeri 1 Makassar.

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