The reciprocal teaching model as the latest solution to improve students’ mathematical representation ability

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Abstract. This study aims to examine the improvement in students' mathematical representation (KRM) after the application of the reciprocal teaching (RT) model. The RT learning model is a group learning process which in its implementation uses four strategies namely 1) concluding, 2) making questions, 3) clarifying, and 4) predicting. This study uses a quasi-experimental method with a non-equivalent pretest and posttest control group design. The subjects of this study were students of mathematics education study programs at Universitas PGRI Palembang academic year 2018-2019. This type of research is quantitative research in which the data were taken in the form of pretest and posttest data whose results show that there is an increase after the implementation of the RT model for student KRM. It can be seen from the n-gain test that gets RT learning models by 0.3 while those who get conventional learning are 0.2. Furthermore, a t-test was performed to see whether it was significant or not, it was found that t-count < t-table so that H\textsubscript{0} was rejected, which means there was no significant increase in measuring student KRM.

1. Introduction
KRM is one of the standard abilities that must be possessed by students. This is because, through KRM, students can develop and deepen their understanding of concepts and relationships between mathematical concepts they already have through making, comparing and using representations [1]. Inclusion of representation as a standard component of the process is quite reasonable because, in order to think mathematically and communicate mathematical ideas, one needs to represent them in various ways [2]. According to [3] a problem that is considered complex and complex will be easily solved if students choose a strategy and use mathematical representation in accordance with the problem. Also added according to [4] states that "Representations can promote learning when instruction supports understanding the representations before using them to elucidate mathematical concepts". In learning mathematics, the ability of representation is very necessary to simplify and solve problems in everyday life into the language of mathematics, especially in Basic Statistics courses.

Basic Statistics is an arrangement of numbers that gives an overview of the data presented in tables, diagrams, histograms, frequency polygons, and ozaiv (ogive) [5]. However, in reality there are still many students who do not understand and are interested in the subject such as difficulties in representing data in diagrams and tables as well as difficulties in solving problems related to the presentation of data. This is in line with [6, 7, 8] which states that statistics are not yet connected to the real world so students do not know the application in each material and are less able to interpret tables or diagrams into everyday language. These problems will certainly result in students not being able to draw statistical data into diagrammatic form. This further reduces student interest in learning the
material available in statistics which shows that the student KRM is still low. Therefore, an innovative atmosphere of teaching and learning will create enthusiasm for learning and student interest in learning will increase.

The latest solution to support an innovative atmosphere in improving student KRM is to apply the RT model. Because in the learning process, students are trained to conclude, make questions, clarify, and predict [9,10]. According to [11] the RT model is a learning procedure that is designed to strengthen students' understanding and reasoning in presenting their ideas. Meanwhile, according to [12,13] RT is a student-centered instructional strategy in which students and teachers switch roles in a lesson. The RT model in this study uses Student Worksheet as a medium to measure student KRM. This is what distinguishes previous research, namely using the RT model to measure the ability to learn independence and communication skills [14] and measure the ability to understand concepts [15].

This study is in line with research conducted by previous researchers, namely the ability of reasoning and representation ability to have a role in learning the statistical concepts of data presentation. From the results of the posttest data analysis, it was concluded that the association between the ability of mathematical representation with the mathematical reasoning ability of students was high [16]. In line with the research [17] which shows that the average results of the representation ability test is 65 which is included in a good category that is shown by students being able to present both representations in the form of pictures by making tables or graphs, representations in the form of mathematical expressions and representations in the form of written texts. Based on the description above, the author is interested in conducting research with the title "Reciprocal teaching model as the latest solution to improve students' mathematical representation ability".

2. Method
The treatment was given by researchers to students of the 2nd semester of the Mathematics Education Study Program who took the basic statistics lectures using the RT model applied in the experimental class from February 2019 to November 2019. The ability measured in this study was the student KRM.

This research method uses Quasi-Experimental because subjects are not randomly grouped, but are accepted as is [18]. The research design used is nonequivalent pre-test and post-test control-group design that is initiated by giving tests to the experimental class and the control class than given treatment using the RT model and ending with giving the test to the experimental class and the control class [19].

3. Result and discussion
1.1 Result
The sample of this study is the second-semester Mathematics Education Faculty of Mathematics and Natural Sciences students taking Basic Statistics courses consisting of 2 classes and a total sample of 43 students consisting of 5 men and 38 women. At the beginning of the meeting a pretest was held to measure the Student's Initial Ability (KAM) and the following results were obtained in Table 1.

| Research Sample Class | Score | Mean | Standard Deviation | N   |
|-----------------------|-------|------|-------------------|-----|
|                       | Min   | Max  |                   |     |
| A                     | 0     | 20   | 54.09             | 22  |
| B                     | 0     | 20   | 5.5               | 21  |

Table 1 shows that the average of the two classes does not differ much so that it can be concluded that the abilities of the two classes are relatively the same. Furthermore, statistical tests will be performed to see whether the ability of the two classes is relatively the same. Before conducting the average difference test, the normality test and the variance homogeneity test of the two groups of data
are first performed. The researcher normality test uses the Kolmogorov-Smirnov test, while the variance homogeneity test uses the Levene test. The results of the TKAM data normality test in Table 2.

Table 2. TKAM data normality test based on research sample class

| Class | N  | K–S | Sig. | H₀   |
|-------|----|-----|------|------|
| Class A | 22 | 0.156 | 0.175 | accepted |
| Class B | 21 | 0.151 | 0.200 | accepted |

Table 2 shows that the significance of class A is 0.175 and the significance of class B is 0.2. The two classes of significance values are greater than the significant level of 0.05 so that H₀ is accepted and this shows that both classes are normally distributed. Then homogeneity analysis is performed to see the equivalence of mathematical abilities of the two classes. The homogeneity test results of the two classes are in Table 3.

Table 3. Homogeneity test TKAM data based on the research sample class

| Class | F  | Sig. | H₀   |
|-------|----|------|------|
| Class A | 0.095 | 0.759 | Accepted |
| Class B |  |  |  |

Table 3 shows that the TKAM data is greater than the 0.05 significance level, which also means that the data variance is homogeneous. Therefore, because the data is normally distributed and homogeneous, to find out the average equivalence of class A and B, parametric statistics are used, namely the t-test. Here are the results of the t-test analysis.

Table 4. TKAM data mean difference test based on the research sample class

| Class | Sig. | H₀   |
|-------|------|------|
| Class A | 0.200 | accepted |
| Class B |  |  |

Table 4 shows the value of significance obtained is greater than the significant level of 0.05 so that H₀ is accepted, that is, there is no average difference between class A and class B. This shows that the KAM class of study samples A and B is relatively similar. After that, the random selection of classes is determined to be used as the experimental class and the control class. After the selection is obtained class A as an experimental class and class B as a control class. KAM test given at the beginning of the meeting aims to see the equality of initial abilities possessed by students in both classes of research samples. KAM test consists of 5 questions that have been validated by experts and colleagues according to the ability to be analyzed, namely the ability of representation.

After the results of the pretest, posttest, and n-gain were compared, compared to the average of the two classes to measure whether there was an increase after the RT model was conducted on the students’ KRM. The average value-gain of the experimental class and control class in Table 5.

Table 5. Average grade of experiment class and control class

| KRT | KK |
|-----|----|
| KRM | 11.4 | 10.6 |
| g   | 0.3  | 0.2  |

Table 5 shows that there is an increase after being given the RT model treatment to measure the student KRM. This is indicated by the n-gain value that gets the RT model to measure student KRM
that is equal to 0.3, while those who do not get treatment is 0.2. Table 6 shows the descriptive statistics of the KRM data based on the KAM group of students.

Table 6. Descriptive statistics of KRM data based on student capabilities

| KAM   | N  | Stat. | PRT Pretest | Posttest | <g> | PK Stat. | Pretest | Posttest | <g> |
|-------|----|-------|-------------|----------|-----|----------|---------|----------|-----|
| Total | 22 | 𝑥̅   | 7.45        | 11.4     | 0.3 | 21       | 𝑥̅      | 12.90    | 0.47|
|       |    | s     | 3.01        | 2.24     | 0.16| 𝑠       | 0.47    | 3.04     | 0.14|
| High  | 3  | 𝑥̅   | 11.7        | 13       | 0.24| 4        | 𝑥̅      | 11.5     | 13.5 |
|       |    | s     | 2.3         | 1.73     | 0.09| 𝑠       | 0.5     | 0.5      | 0.07|
| Medium| 15 | 𝑥̅   | 7.8         | 11.73    | 0.32| 13       | 𝑥̅      | 7.84     | 10.23|
|       |    | s     | 1.65        | 2.09     | 0.15| 𝑠       | 1.86    | 2.31     | 0.14|
| Low   | 4  | 𝑥̅   | 3           | 9.75     | 0.4 | 4        | 𝑥̅      | 2.5      | 9    |
|       |    | s     | 1.63        | 2.06     | 0.1 | 𝑠       | 1.29    | 1.41     | 0.07|

Table 6 shows that an increase in student KRM starting from a high ability of 0.24 for the experimental class while for the control class an increase of 0.22. This shows that learning that gets the RT model is bigger than conventional learning.

To see whether or not a significant increase in students’ abilities, further tests are needed by using the t-test. The t-test results on the KRM experimental class students is in Figure 1.

![Figure 1](image)

**Figure 1.** T-test results against student KRM

Table 5 obtained sig values of 0.0 and t = 23.889. This shows that H₀ is rejected because t-count < t-table which means there is no significant improvement to measure student KRM.

3.2 Discussion

Based on the research results above, there is an increase in the RT model to measure student KRM, of course, determined by each learning step in the RT model. The steps of this RT model encourage students to be able to develop their KRM as seen in the results of the posttest. This is in line with research [20] where the results of the research have the influence of the RT model on the KRM of VII grade students of SMP Negeri 6 Purwokerto. Student KRM is seen when compiling data that has been given and students present in the form of bar charts and pie charts. This is following the theory of representation which is a form of student representation of a problem that is used as a tool to find solutions to these problems. Student interpretation can be in the form of words or verbal, written, drawing, tables, graphs, concrete objects, mathematical symbols and others [21]. The results of student answers that present data in the form of bar and circle diagrams in Figure 2.
Figure 2 shows students can present the semester test scores of SMA Harapan Jaya students in mathematics using bar and circle diagrams. Writing down the steps to solve mathematical problems with words is also one indicator that students have KRM that is by explaining the results of activities that have been carried out to the class. According to [22] stated in his research about the importance of the use of representation in mathematical communication so that mathematics learning does not only focus on results but looks at the process as well. Students presented the results of their work on the material with the steps in solving mathematical problems with words. Students can complete and explain the steps of completion and obtain the final results. Representation in the form of mathematical expression which includes making a mathematical model of a given problem is shown by making mathematical symbols and solving systematically in Figure 3.

Figure 3 shows that it can be solved the problem of the amount of mathematical student body height data. The median should be done by making a mathematical model containing the symbol of giving and completing it systematically.

4. Conclusion
From the results of the study it was found that based on the t-test for student KRM did not show a significant increase but seen from the n-gain value there was an increase in the student KRM ability. The n-gain value for the class that gets the RT model is greater than the conventional class.
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