

## Implementation of Reciprocal Teaching Models to Increase The Capability of Writing Definition and Theorem in Symbolic Form

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**Abstract.** This study aims to obtain objective information about increasing in writing skill about definitions and theorems in symbolic form students through RT models in the sets, all kind of relations and functions in set and logic courses. In addition, this study develop the ability of understanding of definitions and theorems, because the ability of students to write definitions and theorems in symbolic form will foster the ability of understanding of the definitions and theorems. The sample of this study are the first semester students in class A2 who follow sets and logic course in mathematics education program of PMIPA FKIP Untan 2016-2017. Implementation focus on subject, sets and all kind of relations and functions. The data collection conducted in providing achievement test after being given treatment. Form of test is Essai with 15 questions which consist of 4 questions from subject set, 8 questions from kind of relations and 3 questions from functions. The results showed if the Reciprocal Teaching Model is one of model that could improve the writing skill about definitions and theorems through symbolic form in the subject matter ; Sets, kind of relations, functions in Sets and Logic courses.

Keywords: Reciprocal Teaching Model; Writing Skill in the symbolic form

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### I. INTRODUCTION

Future education faces severe challenges, because education has a function to improve the quality of human resources. Education Indonesia directs its objectives in accordance with the values of Indonesia's cultured noble and religious culture depicted in the functions and objectives of National Education.

Learning mathematics oriented to the objectives and essence, the implementation in front of the class is not enough to equip students with a variety of mathematical knowledge but more than that required a real effort done intensively to grow the ability to acquire knowledge of mathematics by finding their own or in collaboration and the ability to apply In the situation of modern society. Sumarmo [1] states that learning mathematics at all levels of education include: (1) learning to know, (2) learning to do, (3) learning to be yourself (learning to be) , (4) learning to live in a peaceful and harmonious togetherness (learning to live together in peace and harmony).

Mathematics learning at every level of education refers to two main objectives, namely formal goals and material goals [2]. The formal purpose of learning mathematics is the purpose that barkaitan with the arrangement of reasoning and the

formation of the attitude of learners, while the objective material of learning mathematics is the goal associated with the use and application of mathematics, both in mathematics itself and other fields. For the arrangement of reason as a benchmark the ability of students to understand the definition and theorem, whether presented in verbal sentences (words), pictures (figural) or in symbolic form. Meanwhile, the essence of mathematics education [3] has two directions of development, namely development for the needs of the present and the future. The development of today's needs is the learning of mathematics leading to an understanding of the concepts necessary to solve other mathematical and scientific problems. While the need in the future is a mathematical learning that provides the ability to reason and logical, systematic, critical, and careful and objective and open thinking. Therefore, in the learning of mathematics (lectures), the ability of students to develop ideas / ideas in understanding a concept. In mathematics education program of PMIPA FKIP Untan, several subjects which become the basis for developing the logical arrangement, namely the subjects of Set and Logic, algebra, and number theory.

The facts on the field show that the ability and understanding of definitions and theorems are still relatively

weak, especially in writing definitions and theorems in symbolic form. The weakness is due to (1) lack of understanding of symbols in mathematics, (2) weak mastery of the material, (3) less able to understand the meaning of a definition and theorem. In addition there are also factors that are internal, among others, less accustomed to discuss or express opinions in class. This weakness leads to some courses that are a continuation of difficulty, such as theories of opportunity theory, mathematical statistics and differential equations. Recognizing the importance of the ability to write definitions and the theorems with the symbolic it is necessary to seek learning by using approaches that can provide opportunities and encourage students to trained writing skills.

There are several learning skills of reading, including Reciprocal Teaching (RT). This model refers to learning activities between teachers and students about the segment of a material, organized into four strategies of understanding: summarize or conclude, question, explain and predict. To optimize the learning outcomes to be achieved then the RT model can be done in groups to occur interaction between students in giving content to other students of different abilities. The RT model leads students alternately to play like a teacher, explaining to their friends what they have gained in their activities. Therefore, this study is to see whether there is an increase in the ability to write definitions and theorems in a symbolic form after being taught through the RT model on the set matter, the various relationships and functions of the course set and logic.

#### **Theoretical review**

The Reciprocal Teaching (RT) model or reversed learning focuses on the child's mental process or child's thinking process, since the RT model prioritizes the role of the student in initiating and actively engaging in learning. This model is a teaching procedure or approach designed to teach students about cognitive strategies and to help students understand the reading well. While Palincsar, et al [4] states that the stages in the RT model in the form of a reading comprehension strategy consists of summarizing, questioning, explaining and predicting. From the definition of RT model it is seen that the four stages of understanding strategy must exist in learning but the four strategies do not have to be a sequence. Palincsar, et al [4] states that the sequence of the four strategic stages that occur in the RT model is not important.

According to Ibrahim [5] states RT model is a learning strategy through the activities of teaching friends. In this strategy students play a role as a "teacher" replacing the role of teachers to teach their friends. In the meantime the teacher is more of a role model as an example, facilitating facilitator, and scaffolding supervisor. Scaffolding is the guidance given by people who know better to people who are less or do not know (eg lecturers to students or students with students). The guidance given in the early stages is done strictly, then gradually the responsibility of learning is taken over by the studying students.

The RT model provides an opportunity for students to be familiar with analyzing and developing their reasoning from a given situation or problem whether in the form of reading materials or questions. The success of this analysis is seen in the conclusions obtained by the students and the ability to explain back the knowledge gained. This strategy is one of the strategies of reading and taking notes during learning.

Based on the description of the RT model above, the learning using this model is prepared using four strategies of understanding: summarize or conclude, compile questions, explain and predict. The four activities or strategies used in the RT model are to improve students' understanding of a material. In detail the four strategies of his understanding are described as follows:

1. **Summarizing (Summarizing or summarizing)**  
Activities summarize or conclude helps students to identify what matters in the reading or the material to be read. Summarizing means that a student provides an opportunity to identify and integrate important information from a reading or text. Material or texts can be summarized by students when the first student begins to implement the reverse learning procedure. By integrating intelligent students with less ability to understand reading material or dictates and at the next level of procedures.
2. **Questioning (Compiling Questions)**  
After students read materials from teaching materials or diktat, students are guided to make inquiries in order to increase students' curiosity and motivate students to learn and develop students' minds. Questioning is a flexible strategy at a level where students can be taught and supported to generate a question. The prepared questions explain and reinforce what students have summarized. So the strategy undertaken takes the student at one stage again the steps of the learning procedure. Students can make inquiries when they are beginning to have identified important information.
3. **Clarifying (Explaining)**  
Explain asking students to try to answer questions that have been compiled or submitted. Explaining in the learning process is an activity that is very important when students learn in groups. Student learning groups formed are heterogeneous, so clever students can explain to students who are not smart.
4. **Predicting**  
Creating new or predictable questions helps students to determine key ideas from materials or materials. Predicting can link their background knowledge. Predicting occurs when students make inferences of what will be discussed next from the material. In order to predict this to run successfully, students must master or understand basic knowledge of the material. The students have a purpose to read, to confirm or prove the reverse of their hypothesis. Opportunities have been created by

students to connect new knowledge with knowledge they have mastered. This strategy facilitates use when students play a role as teachers. Predicting can encourage students to actively think ahead.

Fachrurrazy [6] develops a RT modeling procedure that contains the following steps: (1) summarizes a learned paragraph, (2) questions about reading content to be asked to classmates, (3) asks for an explanation or asks the teacher what The less obvious, and (4) make predictions about the contents of the next paragraph. In addition, Palinscar and Brown [7] describe the steps of the RT model as follows:

1. At the beginning of the learning activities, teachers are responsible for leading question and answer and implementing four reversed learning strategies: summarize, question, explain and predict when students finish reading certain topics
2. The teacher exemplifies how to summarize, question, explain and predict after the student has finished reading a particular topic
3. Students practice using RT strategies with teacher guidance.
4. Students learn to lead questioning with or without teachers.
5. The teacher acts as a facilitator by providing assessments regarding student performance and motivating students to participate in question and answer activities.

Meanwhile, according to Wright [8] stage of reciprocal teaching model is described as follows:

1. It takes at least four days to introduce a reciprocal teaching strategy to students:  
 First day: prediction, second day: conclude, third day: make a question and fourth day: explain  
 Then model the strategy to students and check students' understanding of the key concepts.
2. After students are introduced to the reciprocal teaching strategy, apply the 4 strategies to the students by forming a group. Then randomly select a group member to play the role of teacher by applying the reciprocal teaching strategy, namely: concluding, making questions, explaining and predictions.
3. To demonstrate mastery of group strategies, assign students to calmly read the material. Then call several different students to discuss how they apply it.
4. Give a copy of the reciprocal teaching strategy to students and instruct to read calmly. And remind students to make predictions, keep track of important ideas, make inquiries and explain material that has not been clear as long as students are reading.

From some sense and procedures and steps RT model above the four stages of understanding strategy in learning must remain and the order should not always be the same. Stages of RT model in learning according to some experts described in the form of diagrams as follows:

According to Wright [8]:

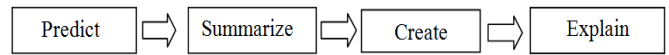


Fig. 1 Stages of understanding strategy in RT model according to Wright

Meanwhile, according to Palinscar and Brown [7]:



Fig. 2 Stages of understanding strategy in RT model according to Palinscar and Brown

Based on the above description, RT model learning in this research is following the strategy stages according to Palinscar and Brown [7], namely:

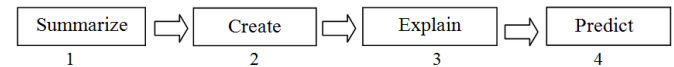


Fig. 3 Stages of understanding strategy in this research

### Rewrite Definition And The Theme By Using Symbolic

The difficulty of the students understanding the courses that have been proposed (the theory of opportunity, mathematical statistics and differential equations) shows the weakness of the students in reading, and writing down ideas or ideas from the mathematical text given. In that course there are so many definitions and theorems that students find it difficult to illustrate the definitions and prove the theorems that make them difficult to understand. Fundamental student difficulties have difficulty understanding definitions and theorems even though they are familiar. This is because they lack the meaning of each statement of the definition and theorem. The student's inability leads to reasoning ability and creativity does not arise. Because to write the definition and the theorem with the symbolic students are required creativity and reasoning ability. Creativity is an element in solving math problems. At each step in the problem-solving process that emphasizes creativity demands creative thinking from the students involved. Creative thinking is supported by two components as follows:

1. Lateral thinking is the ability to see and gain insight into a problem or symptom of previously acquired experiences.
2. Divergent thinking is the ability to see and formulate new tools or traits and apply them to utilize the tools or obtain solutions of problems encountered, or utilize existing tools or traits under different conditions from previous use [9].

The steps in troubleshooting the RT model are as follows:

1. Read definitions and theorems carefully to capture the meaning of each statement (single statement).
2. Sorting out compound statements (definitions and theorems) into several single statements.
3. Write a logical hyphen word used in compound statements and other words.
4. Specifies symbols relevant to logic and other words.
5. Write a single statement with symbol form.
6. Incorporates single statements that have been written with symbols based on hyphens and other specified words.

Example of Writing Definitions and Theorems in Symbolic Form

A. Definiton

1. To say that  $\lim_{x \rightarrow c} f(x) = L$  means that any given  $\epsilon > 0$

(however small) there is  $\delta > 0$  corresponding to such that  $|f(x) - L| < \epsilon$  provided that  $0 < |x - c| < \delta$  ie

$$0 < |x - c| < \delta \rightarrow |f(x) - L| < \epsilon$$

Settlement

a. Ask students to read carefully and understand the meaning of each statement.

b. His single statement is:

1) Say that  $\lim_{x \rightarrow c} f(x) = L$

2) That every  $\epsilon > 0$  given there is  $\delta > 0$  corresponding

3) Such that  $|f(x) - L| < \epsilon$  provided that  $0 < |x - c| < \delta$ , atau  $0 < |x - c| < \delta \rightarrow |f(x) - L| < \epsilon$

2. Logic hubs are:

- a. Means
- b. Every
- c. There is
- d. So much so

3. The symbols of the word logic are:

- a.  $\leftrightarrow$
- b.  $\forall$
- c.  $\exists$
- d.  $\ni$

4. Write a single statement form with symbols

a.  $\lim_{x \rightarrow c} f(x) = L$

b.  $\forall \epsilon > 0 \exists \delta > 0$

c.  $0 < |x - c| < \delta \rightarrow |f(x) - L| < \epsilon$

5. The equivalent form of the above definition

$$\lim_{x \rightarrow c} f(x) = L \leftrightarrow \forall \epsilon > 0 \exists \delta > 0 \ni 0 < |x - c| < \delta \rightarrow |f(x) - L| < \epsilon$$

B. Theorem

If  $f$  is continuous at  $[a, b]$  and if  $w$  is a number between  $f(a)$  and  $f(b)$  then there is a number  $c$  between  $a$  and  $b$  such that  $f(c) = w$ .

Resolution:

1. Ask students to read carefully and understand the meaning of each statement.

2. His single statement is:

- a. If  $f$  is continuous at  $[a, b]$
- b. If  $w$  is a number between  $f(a)$  and  $f(b)$
- c. There is a number  $c$  between  $a$  and  $b$  such that  $f(c) = w$ .

3. Logic hubs are:

- a. If .... Then ....
  - b. and
  - c. Such that
- The symbols of the word logic are:
- a.  $\Rightarrow$
  - b.  $\wedge$
  - c.  $\ni$

5. Write a single statement form with symbols

- a.  $f$  continues on  $[a, b]$
- b.  $\exists w \in \mathfrak{R}, f(a) < w < f(b)$
- c.  $\exists! c \in \mathfrak{R}, a < c < b \ni f(c) = w$

6. The equivalent form of the above theorem,

$$f \text{ continuous on } [a, b] \wedge \exists w \in \mathfrak{R}, f(a) < w < f(b) \Rightarrow \exists! c \in \mathfrak{R}, a < c < b \ni f(c) = w$$

II. RESEARCH METHOD

The method used is experimental research. The purpose of the experimental study was to investigate causal relationships by treating experimental groups. This is because the object of research is the student. This means that there are variables whose condition can not be made the same, such as the level of student intelligence, background, or socio-economic conditions of students. Therefore, this research is in the form of quasi experiment (Quasy Ekspeimental Design). The sample in this research is the students who take the subjects of Set and Logika semester I class A2 Mathematics Education Study Program 2016-2017.

The data obtained is the score of student learning outcomes before and after given treatment by using the model RT on the set material, the various relationships and functions. Data pengelohan to see the difference and increase the ability to write the definition and theorem in the form of student symbolic is calculated by using t test and gain score.

III. RESULT AND DISCUSSION

After the analysis of the preliminary and final test results can be seen in Table 1, the average initial test score is 6.7 (scale 0-15) or about 44.7% comprehensible material, and the average final test score Is 10.8 (scale 0-15) or about 72% of the material can be understood after treatment is given. With a change in the mean score of the initial test with the average of the final test, it shows an increase in the ability to write the definition and the theorem in symbolic form by the students after the treatment with the medium classification (gain score obtained  $\langle g \rangle = 0.49$ . The difference of ability to write definition and theorem in symbolic form by student before and after given treatment, then used parametric statistic Parametric statistic test used normality test and t test Normality test result from initial test and final test can be seen in table 1 as following.

Table I  
 Normality Test

Statistics	Pre-test	Post-test
$\bar{x}$	6,7	10,8
<i>SD</i>	1,02	2,82
$\chi^2_{\text{tabel}}$	5,9	7,8
$\chi^2_{\text{hitung}}$	3,49	3,13

Based on the calculation results of normality test, obtained value  $\chi^2$  count from the initial test is 3.49 while the value of  $\chi^2$  table is 5.9. Thus it can be concluded that the initial test data is normally distributed. Furthermore, the calculation result of normality test value  $\chi^2$  count from final test is 3,13 whereas value of  $\chi^2$  table from final test is 7,8, so it can be concluded that final test data is normal distribution.

Since the data from the initial test and the final test are normally distributed, it will continue with the t test. From the calculation obtained t test results can be seen in table 4.4. As follows.

Table 2  
t-test

Df	35
Md	4,11
$T_{\text{hitung}}$	8,75
$T_{\text{tabel}}$	2,75

Based on calculation result by using  $\alpha = 0,05$ , and  $T_{\text{hitung}}$  with value 8,75 while  $T_{\text{tabel}}$  value 2,75, hence concluded that there is difference of ability to write definition and theorem in symbolic form by student before and after done learning with model RT in set, Various relationships and functions in the course Himpunam and logic semester 1 class A2.

The results of the study include the ability to write definitions and theorems in the form of symbolic on the set material, the various relationships and functions. Preliminary test and final test given in the form of essays as many as 15 questions consisting of 4 material problems set, 8 material problems of various relations and 3 matter of function material. Each issue includes indicators that show the ability to write definitions and theorems in symbolic form. After the test then the answer sheet given the score in accordance with the provisions if true given the score of 1 and incorrectly given score 0.

The success of this analysis is seen in the conclusions obtained by students and the ability to write definitions and theorems in the form of student symbolic re-explain the knowledge obtained. Because according to Palincsar, et al [4] RT model provides an opportunity for students to accustomed to analyze and develop the reason of the situation or problem given either in the form of reading material or a matter.

Based on the observations made on the experimental class that gets RT model learning following the set and logic subjects, it is found that the students appear to be more active in their activities and have high spirit in solving the given problem. The quality of learning process activities from the

observations tends to increase at each meeting. In the first meeting, second, the student activity tends to be still in the adjustment stage with the new learning model they received, but at the meeting the activities of the students seem more active, creative and courageous in the learning process in the classroom, for example the courage of students to ask questions and express opinions. In general, the activity during the RT model learning process on the set material, the kinds of relationships and functions are good and very positive.

When viewed from the readiness of learning, at the third meeting students are better prepared to learn and easier to conditioned than the first and second meeting. This is because the students have got a picture of RT Model implementation and just continue the learning from the previous meeting with the same way of learning.

Based on result of data analysis and discussion hence there are difference and significant increase ability writing definition and theorem in symbolic form of student after taught by learning model of Reciprocal Teaching on himpunam material, kinds of tiger relation, function of course of Set and Logika semester 1 class A2 education program Mathematics Department PMIPA FKIP Untan.

#### IV. CONCLUSIONS

Based on result of data analysis and discussion hence there are difference and significant increase ability writing definition and theorem in symbolic form of student after taught by learning model of Reciprocal Teaching on himpunam material, kinds of tiger relation, function of course of Set and Logika semester 1 class A2 education program Mathematics Department PMIPA FKIP Untan.

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