Implementation of Index Card Match Learning Model with
Problem Posing Approach Assisted by MATLAB Software to
Improve Students' Problem Solving Ability

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Abstract. The purpose of this study was to examine the steps of the Index Card Match learning
model with the problem posing approach assisted by MATLAB software and its effect on the
problem solving ability of high school students. This research is a quasi-experimental research
with non-equivalent control class design. The population in this study were all students of class
XI Senior High School 2 Kuningan, with purposive sampling technique taken two classes as a
sample. A distinctive feature of this combined model is that students make their own questions
and answers on separate cards, so that after the cards are collected and randomized, students
are asked to find suitable questions and answers. While the results of the data analysis showed
the average initial problem solving ability of students in the experimental class is equal to the
average initial ability of students in the control class with a significance value of 0.212. But
after the treatment, there were differences in the average problem solving ability in the
experimental class and control class that is equal to 3.38 and p-value of -2.563 with asymp. sig
0.010, rejection for H0 which means the mathematical problem solving ability in the
experimental class is better than control class.

1. Introduction

The purpose of mathematics learning that has been established in the current curriculum in Indonesia
is that students understand the concepts of mathematics, explain the interrelationship between
concepts and apply concepts or algorithms, flexibly, accurately, efficiently and precisely, in problem
solving, using reasoning on pillars and traits, manipulating mathematics in generalizing, compiling
evidence or explaining mathematical ideas and statements, solving problems that include the ability to
understand problems, design mathematical models, complete mathematical models, and interpret
solutions obtained, communicate ideas with symbols, tables, diagrams or other media to clarify a
situation or problem and have an attitude of respect for the usefulness of mathematics in life, namely
having curiosity, attention, and interest in learning mathematics, as well as tenacity and confidence in
problem solving (RI ministerial regulation Number 22, 2006). It is very clear that problem solving is
included in the purpose of learning mathematics in Indonesia so that it is expected that after learning
mathematics students are able to solve mathematical problems and interpret the solutions they obtain.
Mayer's opinion about the definition of the problem (Royer, 2003: 70) is a problem exists when someone has a goal but can’t immediately know how to achieve that goal, so that a problem consists of three elements, namely a particular situation, a state of the desired situation, and obstacles that hinder a move directly from the situation given to the desired state.

Bell (1978: 310) formulates general problem solving as a way out of a situation which is seen as a problem by someone who resolves it. Mathematical problem solving according to Bell (1978: 310) is a way out of a situation in mathematics which is seen as a problem by someone who resolves it. Mathematical problem solving is an attempt to find the right approach to solving mathematical problems or related to mathematics both routine and non-routine problems, which involve cognitive systems and calculations and directed to complete the desired goals. Therefore improving the ability of students to solve problems is one of the goals of mathematics learning in schools in the hope that students can apply these abilities in various situations.

In line with the objectives of mathematics learning, Witri (2014) states that problem solving abilities are closely related to students' ability to read and understand the language of story problems, present in mathematical models, plan calculations from mathematical models, and complete calculations from non-routine questions. Achieving mathematical solving skills requires good mathematical communication between students and students, or students with teachers. Therefore increasing students' abilities is one of the goals of mathematics learning in schools in the hope that students can apply these abilities in various learning situations.

Efforts to improve students' ability to solve mathematical problems have been carried out. The right learning approach to improve students' ability to solve mathematical problems is one of them is problem posing approach. Problem posing according to Ellerton (Christou et al, 1999), in Mahmudi (2011) is defined as the making of questions by students that they can think of without any restrictions regarding the content or context. In addition, problem posing can also be interpreted as the formation of questions based on context, stories, information, or known images (Lin, 2004). Problem posing or question formation is an effective way to develop students 'ability in order to improve students' ability in applying the math concept mathematics. Ellerton (in Ali Mahmudi, 2011), defines problem posing as making students' questions that they can think of without any restrictions on the content or context.

In addition, problem posing can also be interpreted as the formation of questions based on context, stories, information, or known images (Lin, 2004). Problem possession can help students to search for new topics and provide deeper problem solving. In addition, problem posing can encourage the creation of new ideas that come from each topic given. Problem posing is the most effective way to develop students' ability in order to improve students' ability in applying mathematical concepts.

The Mathematical Action Research Team or PTM (2002: 2) says that there is a positive correlation between the ability to form questions and the ability to form problems and practice forming questions is an effective way to increase student creativity in solving a problem. In addition, research conducted by Abdul Jabar (2015) states that student learning outcomes using the problem posing learning approach have increased. From the results of the study it is known that students' problem solving abilities in mathematics are at very good levels.

As a facilitator in learning, a teacher must be able to facilitate students with the best learning possible. As an effort to be able to improve students' mathematical problem-solving ability, one alternative learning that is thought to be able to improve mathematical problem solving ability is computer-aided learning or better known as learning using IT (Information Technology) / ICT (Information Communication Technology). Learning to use computers in the form of software is now being widely used. This is because IT-based learning provides opportunities for students to solve problems individually, improve the development of students' problem solving towards the material presented, stimulate students to learn with enthusiasm, and provide convenience to students to determine their own pace of learning (Weda, 2013: 204). Some math software has now developed and is available for
free, such as MATLAB, GeoGebra, Maple, Scatterplot and others. One of software that helps solve integral problems is MATLAB software.

According to Cahyono (2013) MATLAB is software that is the most efficient software for numerical calculations based on matrices. Thus if in the calculation we can formulate the problem into a matrix format, MATLAB is the best software for its numerical solution. MATLAB, which is a high-level programming language based on matrices, is often used for numerical computational techniques, to solve problems involving mathematical operations of elements, matrices, optimization, approximation and others. So that MATLAB is widely used in: (1) Mathematics and Computation, (2) Development and Algorithms, (3) Programming modeling, simulations, and making prototypes, (4) Data analysis, exploration and visualization, (5) Numerical and statistical analysis, and (6) Development of technical applications.

In addition to the software that is in accordance with competence, the teacher must also be able to choose the right and interesting learning method, one of which is the Index Card Match learning method. According Suprijono (2014: 120), Index Card Match is a method of "finding a pair of cards" is quite fun to use to repeat the learning material that has been given previously. Meanwhile, according to Silberman (2011: 250) Index Card Match is an active and fun way to review learning material. This method allows the students to pair up and give quiz questions to their friends.

Previous research conducted by Fauzar Adi Rahmantyo (2015) states that: a) there is an influence of learning strategies on learning prestige, b) there is an influence of the level of creativity on learning achievement, c) there is no interaction between learning strategies and the level of creativity towards learning achievement. This study concludes that at each level of creativity, Problem Posing strategies must have a better influence on learning achievement than the Index Card Match strategy and on each learning strategy, high learning creativity must have a better influence on learning achievement than moderate learning creativity and low, while moderate and low learning creativity certainly has the same good effect on learning achievement.

From the description above, the researcher is interested in conducting a research entitled “Implementation of Index Card Match Learning Model with MATLAB Software Assisted Problem Posing Approach to Improve High School Students' Problem Solving Ability”. The problem formulation of this study is whether the Index Card Match learning model with problem posing approach assisted by MATLAB software can improve students' mathematical problem solving ability?

2. Index Card Match Learning Model With MATLAB Software Assisted Problem Posing Approach

Index Card Match Learning Model With MATLAB Software Assisted Problem Posing Approach is a combination of Index Card Match learning models that look for pairs of cards, with the Problem Posing Approach where students make their own questions and answers with the help of MATLAB Software. The steps of the Index Card Match learning model with the assisted Problem Posing Approach MATLAB software are as follows:

1. Divide 2 pieces of paper as much as the number of students in the class
2. Ask students to make a question about integrals on one piece of paper, and write answers on another piece of paper. To facilitate students in making problems, they can use MATLAB software.
3. Then shake all the paper so that it will mix the questions and answers.
4. Each student is given one paper.
5. Explain that this is an activity carried out in pairs, half of the students will get the questions and the other half will get answers.
6. Ask students to find their partner.
7. Repeat until all cards find a partner. After all cards find a partner, ask students to correct the problem and answer. If there are questions and answers that are not appropriate, the teacher and
students discuss them together to find the right solution. End this process by making clarifications and conclusions.

3. Research Methods

This study was included in a quasi-experimental study or quasi-experimental research where classes used existing class. The subjects of this study were students of class XI Senior High School 2 Kuningan. While the sample is class XI B as the experimental class and class XI C as the control class.

The instrument in this study is a test instrument used for data retrieval of students' mathematical problem solving abilities. In addition to instruments for data collection, researchers also made instruments for treatment, namely lesson plan and student worksheets. The treatment given in the form of mathematics learning for the experimental class used Index Card Match learning with problem posing approach assisted by MATLAB software while for the control class using conventional learning. Before the treatment is given to the experimental class, the research begins with the pre-test of problem solving abilities. When a series of treatments in learning activities have been completed, post-test problem solving skills are held.

Retrieval of data after treatment to determine students' abilities in problem solving math after receiving treatment in the experimental class. The data analysis techniques are as follows:

a. Give a score on the students' answers according to the alternative answers and the scoring system used.

b. Make a table of the pre-test and post-test scores of the experimental class and control class students. Calculate the average test score for each class.

c. Calculate the standard deviation to determine the distribution of groups and show the level of variance in the data group.

d. Furthermore, normality and homogeneity of variance tests were performed using the Lavene test.

e. After the normal and homogeneous assumptions are fulfilled, then it can then do a two-level difference test (t-test) to test whether there are differences in students' mathematical problem solving abilities using Index Card Match learning with problem posing approaches assisted by MATLAB software when compared to students who got conventional learning.

4. Research Results and Discussion

In general, the learning process that occurs in the experimental class is in accordance with the signs and criteria and characteristics of assisted learning. This is reflected in the active process of students in discussions, asking questions, answering problems in more than one way, explaining and displaying the results of their work in front of the class and checking answers using MATLAB software. Student activities during the learning process run smoothly, although initially students are a bit stiff in applying the software. This is understandable because the learning process carried out in the experimental class is somewhat different from the learning they have been accustomed to. The initial stage analysis carried out in this study was to analysis the pre-test score. Pre-test score analysis was conducted to determine whether there were differences in students' mathematical problem solving abilities in the experimental class and the control class calculated by the similarity test of the pre-test score using the Mann-Whitney nonparametric test. Similarity test results with a significant level of \( \alpha = 0.05 \) in the pre-test score are shown in table 1 below.

| Code    | N   | Mean Rank |
|---------|-----|-----------|
| Pre-test|     |           |
| Control | 32  | 37.29     |
| Experiment | 35  | 28.53     |
| Total   | 67  |           |
Chi-square calculation obtained 3.569 and significance of 0.059 which means greater than α = 0.05. So that H₀ is accepted, meaning that the average initial problem solving ability of students in the experimental class is equal to the average initial ability of students in the control class.

While to find out the difference in post-test average problem solving ability of students in the experimental class and control class was calculated by the difference test of post-test score using t-test with independent samples test. Hypothesis testing with one-way test with α = 0.05. The results of the post-test average difference test the ability to solve problems using SPSS 21.0 is shown in Table 2.

|                | t     | df  | Sig. (2-tailed) | Difference in average | SEM  |
|----------------|-------|-----|-----------------|-----------------------|------|
| Posttest       | 3.178 | 64  | .002            | 19.276                | 6.066|
| Same variance is assumed |       |     |                 |                       |      |
| The same variance is not assumed | 3.249 | 60.445 | .002            | 19.276                | 5.934|

Based on the table above, the value of asymp. sig (2-tailed) is obtained for post-test problem solving ability amounting to 0.02. If taken α = 0.05 then asymp. sig (2-tailed) < α so that H₀ is rejected, meaning that the problem solving ability of students who use Index Card Match learning model with problem posing approach assisted by MATLAB software is better than students who use conventional learning. The descriptive statistics were obtained as shown in the following table 3.

| Test  | N  | Xmin | Xmax  | ̄x  | Sd  | N  | Xmin | Xmax  | ̄x  | Sd  | Score Max Ideal |
|-------|----|------|-------|-----|-----|----|------|-------|-----|-----|-----------------|
| Pre-test | 32 | 3    | 18    | 10,28 | 5,42 | 35 | 2    | 18    | 8,63 | 5,79 | 20              |
| Posttest | 32 | 5    | 20    | 14,61 | 4,70 | 35 | 2    | 20    | 11,23 | 5,67 | 20              |

To provide a clearer picture of the data, the average score of both abilities based on the research group is presented in the following figure.

**Figure 1.** Average Pre-test and Post-test Score Problem solving ability

The picture above shows the average pre-test and post-test results of students' problem solving abilities in each research group. The difference between the average score between the pre-test score of the experimental class and the control class is 1.65. This shows that the average pre-test score on aspects of students' problem solving ability between experimental and control class is relatively different because the score difference is small. While the difference in the average post-test score between the experimental and control class was 3.4. This shows that in the aspect of students' problem solving ability the average post-test score between the experimental class and the control class is different because the score difference is quite large.

The results showed that students who learned the Index Card Match learning model with problem posing approach assisted by MATLAB software had higher average problem solving abilities than
students who used conventional learning. This result is possible because through assisted learning, the teacher as a facilitator provides instructions and suggestions in group discussions conducted by students when students feel difficulties in understanding and solving problems so that students get better problem solving. Meanwhile, these activities did not occur in the control class.

The learning experience gained by students after learning mathematics using the learning model applied in this experimental class has motivated students to learn more independently. Other findings, during the mathematics learning process using Index Card Match learning model with problem posing approach, assisted by MATLAB software that students are more eager to follow mathematics learning, in each learning students have an interest in the problems given in learning to be completed then each student check the correctness of the answer using MATLAB software.

5. Conclusions and Suggestions
Based on the results of the study, it can be concluded that the problem-solving ability of students who are learning using mathematics learning uses Index Card Match learning model with problem posing approach assisted by MATLAB software better than students who obtain learning with conventional learning. Suggestions for other researchers who will implement mathematics learning using Index Card Match learning model with problem posing approach assisted by MATLAB software, can take subjects and other objects and explore further the relevance of implementing mathematics learning using Index Card Match learning model with problem posing approach assisted by MATLAB software towards other mathematical abilities.

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