Learning algebra through MCREST strategy in junior high school students

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Abstract. The aims of this paper are to describe the use of MCREST strategy in learning algebra and to obtain empirical evidence on the effect of MCREST strategy especially on reasoning ability. Students in eight grade in one of schools at Cimahi City are chosen as the sample of this study. Using pre-test and post-test control group design, the data then analyzed in descriptive and inferential statistics. The results of this study show the students who got MCREST strategy in their class have better result in test of reasoning ability than students who got direct learning. It means that MCREST strategy gives good impact in learning algebra.

1. Introduction
Algebra is one of the branches of mathematics that studies the symbol and its operation. Students at the beginning of junior high school are expected to learn algebra well. Students who study algebra will be better prepared to enter the higher education as well as the world of work Ladson-Billings in Knuth et al [1], Kaput [2]. Learning algebra not only learns about symbols but how to apply knowledge about algebra in everyday life. The importance of students' knowledge of algebraic material can be seen from the distribution of test material conducted by TIMSS which is about 30% of the total; the results obtained from the students took the test was not quite encouraging [3].

Several attempts have been made to facilitate students in learning algebra, such as by using alternative learning, technology, even formal approach [4]. From the results of learning conducted by previous researchers, it appears that students have difficulty in understanding the concept of algebra, i.e. distinguish algebraic terms, perform algebraic operations, propose representation for function. Learning that allows students to interpret the concept of algebra seems to be an issue among other researchers. Yet by applying meaningful learning to students it is possible their understanding related to the concept of algebra would be better [5].

One of the learning process that is suitable for improving students' mathematical reasoning ability involving attitude, knowledge, and skill aspects is learning with MCREST strategy. Learning with MCREST strategy is a learning that involves six movers or motives [6]. The six motives are: meaningfulness, confidence, relevance, enjoyment, social relationships, and targets. Students are motivated to follow the learning from the beginning to the end because of meaningfulness in learning mathematics. When students feel that mathematics is meaningful, their confidence will increase. In addition, teachers can also provide questions from easy and simple levels to help improve students' confidence. To maintain students' confidence, learning should pay attention to the needs of students. It
means that learning must have relevance to student life. This can be done by giving questions related to the daily life of the students. Providing feedback with a variety of forms such as flattery, gifts, or "punishment" that keeps maintaining and even improving students' confidence after they interpret math, make math a fun thing. From the description, the author assume, it needs a comprehensive study of students' mathematical reasoning ability by applying the MCREST learning strategy in study algebra. The purposes of this study are to describe the use of MCREST strategy in learning algebra and to obtain empirical evidence on the effect of MCREST strategy especially in mathematical reasoning ability. It is expected from the study, comprehensive description of learning algebra with MCREST strategy and evidence that it has a significant influence on the students in terms of mathematical reasoning ability.

2. Learning Algebra with MCREST Strategy

The topics of algebra that are studied in this research are algebraic operations and functions. In algebraic operations, students learn to recognize algebraic forms and simplify algebraic forms. While on the function material, students learn about the characteristics and forms of function representation. Learning about introduction of algebraic forms to students is not immediately informed that there are consists of variables, constants, coefficients, like and unlike terms, and others. For example mentioned \( 2x + 4 \), then the teacher mentions 2 is the coefficient \( x \) is a variable, and 3 is a constant, \( 2x \) is called a term, 3 is called another term, so \( 2x + 4 \) consists of two terms.

The above explanation will not be meaningful to students. It should be taught by using meaningful representations for students. This corresponds to one element of MCREST, that is meaningful. Students are given a worksheet containing activities related to knowing the algebraic form, i.e. their activities by using candies placed in closed containers, while some candies are outside, the illustrations are then written on a paper called a multimodel board "MM", as follows:

![Figure 1. Example of Multi-Model Board](image)

The activities of the students tell their daily activities are activities of relevance. Students who study in groups are a form of one element of MCREST, namely social relationship. After the students complete their tasks in the student worksheet, then the students are asked to show the results of their discussion in front of the class, this is nothing but to increase her confidence. At the end, the teacher asks what is the target of learning today. Furthermore students are given an explanation of the formal term of the algebraic form.
Figure 2. Example Expression of Algebra

In addition, to perform simplification operations of algebraic forms, we may use “ubin aljabar” representation, as follows: \((3x - 4z + 5) - (2x - 3z + 4) = x - z + 1\).

Figure 3. Representation of Simplify Algebraic Expression

The activity is certainly enjoyed by students throughout the learning. In MCREST strategy, it is included in the element of enjoyment. From learning algebra using MCREST strategy, the ability of students' mathematical reasoning can develop well. Some of the reasoning ability expected from students in learning algebra are: being able to check the truth of a statement related to algebraic operations based on given data; simplifying algebraic expressions through mathematical calculations; understanding examples of functions based on given data; being able to investigate patterns then use it to determine the value of a multiplication of algebraic forms; using the regularity of the patterns associated with the form of a linear function; being able to investigate the structure and then solving problems associated to algebraic operations involving rational numbers; writing some conjectures of a problem related to the application of algebraic operations in daily life and being able of making conjecture of a problem related to the application of algebraic expressions in everyday life.

3. Method
This study was a quasi-experimental with a nonequivalent control-group design [7]. The selection of experimental and control group was not randomized and only experimental group received special treatment.

In the implementation of the study, the researcher selected two classes, hereinafter referred to as experimental group and control group. The experimental group received special treatment in the form of learning with MCREST strategy (X) while the control group received no special treatment, in this case the control group got direct learning. Before the treatment, both groups were given pre-test (O) as well as after the treatment was given post-test (O). Form of pre-test and post-test tests are essays test.
The population in this study was all students of grade eight in Cimahi City in the academic year 2016/2107. Selection of research samples consider to the material in the current semester because not all schools in that academic year applying the national curriculum 2013. From the eleven of public schools in the city of Cimahi, just three school applying kurtilas, namely SMP Negeri 1, SMP Negeri 8, and SMP Negeri 5. Considering the time of research conducted then SMP Negeri 1 Cimahi was selected as the location of research. Furthermore, the selection of the class is not done randomly because the researcher as a subject teacher consider the teaching schedule, class VIII A is chosen as the control group and class VIII B as the experimental group.

There are three major stages of the procedure in this study, namely the preparation, implementation, and data processing.

1) Preparation stage: identifying the research problem, conducting preliminary study, then the researcher preparing the hint problem for research instruments in the form of mathematical reasoning test. After the research instrument was examined by the expert, then tested the instrument in two equivalent schools to see the reliability and empirical validity. The test results are then analyzed. From the analysis result selected some items of test questions that meet the validity and reliability, then the instrument is ready to be used as a measuring tool. Preparation of learning tools for the experimental group in the form of learning implementation plans and student activity sheets also did not escape the preparatory steps that researcher done. Once the learning tool is checked by an expert, the next step is to carry out the research.

2) Implementation stage: determining the population and the sample that will be the subject of research, then make sure of the research permit at the school concerned. The next step is to determine the experimental and control groups based on the considerations of the school, followed by the pre-test of each group. The next activity is the treatment of each group in the form of learning with the MCREST strategy in the experimental group and direct learning in the control group. The material given on algebraic operations and functions performed during the twelve meetings. After the learning activities are completed, each group is given a post-test with the aim of viewing the students’ learning outcomes after being given treatment related to their mathematical reasoning ability.

3) Data Processing stage: data in the form of test result of mathematical reasoning ability is analyzed quantitatively by using descriptive and inference statistic test. To determine the test of inference statistics to be used, firstly tested the data normality and homogeneity of pre-test and post-test variance. Furthermore, it calculates the magnitude of students' mathematical reasoning ability by using the normalized gain developed by Hake [8].

4. Result and Discussion
Descriptive statistical analysis was conducted to obtain a description of the students' ability before and after being treated, while inferential statistical analysis is used for drawing conclusions on differences in student ability improvement. Data processing was done by using Microsoft Office Excel application and software SPSS 16. Here is description of data results and discussion.

| Test   | Experiment Group | Control Group |
|--------|------------------|---------------|
|        | N    | $X_{\text{min}}$ | $X_{\text{max}}$ | $\bar{X}$ | S   | N    | $X_{\text{min}}$ | $X_{\text{max}}$ | $\bar{X}$ | S   |
| Pre-test | 34  | 5      | 26      | 11.760 | 4.479 | 31  | 3      | 20      | 9.610  | 3.947 |
| Post-test | 34  | 14     | 39      | 23.794 | 5.896 | 31  | 8      | 28      | 18.967 | 5.694 |
| G       | 34  | 0.180  | 0.870   | 0.423  | 0.178 | 31  | 0.030  | 0.540   | 0.301  | 0.141 |

Ideal Score: 41
Table 1. presents descriptive statistics of mathematical reasoning ability of the pre-test, post-test, and normalized gain (g) scores of the experimental and control groups. The pre-test and post-test scores are expressed in a score of 0 - 41, while the normalized gain (g) is expressed in a score of 0 - 1. It is seen at a glance, the third rows above show that the average ability of the experimental group is better than the control group. To ascertain whether the experimental and control group mathematical reasoning ability differ significantly or not, the next step is comparing means of normalized gain to see the difference.

Since the pre-test mean of one of the groups is not normally distributed then to draw the conclusion was used non-parametric test Mann-Whitney. For the normalized gain, both of groups were normally distributed and homogeneous, so to draw the conclusions parametric t-test was used. The significance level of each test was 0.05 with confidence level 95%. The results can be seen in the Table 2.

| Test of Pre-test Means | Group     | Mann-Whitney | t   | Asymp.Sig. (2-tailed) | Conclusion | Comment |
|------------------------|-----------|--------------|-----|-----------------------|------------|---------|
| Comparing              | Experiment| 382.000      |     | 0.056                 | Accept H_0 | No difference |
|                        | Control   |              |     |                       |            |         |
| Comparing Normalized Gain | Experiment | -           | 3.017 | 0.040 | Reject H_0 | Difference |
|                        | Control   |              |     |                       |            |         |

From Table 2. it can be seen Asymp.Sig value for pre-test average is higher than the level of significance selected. This means that the average of the experimental and control groups for mathematical reasoning ability is not different. Thus, before the experiments performed both groups had equal ability on mathematical reasoning ability, so the requirement that both groups should have the same prior knowledge was fulfilled.

Furthermore, the analysis runs of increasing the ability of mathematical reasoning in both groups. In general, as shown in Table 3. that the mean score of mathematical reasoning ability of the experimental group shows an increasing about 0.122 more than the control group. For the dissemination of mathematical reasoning ability after learning, the experimental group is more diffuse than the control group because the experimental standard deviation looks bigger. However, to prove that improving students' mathematical reasoning ability better than control group requires further statistical tests. As can be seen in Table 3. it can be concluded that the average normalized gain of the experimental group is better than the average normalized gain of the control group. To see the improved quality of mathematical reasoning ability in each group can be seen based on the normalized gain criteria expressed by Hake [8].

| Table 3. Classification of Normalized Gain Score in Mathematical Reasoning Ability |
|-----------------------------------------------|---------------|---------------|
| Interpretation             | Experiment N | Control N  |
| High                        | 2             | 0             |
| Middle                      | 22            | 14            |
| Low                         | 10            | 17            |
|                             | 0.86          | 0.46          |
|                             | 0.25          | 0.19          |

Table 3. shows the majority of students in the experimental group achieved normalized gain score in middle category, there are only two students categorized high and ten students in low. In the control group, the normalized gain gain category looks balanced, that is seventeen students in low category
and fourteen students are in middle category. However, when viewed thoroughly both groups achieved normalized gain in the middle category. It can be said that the quality of the reasoning ability improvement of both groups is not much different, that is in the middle category, although they are difference statistically.

5. Conclusion
From the results and discussion above it can be concluded that the learning with MCREST strategy gives a significant impact on improving students' mathematical reasoning ability. Nevertheless, the results have not been maximized. It is suggested that further researchers who will use this strategy can conduct research for a wider sample with different school levels.

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