Improving of mathematical proficiency and disposition using multi representation approach on vocational students

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Abstract. This study aims to examine the achievement and improvement of mathematical proficiency and disposition of vocational students using multi-representation approach. The method used in this study is a quasi-experimental method. The population in this study were all students of class XI in one of the vocational schools in the city of Cimahi, while the sample was chosen by two classes, 1 control class that used the usual approach, one class again, the experimental class using a multi-representation approach. The instruments used were in a set of mathematical proficiency and non-test in a set of a questionnaire to measure students' mathematical dispositions. All data processing used SPSS. Based on the results of data processing, it was concluded that mathematical proficiency and mathematical disposition of vocational students whose learning using a multi-representation approach were better than the usual approach.

1. Introduction
The process of student learning activities designed is a process that leads students to mathematical abilities. The competency of mathematical knowledge demanded in the 2013 curriculum for middle school students includes the ability to explain, perform count operations, determine representation, analyze, associate, describe, and generalize abilities [1].

Referring to the competency of mathematical knowledge demanded by the 2013 curriculum, mathematics is a means of forming students' mindsets that are measured by their abilities or abilities. Skills can help solve mathematical problems. This mathematical skill is not something "innate" skills of students only, but is a combination of knowledge, skills, abilities, and beliefs obtained by students with teacher assistance / support, curriculum, and learning environment (class).

Groves [2] in his article entitled "Developing Mathematical Proficiency", it was stated that many countries have adopted the process of mathematical skills as a standard of ability in schools, because mathematical skills are not only developing skills and understanding of students but the process of understanding, reasoning, using procedures, formulating, representing and solving problems, the ability to think logically, reflect, explain and prove the truth, to have productive habits, see mathematics as a useful thing. In research Khairunnisa and Pamungkas [3], there is a good potential effect of student learning outcomes which are usually given mathematical skills.

Hariwijaya [4] argues that one of the requirements for advanced students in mathematics is that students must have a positive disposition attitude, namely the attitude that mathematics is useful in their lives. The development of interest and interest in mathematics will form a strong tendency called mathematical disposition. Mathematics learning is not only related to conceptual, procedural, and
application learning, but also related to the development of interest and interest in mathematics as a powerful way of solving problems [5].

Unproductive mathematical disposition results in obstruction of mathematical achievement [6]. It is important to note that mathematical dispositions are not a single scale, but rather even multi-dimensional dimensions of intellectual and emotional factors related to completing tasks that require mathematical thinking or processes, Feldhaus [7]. Mathematical disposition is a combination of attitudes, behaviors, motivations, interests, and real feelings from mathematical achievements that can activate or hinder mathematics learning.

So that from this explanation it can be understood that mathematical dispositions greatly support the success of learning mathematics which has implications for the achievements obtained. Students require mathematical dispositions to survive in facing problems, take responsibility in learning, and develop good work habits in mathematics. Based on research Prasetyo, Dwidayati and Junaedi [8], Artisan personality types have moderate disposition rates, Ideal personality type students have high mathematical disposition levels characterized by mastering the dominating class, Guardian personality type students have moderate mathematical disposition rates, Rational personality students have high mathematical disposition levels marked have a good attitude towards mathematics, but none of these types have a very high level of disposition.

One approach that makes it possible to support students’ skills and mathematical dispositions is the approach multi representation. Multi-representation is a form of arrangement of concepts represented by verbal sentence writing, symbols as mathematical forms, images and graphics so that the delivery of an information data can be conveyed. As the solution given by Murtono, Setiawan and Rusdiana [9] the way to access appropriate knowledge is to use an understanding of the form of representation.

There are five reasons why multi representation is good for use in learning according to [10], namely: (1) multi-representation learning helps learners who have different intelligence backgrounds (multiple intelligences). (2) quantity and concepts can often be visualized and understood better by using representations; (3) help construct other representations that are more abstract; (4) qualitative reasoning is often helped by using concrete representations; (5) abstract mathematical representations can be used for quantitative reasoning where mathematical representations can be used to find quantitative answers to questions. In line with research Wati and Iriani [11] learning with multiple representations of learning outcomes test scores and high visual representation abilities and students’ responses to positive students in the learning process, with activities centered on students so that learning gets a positive response and results in student learning outcomes increase.

2. Method
On the characteristics to be measured in this study is the ability of mathematical skills (mathematical proficiency) students who obtain the multi-representation approach. This measurement of mathematical abilities was carried out on groups of students who were treated (experiments) and groups of students as a comparison or control.

The design used in this study is quasi-experimental. The design of this study was used because this study used a control group, there were two different treatments. Observations were made twice namely before the learning process and after the learning process. In short, the research design is as follows:

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O & O \\
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Information:
O : Pretest = posttest (test of mathematical proficiency)
X : Treatment of multi-representation approach

This research will be conducted in one of the Vocational Schools in Cimahi. This research was be held from March to May 2019. The subjects in this study were grouped in 2 classes, one class was made into the experimental class or the experimental group. While the other 1 class is used as the control class or control group. The group is selected based on the class given by the school. The instrument developed in this study is a written test in the form of a description. In this case, given the
written test will be used to determine the ability of mathematical skills (mathematical proficiency) students. This written test measures mathematical proficiency aspects students.

Before the test is used in the research, first a question grid is made which is followed by compiling the questions along with alternative answer keys and scoring rules for each item. Next the questions are tested to determine the validity, reliability, level of difficulty and distinguishing power of each test item that will be used in the study.

The scale of attitude (mathematical disposition) used in this study aims to determine mathematical dispositions students against the indicators. Mathematical disposition questionnaires are given in the experimental class after all learning is complete.

The scale model used is a Likert scale model. The degree of assessment of a statement is divided into 4 categories, namely: strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). In analyzing the results of the attitude scale, the qualitative scale is transferred to a quantitative scale. The value is differentiated between negative statements and positive statements. For statements that are positive, the score is SS given a score of 4, S is given a score of 3, TS is given a score of 2, and STS is given a score. As for negative statements, the score is SS given a score of 1, S is given a score of 2, TS is given score 3, and STS is given a score of 4.

Data in this study will be collected through tests and questionnaires on attitude scale (mathematical disposition). Data relating to students' mathematical proficiency abilities are collected through tests. While students' mathematical disposition data during learning was collected through questionnaires. Data to be analyzed are quantitative data in the form of mathematical proficiency test students, and qualitative data which is then converted into quantitative data in the form of questionnaires for students.

3. Result and Discussion

3.1. Results

Based on the results of data processing on the pretest, posttest and N-gain of mathematical proficiency and disposition, the results showed in Table 1 below:

| Measured aspects          | Experimental Group | Control group |
|---------------------------|--------------------|---------------|
|                           | Pretest | Postes | N-gain | Pretest | Postes | N-gain |
| mathematical proficiency  | 3.09    | 0.926  | 15.59  | 0.742   | 0.024  | 3.19   |
| mathematical disposition  | 104.88  | 89.661 |        | 13.91   | 9.701  | 0.644  |

The next step is the normality test for pretest, posttest, and N-gain, the results of data processing were presented in the following Table 2:

| Measured Tests | Experimental Group | Control group |
|----------------|--------------------|---------------|
|                | Statistics | Df | Sig. | Statistics | Df | Sig. |
| Pretest        | 0.216      | 32 | 0.001 | 0.213      | 32 | 0.001 |
| Posttest       | 0.278      | 32 | 0.000 | 0.200      | 32 | 0.002 |
| N-gain         | 0.207      | 32 | 0.001 | 0.170      | 32 | 0.001 |

Table 2 shows for pretest, both the experimental and control class had a significant value of 0.001, the value was less than 0.05, so it can be concluded that both the experimental class and the control class are not normally distributed. For posttest, the experimental class has a significant value of
0.000, the significant value is less than 0.05 and for the control class has a significant value of 0.002, the value is less than 0.05, so it can be concluded that both the experimental class and the control class are not normally distributed. Furthermore for N-gain, both the experimental and control classes have a significant value of 0.001, the value was less than 0.05, so it can be concluded that both the experimental class and the control class are not normally distributed.

The results of data processing in Table 2 concluded that the results of pretest, posttest and N-gain were not normally distributed, then the Mann-Whitney test was used to test the hypothesis, based on the results of data processing the following results were obtained (Table 3).

**Table 3. Mann-Whitney test for pretest, post-test and N-gain mathematical proficiency**

| Measured Tests | Statistics | Mann-Whitney U | Z | Asymp. Sig. (2-tailed) | Asymp. Sig. (1-tailed) |
|----------------|------------|----------------|----|-----------------------|------------------------|
| Pretest        | 503,500    | -0.119         | 0.271 | -                     | -                      |
| Posttest       | 349,000    | -2.212         | -   | 0.14                  | 0.016                  |
| N-gain         | 350,500    | -2.172         | -   | -                     | 0.016                  |

Table 3 show the pretest obtained a significance value of 0.271, the value was greater than 0.05, so there was no difference in mathematical proficiency. Students who used multi representation approach with the usual approach, for posttest obtained a significance value of 0.014, because it is less than 0.05, it can be concluded that the achievement of mathematical proficiency of students using multi representation approach was better than the usual approach. Furthermore, for N-gain obtained a significance value of 0.016, because the significance value is less than 0.05, it can be concluded that the improving of mathematical proficiency students using multi representation approach was better than the usual approach.

The next step is to test the results of the scale of mathematical disposition between students and multi-representation learning approaches with the usual approach, from the calculation results obtained from the results of the results of normality tests as follows (Table 4).

**Table 4. Normality test of mathematical disposition**

| Measured Tests | Experimental Group | Control group |
|----------------|-------------------|---------------|
|                | Statistics        | D f | Sig.      | Statistics        | D f | Sig. |
| Posttest       | 0.119             | 32  | 0.200     | 0.205             | 32  | 0.01 |

The results of processing the data in Table 4 concluded that the results of the posttest was not normally distributed, then the Mann-Whitney test was used to test the hypothesis, based on the results of the data processing were Obtained the following results (Table 5).

**Table 5. Mann-Whitney test for posttest mathematical disposition.**

| Measured Test | Statistics | Monte Carlo Sig (1-tailed) |
|---------------|------------|----------------------------|
| Posttest      | 175,000    | -4.531                     | 0.000                      |

Table 5 show for of mathematical disposition posttest obtained a significance value of 0.000, because the significance value was less than 0.05, it can be concluded that the achievement of mathematical disposition of students using multi representation approach was better than the usual approach.
3.2. Discussion.
The process of practicing thinking and reasoning in drawing conclusions so as to develop creative activities that involve imagination, intuition, and discovery so that it becomes a provision to develop problem-solving skills and the ability to convey information and communicate ideas.

The skill process can be one of the starting points of students in solving problems. One part of mathematical skills is conceptual understanding according to Hidayat, Noto and Sariningsih [12] there is a direct influence on the understanding of the concept of the operation of the concept has a direct influence on the conceptualization. The results of the study which said that the achievement and improvement of mathematical proficiency in vocational students using a multi-representation approach was better than ordinary learning, according to the research Amalia [13] that vocational students must have the skills to carry out mathematical activities to achieve the ability to understand problems, design mathematical models, complete models and interpret solutions obtained, which are called mathematical skills. Also in line with research Awofala [14] states the mathematical skills of middle school students in Nigeria by looking at gender and performance, categorized well. Also in line with the results of the Dhlamini and Luneta study [15], the mathematical skills of grade 12 students in matrix material can increase.

The results of the study which said that the achievement of the mathematical disposition of vocational students using a multi-representation approach was better than ordinary learning. In line with research Asmara [16] showing that the mathematical dispositions of vocational students can increase with interactive multimedia-based problem-based learning, simulations make it possible to invite students to improve their thinking and mathematical dispositions. Different from research Widyasari, Dahlan and Dewanto [17] showed that the increase in students' mathematical disposition skills between classes who received learning with metaphorical thinking and classes that received conventional learning methods did not differ.

Sumarmo [18] that in learning mathematics students need to prioritize the development of mathematical thinking and disposition skills. Research Irawati and Hasanah [19] mentions students with high mathematical abilities in solving linear program problems using various representations (multi representation), both visual representation, verbal and mathematical expressions. So this helps them to get the right answer. In line with [20] which states, to help improve students' scientific reasoning abilities, learning is needed that invites students such as determining claims, gathering information or data for evidence, then connecting claims and evidence and learning with a multi-representation approach is one of the learning can improve students' scientific reasoning abilities.

4. Conclusion
Based on the results of data processing, it was concluded that 1) The achievement and the improvement of mathematical proficiency of vocational students whose learning using a multi-representation approach were better than the usual approach; 2) The improvement of mathematical disposition of vocational students whose learning using a multi-representation approach was the better than the usual approach

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