Improving Students' Critical Mathematical Thinking Skills Through SAVI Approach on Number Theory Lectures At Mathematics Education Department of Malikussaleh University

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ABSTRACT

The research aimed to see whether SAVI learning approach is better than a normal class in improving students' critical mathematical thinking skills due to number theory lectures of mathematics. This research used a quantitative research approach with experimental method in the form of quasi-experiment. The population of this research was all the fourth semester of mathematics department students of Malikussaleh University. The sampling used was a purposive sampling that consisted of students in class A1 and A2. The research design used a non –equivalent control group design. The instrument used in this research was a set of questionnaire of critical thinking that had been validated by several validators. Then, the analysis of the improvement score of students' critical mathematical skills used a normalized gain data which shows the improvement of students' score classification compared to the ideal maximum score. However, the n-gain score data of students' critical mathematical skills of control class was not normally distributed. so a non-parametric test was conducted, namely the Mann Whitney U Test. Form Test results, the Asymp. Sig. (1-tailed) value was obtined around 0.008 < α = 0,05. This shows that H0 is rejected. Hence, it means that the improvement of students' critical mathematical skills of experimental class is significantly better than a control class. Thus, it is also proven by the hypothesis that applying SAVI approach in learning is better than a normal class without any treatment in improving students' critical mathematical thinking skills.

1. INTRODUCTION

Thinking is a crucial activity processed by brain to transfer information throughout the body. Starting from the thought process, humans can carry out physical and non-physical activities normally. The ability to think is very important for humans to continue their survival, especially in this rapidly growing era. Critical thinking is the ability that every person has to analyze an idea in a more specific direction to pursue relevant knowledge by evaluating its evidence. The ability to critically think is needed in making decisions to do or believe in things that begin with reasoning and reflective thinking (Ennis, 2013; Fascione, 2000). Critical thinking aims to give confidence or not to the claims given. Critical thinking is closely related to Mathematics, especially in solving problems that are related to the ability to remember, recognize the relationship between mathematical concepts, realize the existence of a causal relationship, an analogy or difference,

which can then bring up original ideas, as well as smooth and flexible in making decisions or conclusions precisely, quickly and wisely. But in reality, many graduates do not have sufficient competence in subjects and show weaknesses in critical thinking, time management, and the capacity to work independently and ethics in work (Al-Kindi & Al-Mekhlafi, 2017). This is also in line with the results of students' critical mathematical skills test at mathematics department of Malikussaleh University, showing 24 students obtained the highest and the lowest score of critical mathematical thinking skills. each of them is around 56.3 and 15.6 percent in the ideal value of 100. The mean score is 41. The results show that the students' critical mathematical thinking skills is still relatively low.

The ability to critically think is a high level thinking skill that must be possessed by every student. In learning mathematics, this critical thinking ability can be achieved based on what it means to teach, do, and understand

mathematics in details. This is in line with the thoughts of Maulana (Karim: 2011) critical thinking skills can be developed both at school and in higher education which focuses on concepts, systems, principles, structures and tight links between one material with another material. Cabrera (Sumarmo: 2008) revealed that critical thinking is a basic process in a situation that allows students to repeat and reduce future uncertainties.

Here are some indicators of mathematical critical thinking ability based on Suwarma (2009) as follows:

1. The ability to generalize which is the ability of students to understand about the problem and know what is asked of each problem provided;

2. The ability to identify which is the ability of every student to write the concepts used from the problems provided;

3. The ability to formulate problems into mathematical models which is the ability of each student to write information about symbols from a predetermined mathematical model;

4. the ability to deduce using principles which is the ability of students to solve problems provided by using concepts and mathematical models that have been determined and able to provide conclusions from the problem.

Moreover, learning that can be considered to be used to improve students' mathematical critical thinking skills is SAVI (Somatic, Audiotory, Visual, and Intellectual) learning. SAVI is a learning-centered approach that combines the four elements in learning, Somatic (S) that is moving, Auditory (A)) listening and speaking, Visual (V) seeing and observing, and Intellectual (I), the ability to think to solve problems and reflect on them (Putra, 2013). These four ways of learning are integrated elements and will provide an optimal result if everything is used simultaneously.

Suyatno (2009) also stated that SAVI learning is a learning that utilizes all the senses students have. Learning activities should be done through listening, listening, speaking and expressing opinions. Thus, the SAVI approach combines four elements in learning that utilizes the senses during the learning process. By using the SAVI approach, somatic, auditory, and visual type learners can meet their needs in learning to improve their intellectual abilities. The stages of SAVI learning are as follows:

1.1 Preparation

The objectives of the preparatory stage include raising the interest of the learners (students), giving them positive feelings about the learning experience that will come and placing them in an optimal situation for learning.

1.2 Submission

The purpose of the delivery stage is to help learners find new learning material that are interesting, fun, relevant, involving the five senses, and suitable for all learning styles.

1.3 Training

The purpose of the training phase is to help learners (students) integrate and absorb new knowledge and skills in various ways. This stage can be done with problem solving activities and pair or group dialogue.

1.4 Appearance Of Results

The purpose of the results display stage is to help learners (students) apply and expand their new knowledge or skills on the job so that learning outcomes will stick and the appearance of results will continue to improve.

These are the strengths of the SAVI approach according to Nasution (2017):

1. SAVI makes students not only sit in a chair and be quiet, but makes them move by using all their senses and thoughts

2. Learning is not only a teacher-centered

3. Learning becomes more fun because many activities are carried out so that you will avoid boredom

4. More flexibility in using various types of media and methods

Besides, the SAVI approach also has some weaknesses. The weaknesses possessed by the SAVI approach according to Meier (2004) as follows in detail:

1. This approach is very demanding for the perfect teacher, so that it can integrate all four components in SAVI as a whole.

2. The application of this approach requires complete learning facilities and infrastructure that are comprehensive and tailored to the needs, so that they require very large tuition fees. Especially for the procurement of sophisticated and attractive learning media. This can be achieved in advanced schools.

So, applying the SAVI approach to learning means combining students 'sensory abilities to better understand the material being taught that is expected to be able to improve students' critical mathematical abilities. Then, the purpose of this study is to see whether the improvement of students' critical mathematical thinking skills of mathematics department students of Malikussaleh University due to the SAVI learning approach is better than the usual learning in lectures on number theory.

2. METHODS

This research used a quantitative research approach with experimental methods in the form of quasi-experiments. This research was conducted with existing classes without forming new classes. This research was carried out on the fouth semester mathematics department students of teacher training and education faculty of Malikussaleh University (2019/2020 academic year). The sampling used in this research was a purposive sampling that consisted of class A1 and A2.

In class A1, the learning process applied the SAVI learning approach, while class A2 used the normal learning model without any treatment. The design used in this study includes three stages: (1) The stage of developing research instruments, (2) The testing phase of research instruments, (3) The stage of conducting research. Each stage is designed so that valid data is obtained according to the characteristics of the variables and research objectives.

The research design used in this study is non-equivalent control group design. In this design, there are two groups chosen by purposive sampling with the experimental design based on Creswell (2012) as follows:

O   X   O   experimental group
- - - - - - - - - - -
O   O   control group
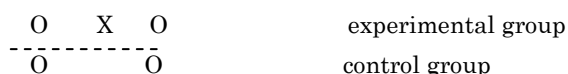
Information :

O   : Pretest or post-test mathematical critical abilities

X   : SAVI Learning

----   : Subjects are not randomly grouped

Data processing is analyzed based on the problems in this study. It starts by conducting prerequisite tests of data analysis such as homogeneity and normality tests before analyzing hypotheses using t-tests.

Data obtained from the results of the pre-test and post-test were analyzed to determine the improvement of students' critical mathematical thinking skills. The scores obtained from student test results before and after being treated with the Realistic Mathematics Approach assisted by teaching aids. They were analyzed by comparing the students' scores obtained from the test results before and after being conducted the normal learning treatment. The amount of improvement before and after learning is calculated by the normalized gain formula (normalized gain) as follows:

$$(g) = \frac{posttest\ score - pretest\ score}{ideal\ score - pretest\ score}$$

The following table is the gain index criteria:

Table 1. Normalized Gain Score Criteria

Gain Score	Interpretation
$g > 0,7$	High
$0,3 < g \leq 0,7$	Medium
$g \leq 0,3$	Low

After the normalized gain results have been collected, the next step is to test for normality and homogeneity as a prerequisite for parametric statistical tests. The statistical hypothesis test in this study are:

$$H_0 : \mu_1 = \mu_2$$
$$H_1 : \mu_1 \neq \mu_2$$

where μ_1 = the mean pretest data of experimental group
μ_2 = the mean pretest data of control group

Test Criteria:

if the Sig. score (*p-value*) <α (α = 0.05), then H_0 is rejected
if the Sig. score (*p-value*) ≥ α (α = 0.05), then H_0 is accepted.

Here are some procedures of the average difference test score analysis in pre-test score, post-test score, and n-gain are:
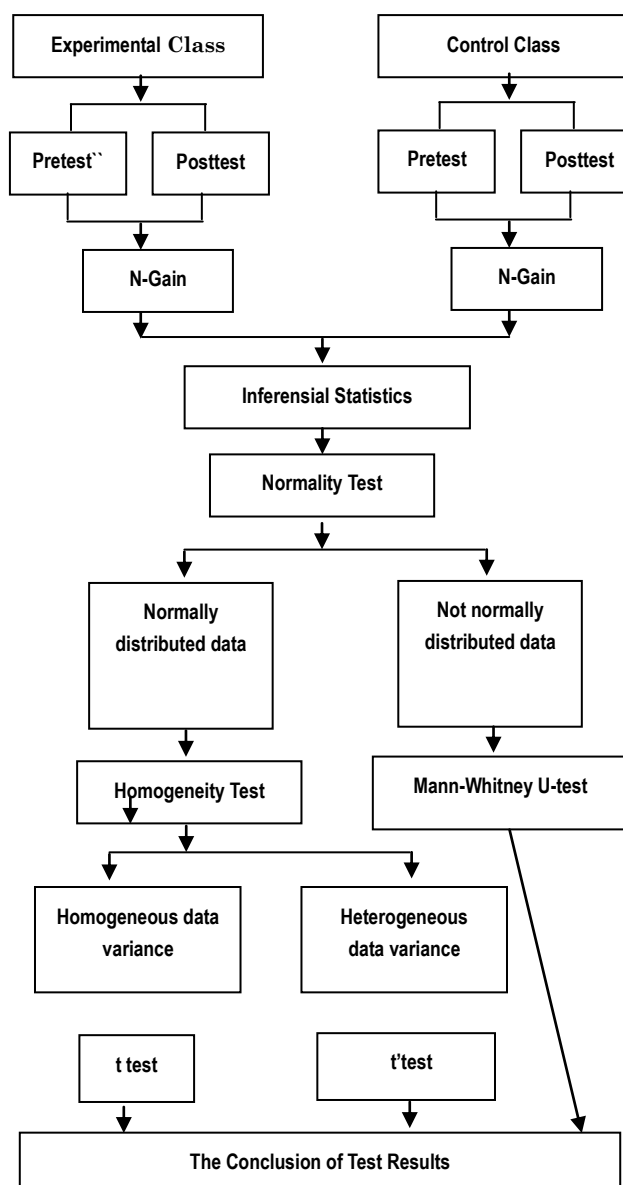

Figure 1. Research Procedure

3. RESULTS AND DISCUSSION

This research aimed to study the improvement of students' critical mathematical thinking skills through SAVI learning. It is better to apply the SAVI approach in learning process than learning without any treatment (normal learning) in lectures on number theory based on the results of research conducted toward mathematics department students of Malikussaleh University.

Data analyzed were n-gain data obtained from pre-test and post-test data. The analysis of the N-gain score of students' critical mathematical skills using normalized data gain. The normalized data gain also shows the improved classification of student scores comparing with the ideal maximum score. The average of n-gain showed the learning improvement of students' critical mathematical skills in both SAVI approach and normal learning.

1) Normality Test of N-gain Data of Critical Mathematical skill

The normality test for the N-gain score was calculated by the Saphiro-Wilk test aided by the SPSS 17 program.

The formulation of the hypothesis used is:

H_0: The samples come from the populations that are normally distributed

H_a: The samples come from the populations that are not normally distributed

The test criteria are as follows:

If the Sig. Score *(p-value)* <α (α = 0.05), then H_0 is rejected

If the Sig. Score *(p-value)* ≥ α (α = 0.05), then H_0 is accepted.

Table 2. Normality Test Results Data

Class	Saphiro-Wilk			Conclusion
	Statistics	Df	Sig.	
Experiment	0,535	21	0,00	H_0 rejected
Control	0,902	24	0,001	H_0 rejected

From Table 2 above, it can be seen that the n-gain score of students' critical mathematical skills of the experimental class shows a Sig. <α = 0.05 so H0 is rejected. This shows that the n-gain score data of control class is not normally distributed due to each of the n-gain data of the critical skills in both the experimental and control classes are from the populations that are not normally distributed. Therefore, the homogeneity testing is not necessary to be conducted.

1) The Difference Mean Test of N-gain Score Data of Critical Mathematical Skill

Based on the results of the normality test that had been done previously, it was concluded that the N-gain scores of the experimental class and the control class were not normally distributed, so as to prove that the n-gain scores of the students' critical mathematical skills of the experimental class were better than the control class, the similarity tests of the average scores of n- gain using a non-parametric test (Mann-Whitney U-Test).

The hypothesis of this study is "Improving students' skills to critically think mathematics toward the students of mathematics department of Malikussaleh University due to SAVI learning approaches is better than normal learning in lectures on number theory".

To test the proposed research hypothesis, the following statistical hypotheses are formulated:

H_0 : $\eta_1 = \eta_2$: The rank of critical mathematical skill (n-gain) of students who obtained SAVI learning was significantly the same as students who obtained normal learning.

H_1 : $\eta_1 > \eta_2$: The Rank of critical mathematical skill (n-gain) of students who get SAVI learning is significantly better than students who get normal learning.

The testing criteria:

if the Sig. Score *(p-value)* < α (α = 0.05), then H_0 is rejected

if the Sig. Score *(p-value)* ≥ α (α = 0.05), then H_0 is accepted.

Table 3. The Test Results of different N-gain Rank on Critical skill

Statistics	core	Conclution
Mann-Whitney U	412,6	H_0 rejected
Asymp. Sig. (1-tailed)	0,008	

From the *Mann-Whitney U-Test* results above, the *Asymp.* Sig. *(1-tailed)* value was obtained   around 0.008 <α = 0.05. This shows that H_0 is rejected, it means that the improvement of students' critical mathematical skills of experimental class is significantly better than control class. Thus, it is evident that the hypothesis stating that the improvement of students' critical mathematical abilities of students who apply SAVI learning is significantly better than students who get normal learning.

The results showed that the improvement of critical mathematical skills of students who obtained SAVI learning was significantly better than students who obtained normal learning. This is indicated by the N-gain students who apply SAVI learning by 0.88 (high category), higher than students who get normal learning by 0.58 (medium category). This finding is in line with Nasution's research results (2017), Putra (2013) and Khasanah (2017) who considered that the improvement of students' critical mathematical skills due to applying SAVI learning is better than students who get normal learning.

Before conducting this research, the researchers drew up the implementation of research plan first. The material discussed in this study was the arithmetic module which is part of a number theory course. The treatment was taken by applying the SAVI (Intellectual Visual Auditory Somatic learning). According to Meier (2004) in accordance with the abbreviation of SAVI itself: Somatic, Auditory, Visual and Intellectual, so the characteristics consist of four parts as follows:

1. Somatic, if it is associated with learning, it can be interpreted that learning by moving and doing. So, somatic learning is learning that utilizes and engages the body (the sense of touch, kinesthetic, involving physically and moving the body while learning activities take place)

2. Auditory, learning by speaking and listening. It can be interpreted that learning by inviting students to

talk when solving problems, making models, gathering information, making work plans, mastering skills, making reviews of learning experiences, or creating personal meanings for themselves.

3. Visual, learning by observing and describing. In the brain, there are more devices for processing visual information than all other senses. Every student who uses his visuals is easier to learn if he can see what is being said by a lecturer or a book or computer program. In particular, visual learners are good if they can see examples from the real world, diagrams, idea maps, icons, and so on in learning.

4. Intellectual, learning by solving problems and pondering. The actions of learners who internally do something with their minds use their intelligence to reflect on an experience and create relationships, meanings, plans, and values from these experiences.

The achievement of students' critical thinking skills test in this study has been set with a maximum score of 16. The average pretest results before having the treatment of experimental and control classes are 3.22 and 3.59, respectively. The results show that the pretest the two classes do not differ much or the same. This is reinforced by further analysis test that compares the average of the two classes using the nonparametric test of *Mann Whitney U-Test*. This test is conducted because the pretest data of the two classes is not normally distributed. The results obtained that both classes have the same ability.

To be compared, learning of experimental class due to applying SAVI approach is more superior than learning in control class that taught with normal learning. This is reinforced by the results of statistical tests using the nonparametric test of *Mann Whitney U-Test*. Similar to the pretest data, the n-gain data in this study are also not normally distributed so t tests cannot be performed. The results of the *Mann Whitney U-Test* show that the improvement of the students' critical thinking skills with SAVI learning are better than students who are taught with normal learning in number theory lectures. SAVI *(Somatic, Auditory, Visual and Intellectual)* learning that focuses on learning across all senses make students more easier to critically think in mathematics skills. Based on the result of the test, it is found that the students are more focused on the material presented while learning, so that it can influence the improvement of students' critical thinking skills in a better direction.

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