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THE APPLICATION OF SCIENTIFIC APPROACH TO IMPROVE CRITICAL THINKING ABILITY THROUGH JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This research aims to check the critical and mathematical thinking ability through junior high school students with using scientific approach. In addition, it aims to check the improvement of critical and mathematical thinking through junior high school students. The method used on this research was quasi experiment which was designed to nonequivalent control group. The population on this research was all the junior high school students of Penida Katapang Junior high School Bandung Regency. The Sample was two classes of 7th grade. The data was attained by critical thinking and mathematical test which using material of shapes.

Keywords: Scientific approach influence, critical and mathematical ability

Abstrak

Penelitian ini bertujuan untuk mengetahui kemampuan berpikir kritis matematis siswa SMP yang mendapat pembelajaran dengan menggunakan pendekatan scientific, mengetahui peningkatan kemampuan berpikir kritis matematis siswa SMP. Metode yang digunakan dalam penelitian ini adalah quasi eksperimen dengan desain kelompok kontrol tidak ekivalen (the nonequivalent control group design). Populasi pada penelitian adalah seluruh siswa kelas VII "Penida Katapang" Kabupaten Bandung. Sampel pada penelitian ini adalah dua kelas dari kelas VII, Data penelitian diperoleh melalui tes kemampuan berpikir kritis matematis siswa SMP dengan pokok bahasan bangun datar.

Kata Kunci: Pengaruh pendekatan scientific, Kemampuan Berpikir Kritis Matematis

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INTRODUCTION

Maths basically contains with abstract terms and symbols. It causes a lot of students only pay attention the whole material without understanding the meaning of it. Most of students apply the cognitive method; memorizing the formula to learn maths. Whereas the core of Maths learning is not only memorizing. That is in line with the ministry regulation no 22 in 2006 about the curriculum guidance about maths subject (Depdiknas:2006)

“Critical thinking is explore the ability and cognitive strategy to decide the goal. This phase process which is passed through after deciding the goal and considering the goal which is accordance with the target. This thinking is needed to contract on problem solving, formulating the conclusion, collecting the possibility and making decision. Using all these abilities effectively and correctly.” Critical and mathematical thinking is also the activity to evaluate and decide the conclusion which are taken when deciding some factors because it connect directly to the focus.

Critical thinking is one of important component in learning process, especially in Maths which contains abstract terms and symbols. Most of students apply the cognitive method; memorizing the formula to learn maths. Whereas the core of maths learning is not only memorizing. That is in line with the ministry regulation no 22 in 2006

The learning process, it focuses on three aspects; affective, cognitive, and psychomotor/skill aspects. 1. Affective aspect deals with the tranformational subtant or material in order to the learners know “why”. 2. Cognitive aspect deals with with the tranformational subtant or material in order to the learners know “how”. 3. Psychomotor or skill aspects deals with “what”. The final result on the scientific research is to improve the balance between the ability of how to be the good human being (soft skill) and the ability of having skills and knowledges (hard skill) of students including attitude, knowledge, and life skill competences.

Based on Ministry of Education and Culture (Rusindrayanti : 2015) learning process which appllied scientific approach must combine with the scientific rule. This approach has the character that add the observation, intelectual activity, finding, legality, and descption things about the truth. These processes have to out of nonscientific value including intuition, mind, prejudice, expreriment, and critical thinking without any reasons. The students’ interaction could be suceed of learning where learning activity involves many students in communicating. In scientific process, students make goups which student can ask each other deal with the materials. After asking some questions, the other group answer the question from the first group. A teacher takes a role by observing and giving the conclusion about the materials that have been discussed.

The scientific approach follows the problems and focuses on learning process. The point is from students to students. Teacher here as the delegator or mediator.

Futhermore, Nuraffifah Imran (2014) in scientific approach concept as it said by Ministry of Education and Cultures, there are seven criterias in scientific approach as follow: 1) Fact or Phenomena based learning which can be explained by logic or intuition, 2) Teacher’s explanation, students’ responses, and class interaction. They have a freedom to think without wrong prejudice or logic, 3) encourage students to be a pioneer to think correctly, critically, and analytically, 4) encourage students to be a pioneer to comprehend see the problem in other side view such as the difference, the similarity and correlation among others in every subject. criticizing any materials, 5) encourage students to be a pioneer to comprehend, apply and develop their rational and objective thinking in responding the materials, 5) concept, theory, and empiric based which legally responsible, 7) The aim of learning is formulated simply and clearly but it is interisting to be presented.

Scientific approach is the approach which uses problem oriented based through students. A teacher here takes a role as a facilitator with using authentic assesment. In addition, both students and teacher formulate the goal together. The scientific approach model consists of 3 stages as follow: a) teacher starts to mention the results of students’ statements on board without evaluating the truths, b) those statments are given to students to consider and discuss the truths. After that, the students give respond to the teacher after they have discussed with their friends about the problem by giving the logical arguments with using counter example c) The statements were correct if they giving the theory or rules, but if the statments are

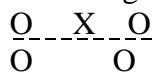
constructed by wrong argument and explain it with wrong statements according with counter-example

This research aims to discover critical and mathematical thinking ability through students who study maths with using scientific approach.

METHOD

This research was quasy experiments because subject of reasearch is not random but only class random. This research aims to observe the influence of treatment through class experiment. The treatment was using scientific approach. Dependent variable is students' critical and mathematical thinking ability.

The design of the experiment used was the nonequivalent control group design. The design which is not equivalent is out of group but it can be categorized to random group. Sample of the research are given pre-test. They were given the treatment and post-test was given after students give the treatments. Therefore, the design of the research as followed:



Note: (Ruseffendi, 2010:53)

- : Unrandom sample
- X : Treatment using scientific approach
- O : Critical and mathematical test (pre-test and post-test)

The population of this research was all of junior high school student in Bandung regency. While, the sample was not taken randomly, the author only take the sample from 2 classes of 7th grade at Penida Junior High School Katapang in Bandung regency.

RESULTS AND DISCUSSION

Pre-test Results and Analysis

This research aims to discover the difference of critical and mathematical thinking between students who get the treatment using scientific approach and regular students who don't get any treatment.

The critical and mathematical thinking ability is a complex critical and mathematical skill which using basic thinking such as logical thinking. So that, they can understand, analyze dan evaluate themselves by interpreting any argument based on reasonable statement. As the result, they can decide what they believe.

Pre-test done before they get the treatment trough two classes, it aims to discover the pre-thinking both of two classes whether they same or not. Data on pre-test attained describe that the general critical and mathematical thinking is presented by table 1 as follow:

Tabel 1. Stage of Critical and Mathematical thinking of Students Pre-test of class Experiment and Control Class

Class	Level	Amount	Predicate
Experiment	75% - 100%	2	High
	50% - 75%	3	Medium
	< 50%	26	Low
Control	75% - 100%	-	High
	50% - 75%	5	Medium
	< 50%	26	Low

From table above it can be concluded that both students on class experiment and class control have low critical and mathematical thinking where the ability of critical and mathematical thinking below 50 % of the class.

Description of Pre-test Result

Based on collected data from each class, it attained max score, min score, average, and standard deviation described by table 2 as followed:

Table 2. Max score, Min score, Average, and Standard deviation Pre-test of Class Experiment and Class Control

Class	N	Max score	Min Score	Average	St Deviation
Experiment	31	80	10	34,03	17,00
Control	31	70	10	31,45	14,56

Normality Test

Normality test between class control and class experiment have applied *Kolmogrof Smirnov* test with significance scale is 0,05 to formulate the hypotesis in testing normality test on pre-test data as follow :

After data have collected, the output looks like on table 3 as follow :

Table 3. Normality Test of Pre-test

Class	\bar{x}	S	N	KS	P	Interpretation
Experimen t	34,03	17,00	31	0,15	0,06	Ho accepted
Control	31,45	14,56	31	0,12	0,15	Ho accepted

From data collected showed that the significance (sig) of *Kolmogrof Smirnov* test pretest score on class experiment is 0,0058 dan (sig) of *Kolmogrof Smirnov* test pre-test score on control class is 0,0150. The result of normality test distributed to pre-test score showed that both of goup experiment and group control is normally distributed.

Homogeneity test

Homogeneity test aims to discover homogeneity or similarity from each part of sample or whether the variances of sample similiar or not, it also discover wheteher the samples come from the same population or not.

Test and CI for Two Variances attained result of homogeneity test that is presented by table 4 as followed:

Table 4. The result of Homogeneity Data on Pre-test

Class	N	S	P	Interpretation
Experiment	31	17,001	0,401	H ₀ accepted
Control		14,56		

Based on data above, it showed that the significance of data $>0,05$ was 0,401. According to criteria of test, two groups of class are homogen.

T-test

From the result of normality test and homogeneity test of two variances, we know that pre-test score of two groups of class were normally distributed and they have homogenous variance. The test of two samples assumed equal variances. It attained homogeneity test on table 5 as followed:

Table 5. T-test on Pre-test

Class	N	\bar{x}	S	T. hit	P	DF
Experiment	31	34	17,0	0,64	0,52	60
Control	31	31,5	14,6			

From data above it showed that the significance score of variances could be assumed as assumed equal variances was 0,523. Because the significance score $\geq 0,05$, It can be concluded that there are the differences between pretest of class experiment and class control. In other word, the pre-critical and mathematical ability of class experiment and class control is similar.

The Result of Post-test and Analysis

The analysis of post-test needed is done after the treatment of the groups of class were given. To find out the post critical and mathematical thinking ability both of classes whether it similar or not. The data of post-test will identify to describe the general thinking ability of students, the level of critical and mathematical thinking ability is presented on table 6 as followed:

Table 6. Stage of critical and mathematical thinking of students Post-test of Experiment class dan Control Class

Class	Level	Amount	Predicate
Experiment	75% - 100%	10	High
	50% - 75%	16	Medium
	< 50%	5	Low
Control	75% - 100%	2	High
	50% - 75%	13	Medium
	< 50%	16	Low

From table, it can be concluded that the critical and mathematical ability of students from both of groups classes increase better than before they get the treatment (learning process).

Description of post test result

From collected data for each class, it attained Max score, Min score, Average, and Standard deviation described by table 7 as followed:

Table 7. Max score, Min score, Average, and Standard deviation Post-test of Class Experiment and Class Control

Class	N	Max score	Min Score	Average	St Deviation
Experiment	31	100	35	63,71	16,73
Control	31	80	20	49,52	15,51

Normality Test

Normality test between class control and class experiment used *Kolmogorof Smirnov* with significance score 0,05. After data collected, the output data showed on table 8 as followed:

Table 8. Normality test

Class	\bar{x}	S	N	KS	P	Interpretation
Experiment	63,71	16,73	31	0,149	0,081	H ₀ accepted
Control	49,52	15,51	31	0,131	0,150	H ₀ accepted

From data collected showed that the significance (sig) of *Kolmogrof Smirnov* test pretest score on experiment class is 0,081 and (sig) of *Kolmogrof Smirnov* test post-test score on control class is 0,150. The result of normality test distributed to pre-test score showed that both of group experiment and group control is normally distributed.

Homogeneity test

After had been analyzed using *Minitab software 16* help through *Test and CI for Two Variances*. It attained the result of homogeneity test which was presented by table 9 as followed :

Table 9. Homogeneity Test of Post-test

Class	N	S	P	Interpretation
Experiment	31	16,73	0,681	H ₀ accepted
Control		15,51		

From data showed that the significance score of posttest is 0,681. It means more than 0,05. It can be concluded that there are not the difference between class experiment and class control. In other word, the post ability of class control and class experiment are homogen.

T-test

T-test aims to test whether critical thinking of students who have gotten scientific approach treatment better than the students who just get normal approach.

By analyzing *two samples assume equal variances*, It attained homogeneity test which is presented by table 10 as followed:

Table 10. T-Test on Post-test

Class	N	\bar{x}	S	T.hit	P	Df	Interpretation
Experiment	31	63,7	16,7	3,46	0,00	60	Ho accepted
Control	31	49,5	15,5				Ho accepted

From data above, it shows that the significance score of both variances which assemmed *equal variances* is 0,000. Because the significance score is less than 0,005, So H₀ rejected. It can be concluded that the critical and mathematical ability of students in experiment class better than control class.

Discussion

In scientific learning model, a teacher prepares a set of teaching such as lesson plans, materials, worksheets, and evaluation/test. Teacher makes group of four or five students for each group where there are various students who have high, medium, and low intellegent. These groups are based on daily test or academic achievement. On this stage, some of students took exception about the groups because that were not their intention. But, teacher ensured them that it was fair and reasonable.

After that, teacher introduced the material that will be discussed. It focused on the topics of materials. At the first lesson, most students didn't understand about the materials with using scientific approach, but the next lesson some students understood about the topic explained. The learning process as followed:

- a. Teacher starts the lesson by reviewing the results of students' statements written on board without evaluating the truths.

- b. Statements are given to students to be considered and discussed. Then, students give the discussion result to the teacher based on their group decision where the problem that they discussed was supported by acceptable arguments with counter example.
- c. The questions are said true by explaining the theorems or standard rule. While, some of wrong statements that are presented wrong statements comparing with counter example.

After having explanation of the learning topics, students are given worksheets to be done with their member of group. The worksheets contain some tasks which should be discussed about the shapes.

The worksheets guide the students to explore and comprehend the Maths concept independently. At the first and second lesson, the learning process didn't run well. Many students tend to ask too much because they aren't used to studying with the new model. Therefore, teacher gave guidance to comprehend the basic concept of the learning materials. Since many students have various intelligent and they aren't use to using the worksheet and work in group.

To make an effective learning process, teacher needs planning and preparing well especially in presenting worksheet and other alternatives if students tackled the problems in learning. The question sentences given must more simply and tends to be more conceptual. Teacher continuously helped students in explaining the questions on worksheets clearly. This help should be group not individual.

Description about Critical Thinking ability of Student

Based on the post-test result, it showed that critical thinking ability of students who had scientific approach treatment were better than those students who got regular approach. As it shown by the average of critical thinking ability of students in control class is $63,71 > 49,52$.

This finding showed that learning maths with scientific approach have good potentials to improve the critical and mathematical thinking ability through Junior High School students.

Scientific approach model direct students to enhance information or material that are discussing, able to ask themselves and explain it with their own words to understand the materials given. The last is students are able to compare, distinguish better and give possible solution of their problems.

This instruction guides the students to think faster, more flexible (with various ideas), more original, and more elaborate in developing and enriching their opinion.

The succeed of learning with scientific approach in improving critical and mathematical thinking ability of students occurred since the scientific approach can encourage students to participate in learning process. So that, the Maths ability will increase rapidly. This improvement will be more so far unless reasearcher or teacher get to be more patient in guiding their students especially Junior High School Students. Thus, management of time and class control management should make students enjoy learning in class.

CONCLUSION

Based on the research that was implemented about the influence of scientific approach on critical and mathematical thinking ability through Junior High School Students. It could be concluded that students who get scientific approach treatment on learning Maths have good critical and thinking ability better than students who only get regular approach (non treatment).

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