THE EFFECTIVENESS OF MATHEMATICS LEARNING WITH SCIENTIFIC APPROACH THROUGH THE COOPERATIVE MODEL OF TYPE NUMBERED HEADS TOGETHER IN TERMS OF STUDENT ACHIEVEMENT OF GRADE X SMA NEGERI 1 KALASAN

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Abstract

The purposes of this research were to know the effectiveness of mathematics learning with scientific approach through the cooperative model of type numbered heads together (NHT) in terms of student achievement, the effectiveness of mathematics learning with scientific approach in terms of student achievement, and to know which one was more effective between mathematics learning with scientific approach through the cooperative model of type NHT and with scientific approach without NHT in terms of student achievement. This research used quasi-experimental with pre-test and post-test control group design. Its population was all students of grade X SMA Negeri 1 Kalasan. The samples were class X MIA 2 as experiment class which given scientific approach through the cooperative model of type NHT and class X MIA 1 as control class which given scientific approach. The instruments used in this research were learning instrument, i.e. lesson plan and student worksheet, pre-test and post-test as test instrument to measure student achievement, and observation sheets as non-test instrument. The hypotheses testing used were one sample t-test and independent sample t-test. The results indicated that mathematics learning with scientific approach through the cooperative model of type NHT was effective in terms of student achievement. Mathematics learning with scientific approach was also effective in terms of student achievement. But, the post-test result means between the two classes were not significantly different. So, the mathematics learning with scientific approach through the cooperative model of type NHT was not more effective than mathematics learning with scientific approach without NHT in terms of student achievement.

Keywords: *mathematics learning, scientific approach, cooperative model of type numbered heads together, student achievement*

INTRODUCTION

The Act Number 20 in 2003 on National Education System mentions that the aim of National Education is to develop the potential students to be citizens who believe and do right in the one and only God, who have high moral standards, healthy, intelligent, skilful, creative, independent, democratic and responsible characteristics. In order to realize this goal, in the graduate competency standard it has been formulated that learning objectives at each educational unit include the development of attitude, knowledge (Permen No 65 in 2013). For that reason, the government has developed the Curriculum 2013 implemented in schools since the academic year of 2013/2014. The characteristics of learning in curriculum 2013 are as in the table below.

Table 1. Characteristics of Learning in Curriculum 2013

Affective	**Cognitive**	**Skill**
Accept	Remember	Observe
Perform	Understand	Question
Respect	Apply	Experiment
Comprehend	Analyze	Reason
Implement	Evaluate	Communicate
		Create

One of the schools applying the Curriculum 2013 is SMA Negeri 1 Kalasan, located in Sleman District, the Special Province of Yogyakarta. The Curriculum 2013 is applied in grade X and grade XI, although not all the learning process apply all approach or methods

recommended in the Curriculum 2013. Based on my observation in SMA N 1 Kalasan, it can be concluded that for mathematics in grade X, the learning process has applied the Curriculum 2013. One of the approaches applied in the learning is scientific approach.

Scientific approach is a learning approach that combines the process of observing, questioning, experimenting, reasoning communicating and creating (Kemendikbud, 2013). The steps usually used in applying scientific approach are observing, questioning, experimenting (collecting data), reasoning (associating), and communicating (networking) (Kemendikbud, 2013). According to Kurnik (2008:421), students should gradually and appropriately be taught how to analyze, synthesize, make an abstraction, draw inductive conclusion, draw deductive conclusion, generalize, specify, observe, and make analogies. If scientific procedures are appropriately and correctly applied, it can be expected that math teaching will be successful.

According to Binkley, the necessary things such as critical thinking, problem solving, communication, and collaboration can be developed through scientific approach (Holbrook, 2013). The research conducted by Carl Wieman (2007) showed results that applying scientific approach to teach physics could increase students' retention of information from lecture (more than 90 % after 2 day) and gain in conceptual understanding (50-70%). Another result was that there was a small improvement in students' belief about physics and problem solving.

But, in fact mathematics learning in SMA N 1 Kalasan does not always produce in accordance with the goal. Sometimes, not all aspects (attitude, knowledge and skills) can be achieved by the students. Until now, one of which is still a focus of attention of SMA Negeri 1 Kalasan is the knowledge (cognitive) aspect. There are many students who have difficulty in mastering the cognitive competency. Besides the students, the teachers also have difficulty to assist students overcoming the problems in cognitive aspect. The data of try out result of State Exam of year 2014/2015 showed that the students' achievements were still low.

The issues above can be caused by many factors; among them is students' and teachers' lack of attention on mastering the mathematical concepts. When given the problem that was quite unusual (been modified), most of the students had difficulty to solve it. It was because they didn't understand the problem and had difficulty in associating the necessary concept to solve the problem. In addition, result of class observation and an interview with one of the mathematics teacher of SMA N 1 Kalasan showed that the students tended to work on their own (individualist) even though it was a group discussion. The students who were joined in group discussions did not fully discuss. This caused some students to have difficulty in understanding the concepts they learned.

Group discussion as one of the forms of cooperative learning should be able to assist students to improve their achievement. According to Slavin (1995: 18), there are many reasons that cooperative learning is entering the mainstream

of educational practice. One is the extraordinary research base supporting the use cooperative learning to increase student achievement, as well as such other outcomes as improved interclass relations, acceptance of academically handicapped classmates, and increased self-esteem. Another reason is the growing realization that students need to learn to think, to solve problems, and to integrate and apply knowledge and skills, and that cooperative learning is an excellent means to that end. Based on the result of research conducted by Ratri (2013), the use of NHT gave effect to student achievement of grade V. The research of Hasmi, tandi, and Laganing (2011) also showed that the learning using NHT could increase student achievement of grade IV SDN Oloboju, Sigi Biromaru District.

One of the learning approaches that can be expected to overcome the problem in student achievement as well as to reduce the individualistic attitude is scientific approach through the cooperative model of type numbered heads together (NHT). In this learning process the steps of scientific approach are done in small groups by all the members of each class. The involvement of all the class members is guaranteed by the steps of NHT, as Kagan (1992, Slavin, 1995: 131) stated that numbered heads together is basically a variant of group discussion; the twist is having only one student represent the class but not informing the class in advance whom its representative will be. That twist insures total involvement of all the students.

Based on the description above, it was necessary to research on the effectiveness of mathematics learning with scientific approach through the cooperative model of type numbered heads together in terms of student achievement of grade X SMA Negeri 1 Kalasan. The problems in this research are to know the effectiveness of mathematics learning with scientific approach through the cooperative model of type numbered heads together in terms of student achievement, to know the effectiveness of mathematics learning with scientific approach in terms of student achievement, to know if there a significant difference in terms of student achievement between students who participate in mathematics learning with scientific approach through the cooperative model of type numbered heads together and students who participate in mathematics learning with scientific approach, and to know which one is more effective between mathematics learning with scientific approach through the cooperative model of type numbered heads together and learning with scientific approach in terms of student achievement.

The purposes of this research are to know the effectiveness of mathematics learning with scientific approach through the cooperative learning of type numbered heads together (NHT) in terms of student achievement, the effectiveness of mathematics learning with scientific approach in terms of student achievement, and to know which one is more effective between mathematics learning with scientific approach through the cooperative learning of type NHT and with

scientific approach without NHT in terms of student achievement.

METHODS

Research Design

This research was a quasi-experimental research. The research design used was *pre-test and post-test control group design.*

Table 2. Research Design

Group	Pre-test	Treatment	Post-test
Experiment	Y_1	X	Y_2
Control	Y_1		Y_2

(Sudjana & Ibrahim, 2001: 44)

Y_1: Initial ability

X : Treatment given

Y_2 : Final ability

Variables

The variables consisted of independent and dependent variables. The independent variable was learning approach which varied as scientific approach through cooperative model of type NHT and scientific approach. The dependent variable was student achievement on Distance topic.

Population and Sample

The population of this research was all the students of grade X SMA Negeri 1 Kalasan. The samples were class X MIA 1 and X MIA 2 which were randomly selected using cluster random sampling technique, provided that the classes were normal and homogenous. Class X MIA 1 was the control class which given scientific approach, while the experiment class was class X MIA 2 which given scientific approach through cooperative model of type NHT.

Time and Place

This research was conducted at SMA Negeri 1 Kalasan, Sleman, DIY in the second semester of academic year 2014/2015 held on February 17th 2015-April 1st 2015.

Instruments

The instruments used in this research were learning instrument, i.e. lesson plan and student worksheet, pre-test and post-test as test instrument to measure student achievement, and observation sheets as non-test instrument. The observation sheets were used to observe and record the student's activity during the learning process.

Data Analysis Techniques

The data collected were analyzed by making the description of the data that consisted of the early stage description and the end of stage description. The early stages description consisted of normality and homogeneity test. Normality test was performed by using the *Kolmogrov-Smirnov* test with a significance level α=0.05. The homogeneity test was performed by using the *Levene* test with a significance level α=0.05. The end stage description was hypothesis test. The first hypothesis test was done to know the effectiveness of learning in the experiment class. The second hypothesis test was done to know the effectiveness of learning in the control class. The test used was *one sample t-test* by comparing the mean (average) of each class to the

minimum standard value (KKM), i.e. 66.7. The third hypothesis test was done to know the difference between means of the two classes, which used *independent sample t-test.* All the tests were done using SPSS 17.00. If the third hypothesis showed significant difference between the means, then the test would be continued to the calculation of *effect size*.

RESULTS AND DISCUSSION

The learning processes of the both classes were conducted by researcher herself according to the lesson plan for each class. The overall learning processes were in accordance with the lesson plans.

Description of Data

The data collected in this research consisted of pre-test and post-test results of the experiment class and control class.

Table 3. Pre-test Result

Data	Number of Students Taking Test	Score		Mean	Standard Deviation
		Max	Min		
Experiment	24	68.18	13.64	46.12	18.71
Control	24	100	13.64	46.50	20.95

Based on the Table 3, the highest score in the control class was 100, and the lowest was 13.64. In the experiment class, the highest score was 68.18 and the lowest was 13.64. The means of the both classes were not significantly different, with the standard deviation of 18.71 for the experiment class and 20.95 for the control class.

Table 4. Post-test Result

Data	Number of Students Taking Test	Score		Mean	Standard Deviation
		Max	Min		
Experiment	23	100	36.36	78.06	15.24
Control	24	100	36.36	74.24	17.85

Table 4 shows that the highest and the lowest score for the both classes were the same. But, the mean of the control class was lower than the experiment class', with the standard deviations are 15.24 and 17.85, respectively.

Analysis on the pre-test results of the control and experiment class showed that the classes were normally distributed. It was indicated by the significant value>0.05. The variances of both classes were equal (homogenous), since the significant value was greater than 0.05.

The post-test result were analyzed using one sample t-test and independent sample t-test to know the effectiveness of learning in the experiment class which given scientific approach through cooperative model of type NHT and the control class which given scientific approach only, and to know the difference between means of the two classes.

The analysis of the post-test result can be seen in the table below.

Table 5. *One Sample t-test* for Experiment Class

t_{ti}	df
3.579	22

Based on Table 5, it was obtained $t_{t_i} = 3.579 > t_{t_i} = 1.717$. It means that the post-test average value (mean) of the experiment class at least reached KKM. So, the learning with scientific approach through cooperative model of type NHT was effective in terms of student achievement.

This result is in accordance with Goeffrey Saxe's thought (1995; Saxe, et al., 1996, Carr & Hettinger, 2002) that social interactions can bring significant effect to individual's (student's) objective and his/her strategy to achieve the objective. In this case, the objective is learning achievement. Through cooperation in group, and with the assist of more competent students, student can develop this/her ability within zone of proximal development, as Vygotsky stated in his socio-constructivist theory. Peer's assist helps students to understand more about the problem and work together to find the solution. Kagan stated that through cooperative setting of type numbered heads together (NHT), the twist of having only one student represent the class but not informing the class in advance whom its representative will be insures total involvement of all the students. Students will be responsible for the success of their group and so give more effort to understand the given problem.

The hypothesis test also been done to know the effectiveness of learning in the control class. The result is showed in Table 6.

Table 6. *One Sample t-test* for Control Class

t_{t_i}	df
2.072	23

The table shows the value of $t_{t_i} = 2.072 > t_{t_i} = 1.714$, which means that the post-test mean of the control class at least reached KKM. So, the learning with scientific approach (without NHT) was effective in terms of student achievement. Kurnik stated that if scientific procedures are appropriately and correctly applied, it can be expected that math teaching will be successful.

After the first and the second hypothesis tests, the third hypothesis test was done to know the difference between post-test result means of experiment and control class. The result is as follows.

Table 7. Result of Test of Difference between Means

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	1.346	0.252	0.788	45	0.435	3.82139

The table shows that the variances were equal since the significant value $0.252 > 0.05$. Hence, the t-test used was based on equal variances assumed. The value of $t_{t_i} = 0.788 < t_{t} = 2.014$, or the significant value is greater than 0.05. It means that there was no significant difference between means of the experiment class and the control class. In other words, the learning with scientific approach through cooperative model of type NHT was not more effective than the learning with only scientific approach. Therefore, the hypothesis testing was not

continued with the treatment effect test (effect size calculation).

Theoretically, the learning with scientific approach through cooperative model of type NHT should be more effective than the learning with only scientific approach. Binkley stated that applying scientific approach to learning can develop student's critical thinking, problem solving, communication, and collaboration. When the steps of scientific approach are done in groups using cooperative model of type NHT, the students can involve totally in solving the problem with their peers and get help from more competent students in the group to construct their understanding. Vygotsky (McLeod, 2007) thought that the help from more competent students (peers) will make easier for the students to construct their knowledge, within the zone of proximal development. So, the student achievement should be maximal. But then, the result of this research showed that the learning with scientific approach through cooperative model of type NHT was not more effective than the learning with only scientific approach.

Practically, the result could be affected by the things happened during the research. One of the cause is the NHT was not maximally implemented in the experiment class. Although the researcher had maximized the involvement of students in group discussion, there were students who less participated in the discussion because they counted on more competent students and preferred to work on their own. This situation showed that there were students who had no high awareness to totally involve in the discussion and be responsible for the learning process of their group. This could affect their learning process in the group. This might happen because it takes a long time to develop students' group awareness (Sanjaya, 2008:249). These factors could affect students' understanding about the given problem, and so it could affect the process of constructing knowledge. As a consequence, the student achievement in experiment class was not maximal. The other factors that could affect the result of this research were student's absence during the learning (although not always absent), the uncertainty of learning schedule because of long postponement, and other uncontrolled factors. These were the limitations of the research which could affect the effectiveness of learning in the experiment class, though must be scientifically proved.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of data analysis and the discussion, the conclusions are as follows.

1. The mathematics learning with scientific approach through the cooperative learning of type NHT is effective in terms of student achievement.
2. The mathematics learning with scientific approach is also effective in terms of student achievement.
3. There is no significant difference in terms of student achievement between students who participated in mathematics learning with scientific approach through the cooperative model of type numbered heads together and

students who participated in mathematics learning with scientific approach.

4. The mathematics learning with scientific approach through the cooperative learning of type NHT is not more effective than mathematics learning with scientific approach without NHT in terms of student achievement.

Suggestions

Based on the results, then the suggestions of the researcher are as follows.

1. For other researchers, to anticipate for the things that might happen during the research, to maximize the observation of the research, and to add variables when conducting research related to this topic.
2. For the school, to apply scientific approach through cooperative model of type NHT in the learning process as one of the alternative learning to increase achievement of students of SMA Negeri 1 Kalasan.

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