Numbered head together with scientific approach in geometry learning

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Abstract. The aim of this research was to find out the influence of learning model implementation toward student’s achievement in mathematics. This research was using quasi-experimental research. The population of the research was all of 7th grade students in Karanganyar. Sample was taken using stratified cluster random sampling technique. The data collection has been conducted based on students’ mathematics achievement test. The results from the data analysis showed that the learning mathematics by using Numbered Head Together (NHT) learning model with scientific approach improved student’s achievement in mathematics rather than direct learning model particularly in learning object of quadrilateral. Implementation of NHT learning model with scientific approach could be used by the teachers in teaching and learning, particularly in learning object of quadrilateral.

1. Introduction
Mathematics is a very important since it is a basic science in human life, but ironically the quality of mathematics competence in Indonesia is still quite low [1-3]. The rank of Indonesian students’ mathematics test score in PISA 2015 is 64th based on 72 countries. Low achievement of students’ mathematics achievement is also showed by the results of average score of national exam in mathematics based on academic year of 2016 [4]. The average score of students’ junior high school national exam in mathematics is 50.24, which is the lowest score compared to other subjects.

One of the possible reasons of Indonesian students’ low achievement in mathematics is inappropriate learning model due to the mathematics learning process [5]. This fact is inline with conducted interview result to some teachers and students in Karanganyar who state that the learning of mathematics is still using direct learning model. Direct instruction is held by a teacher centered model under five steps namely: establishing set, explanation and/or demonstration, guided practice, feedback, and extended practice [6]. In this model, students have only a little chance to join and being active in the learning process, so that they are not capable in develop their social skills and their interpersonal ability. Teacher’s high role in learning process will influence badly toward student’s problem solving skill, independence, and curiousity. Quadrilateral is one of the challenging topics in mathematics, according to student’s statement. The challenges in quadrilateral topics are divided in understanding the problem, determining the correct strategy, and the reasoning ability due to its solution. According to Hwang, in traditional education environments, geometry is most commonly taught using text, 2D image and mathematical formulas. For area topics, such teaching methods are not highly effective [7].

One of the learning models that can be used in learning mathematics is a cooperative learning model. Cooperative learning is an approach with an access of groupwork to minimize the occurrence
of those unpleasant situations and yet maximizes the learning experience through satisfied result from working on a high-performance team [8].

NHT is one of cooperative learning types. NHT provides an opportunity for students to share their ideas and determine the right answers [9]. The use of NHT could improve student’s activity, social skills, and cooperative skills while reducing disruptive behavior [10]. Learning activities through a scientific approach consists of these following steps namely: observing, questioning, experimenting, associating, and communicating [11]. In this study, the NHT was modified by a scientific approach. It is essential to modify the type of NHT with scientific approach since NHT only provides students with a booklet, including problems and incomplete sentences to fill up. Whereas, scientific approach gives authentic and challenging problems to rise student’s curiosity and encourage them to work together to find the solutions. Learning object of quadrilateral is one of learning materials in mathematics that can be presented in authentic and applied problems in daily life. Implementation of NHT with scientific approach is expected to improve student’s activity, social skills, and cooperative skills while reducing disruptive behavior [10]. Learning activities through a scientific approach consists of these following steps namely: observing, questioning, experimenting, associating, and communicating [11]. In this study, the NHT was modified by a scientific approach. It is essential to modify the type of NHT with scientific approach since NHT only provides students with a booklet, including problems and incomplete sentences to fill up. Whereas, scientific approach gives authentic and challenging problems to rise student’s curiosity and encourage them to work together to find the solutions. Learning object of quadrilateral is one of learning materials in mathematics that can be presented in authentic and applied problems in daily life. Implementation of NHT with scientific approach is expected to facilitate student’s knowledge effectively on the learning object of quadrilateral because these two combinations of learning method could give students the opportunity to solve the real and contextual problems scientifically. The teachers are no longer dominate the class, but they only direct and motivate the students to learn independently and develop a sense of responsibility. Besides, teacher could also help to trigger student’s activity to solve real problems in their daily life base on groups.

Implementation of NHT with scientific approach is expected to improve student’s achievement in mathematics, especially on the learning object of quadrilateral. The previous research shows that NHT could improve student’s learning outcomes [12]. The purpose of this research is to know the effectiveness of NHT learning model with scientific approach to improve student’s achievement in mathematics. In this study, each group of student in the first class is given a worksheet of quadrilateral topic. Other classes will use direct learning model.

2. Method
This research is a quasi-experimental study. Besides, the design of this study is random static group comparison design [13]. A group of subjects is taken from the population and they are divided into experimental and control groups. Experimental group is using NHT learning model with scientific approach in mathematics learning. In the other hand, control group is using direct learning model in mathematics learning. Then, both groups are given the achievement test. The study design is illustrated in Table 1.

| Group          | Treatment | Achievement Test |
|----------------|-----------|------------------|
| Experiment Group | X         | T                |
| Control Group  | -         | T                |

The research is conducted in Karanganyar, Central Java, Indonesia using 7th grade students as the population. Sample is taken by using stratified cluster random sampling. Schools in Karanganyar are classified into three categories, which are high level, moderate level, and low level based on mathematics score in national exam. Then, one school is picked to represent each category. Two classes are taken randomly from each selected school. One class is assigned as experimental class and the other class is assigned as control class. The experimental group consists of 96 students and the control group consists of 96 students. Both are in the same condition.

In this research, there are one independent variable and one dependent variable. Learning model is the independent variable and student’s achievement in mathematics is the dependent variable. Instrument of this research is a mathematics achievement test. The test is used to collect the data about the student’s achievement in mathematics and it is given right after the treatment. Content validity of the student’s achievement in mathematics test is conducted by 3 experts in mathematics. To be able to
measure the reliability of the student’s achievement in mathematics test, Kuder-Richardson technique is used in this study. Data analysis techniques used in this research is a one-way analysis of variance with same cells. The level of significance is 5% or it can be said as $\alpha = 0.05$. Based on the hypothesis, $H_0$ is rejected if $F > F_{table}$ [14].

3. Result and discussion

NHT with scientific approach in learning quadrilateral was being conducted in 8 sessions of mathematics class. At the 9th mathematics class session, students are given an achievement test. One session of mathematics class is held along 80 minutes. This test contains 25 items of multiple choice questions. The results of the student’s achievement in mathematics are presented in Table 2.

### Table 2. The data of students’ mathematics achievement

| Group      | N  | Mean   | Std.Dev | Variance | Max Score | Min Score |
|------------|----|--------|---------|----------|-----------|-----------|
| Experimental | 96 | 47.58  | 15.93   | 253.80   | 88        | 12        |
| Control    | 96 | 40.85  | 15.28   | 233.58   | 72        | 8         |

The results from Table 2 shows that the experimental group got 47.58 of mean score and 15.93 of standard deviation based on achievement test in mathematics in quadrilateral topic. The control group obtained a mean score of 40.85 and the standard deviation of 15.28 from the mathematical achievement test on quadrilateral material. Table 2 shows that student’s mean score of experimental group in mathematics achievement is higher than student’s mean score of control group. However, hypothesis testing can be performed if those two data are normally distributed and have the same variance. Table 3 shows the normality of mathematical achievement test results for each group by using Liliefors method with 5% of significant level.

### Table 3. The result of normally test of mathematics achievement

| Group      | $L_{obs}$ | $L_{table}$ | Decision Test | Conclusion |
|------------|-----------|-------------|---------------|------------|
| Experimental | 0.089     | 0.090       | $H_0$ is not rejected | Normal     |
| Control    | 0.083     | 0.090       | $H_0$ is not rejected | Normal     |

Based on Table 3, it can be seen that experimental group has $L_{obs} = 0.089$ less than $L_{table} = 0.090$ and control group has $L_{obs} = 0.08$ less than $L_{table} = 0.09$. It means that $H_0$ is not rejected in each group. So, it can be concluded that the experimental group and the control group are normally distributed. Homogeneity test is conducted to find out whether the student’s achievement in mathematics between two groups has the same variance or not. Table 4 shows homogeneity test results between two groups with a significant level of 5% by using Bartlett method.

### Table 4. The result of homogeneity test of mathematics achievement

| Test                  | $k$ | $\chi^2_{obs}$ | $\chi^2_{table}$ | Decision Test | Conclusion |
|-----------------------|-----|----------------|------------------|---------------|------------|
| Mathematics Achievement | 2   | 0.16           | 3.841            | $H_0$ is not rejected | Homogenous  |

Based on table 4, it can be seen that $\chi^2_{obs} = 0.16$ is less than $\chi^2_{table} = 3.841$. This means $H_0$ is not rejected. So, it can be concluded that the experimental group and the control group have the same variance. The summary of the results of variance analysis is presented in Table 5.
Tabel 5. Summary of one-way ANOVA with same cell

| Source          | S.S   | D.F | M.S.S | F_0.05,1.190 | Decision Test |
|-----------------|-------|-----|-------|--------------|---------------|
| Learning Model  | 2173.52 | 1   | 2173.52 | 8.92         | H_0 rejected  |
| Error           | 46301.29 | 190 | 243.69 | -            | -             |
| Total           | 48474.81 | 191 | -     | -            | -             |

Based on table 5, it can be seen that F_0.05 is less than F_{table}. So, H_0 is rejected. It means that NHT learning model with scientific approach gives different influence on mathematics achievement. The gap of mean score between those two groups are 6.73. To be able to know which one of learning model that gives better influence for student’s achievement in mathematics can be seen from the mean score. Based on table 2, the mean score of experimental group is 47.58 and the mean score of control group is 40.85. So, it can be concluded that NHT learning model with scientific approach can improve student’s achievement in mathematics rather than direct learning model.

The use of the NHT model with a scientific approach is more effective than the direct learning model. According to Hunter [15], NHT requires all students to respond actively in class and by sharing responses before responding, all students gain access to credible information. This is due in part to the use of mixed-ability teams [16]. The implementation of NHT can increase active student engagement, enhance interpersonal relationship, and improve student learning [17].

4. Conclusion
Based on the results of data analysis and discussion, it can be concluded that the implementation of NHT learning model with scientific approach will effectively improve student’s achievement in mathematics rather than direct learning model, especially in teaching and learning about quadrilateral topic. Hence, NHT learning model with scientific approach can be used as an alternative learning model by teacher in the process of learning mathematics toward students. For further research, it can examine the effect of NHT learning model with scientific approach on other materials and can modify NHT learning model with other learning approaches.

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