TTW and NHT in problem solving

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Abstract. This research aims to analyze and determine effect of the model on problem solving. Subjects in this research are students of class X SMK in Purworejo. The learning model used in this research was TTW in class experimental 1 and NHT class experiment 2. This research used quasi experiment. Data analysis technique in this research used ANOVA two way. Data collection techniques in this research used tests to measure student problem solving and GEFT to measure students’ cognitive style. The results of this research indicate that there are differences in problem solving between experimental classes used TTW and NHT. The impact of this research is that students are able to remind problem solving used learning model and to know cognitive style of the students.

1. Introduction
Mathematics is the science that underlies all technological developments and has an important role in improving human resources. According the argument, without science there is no modern technology no modern technology [1]. The basic learning needs comprise of both essential learning tools such as literacy, oral expression, numeracy and problem solving [2]. Mathematics is considered important in everyday life so that math is taught at all levels of school. Mathematics developing human thinking more creative and helps to analyze real life problem [3].

In studying mathematics, problem solving is one of the important facts in mastering mathematics. Mathematics cannot separated from problem solving [4], because problem solving is one of the ability in learning mathematics. By learning problem solving in mathematics, students should acquire the ways of thinking, habits of persistence and curiosity and confident in unfamiliar situations that will serve them well outside the mathematics classroom [5]. Problem solving trains student discipline in solving existing problems.

One of the factors that affect student solving problem is cognitive style. The cognitive style of the students will differ between one student and another. The cognitive style that the student has will not change, according to the learning strategy argument will be changed, but his cognitive style does not change [6].

In addition to the cognitive style, the learning model is a factor that affects the problem solving students. Applying a learning model that is appropriate to the classroom situation and the state of the student will increase the problem solving students. In the process of studying mathematics, students only memorize lesson. Cooperative learning model is one of the learning models that apply
cooperation in one group. Students will be active in learning, so that students not only remember learning but students understand what is learned and done.

TTW is a learning model that requires students to think independently then discuss the thoughts of each student in the group and write down the result of the group discussion. TTW learning model requires students to study independently before learning.

NHT is a learning model that requires all students in each group to understand what is being discussed in the group. This is because students are asked to explain the results of the discussion with the group. Students who convey the result of the discussion are students who have the number mentioned by the teacher so that each student in the group must understand the result of the discussion.

2. Methods
This research used quasi experiment. TTW applied to the experimental class 1 and NHT applied to the experimental class 2. Subject used in this research were 62 students. This research was conducted in SMKN 2 Purworejo, because it included a school that has the ability to categorize high. Data analysis in this research using ANOVA two-way. Data collection in this research used problem solving to determine student problem solving abilities and GEFT to determine the type of cognitive style of the students.

3. Results and Discussion
Problem solving is a process of learning components, rules, techniques, skills and concepts to a solution to the new solution [6]. In solving the problem solving problem, requires several steps, the steps used to solve the problem is an indicator of problem solving. The indicator of mathematical problem solving abilities include: understanding the problem, making a plan, carrying out the plan and looking back [7].

Cognitive style is one of the factors that affect problem solving. Cognitive style are characteristic of perceiving, remembering, thinking, problem solving and decision making that develop in congenial ways [8]. A theory of cognitive style that has been field independent (FI) and field dependent (FD) cognitive style [9]. FI students who like to student dependently [10], but FD student prefer to be guided in their learning [11]. FI student are better at learning impersonal abstract material [12], but FD student is better at studying concrete material.

In cooperative learning model has many types, among others TTW (Think Talk Write) and NHT (Numbered Heads Together). TTW strategy was proven to increase technical, creative thinking skills and problem solving skills of students [13]. NHT indirectly trains the students to share information, so that student becomes more productive in learning [14].

To know the problem solving ability, then do post-test and pre-test. Table 1 is a summary of pre-test and post-test problem solving.

| Test    | Source | N  | Value Minimum | Value Maximum | X   | S     |
|---------|--------|----|---------------|---------------|-----|-------|
| Pre-test| TTW    | 30 | 23            | 43            | 35  | 6.51  |
|         | NHT    | 32 | 23            | 41            | 33.97 | 5.04 |
|         | TTW    | 30 | 29            | 43            | 37.13 | 4.66 |
|         | NHT    | 32 | 26            | 40            | 35.43 | 3.26 |
|         | FI     | 28 | 37            | 43            | 40   | 2.09  |
|         | FD     | 34 | 26            | 39            | 33   | 2.90  |

Table 1. Summary of pre-test and post-test problem solving.
After several lessons, students are given tests to determine problem-solving skills and determine the type of cognitive style of students. Before the hypothesis testing of the data, first tested normality and homogeneity.

3.1. Normality Test on Problem Solving

Normality test is used to know that the data taken is normally distributed or not. Normality test in this research using Lilliefors method, table 2 is a summary of normality test that has been done.

| Source | $L_{obs}$ | $L_{tab}$ | Decision Test | Conclusion       |
|--------|-----------|-----------|---------------|------------------|
| TTW    | 0.1056    | 0.1617    | $H_0$ accepted| Normally         |
| NHT    | 0.0829    | 0.1566    | $H_0$ accepted| Normally         |
| FI     | 0.1331    | 0.1674    | $H_0$ accepted| Normally         |
| FD     | 0.1181    | 0.1519    | $H_0$ accepted| Normally         |

Based on Table 2, that $L_{obs}$ for each sample is not more than $L_{tab}$ so it can be concluded that the data is normally distributed.

3.2. Test homogeneity on problem solving

Homogeneity test in this research using Bartlett test, Table 3 is a summary of homogeneity test.

| Source          | $\chi^2_{obs}$ | $\chi^2_{tab}$ | Decision Test | Conclusion                      |
|-----------------|-----------------|-----------------|---------------|---------------------------------|
| Learning Model  | 3.729           | 3.841           | $H_0$ accepted| Population of Homogeneity Variance |
| Cognitive Style | 3.055           | 3.841           | $H_0$ accepted| Population of Homogeneity Variance |

Based on Table 3, that $\chi^2_{obs} < \chi^2_{tab}$ so it can be concluded that the data has the same or homogeneous variance.

3.3. Test the hypothesis using analysis of variance two way with unequal cells

Hypothesis test in this research using analysis of variance two way with unequal cells, Table 4 is a summary of hypothesis test.

| Source          | Sum of Square | Degree of Freedom | Mean Square | $F_{obs}$ | $F_{\alpha}$ | Decision Test |
|-----------------|---------------|-------------------|-------------|-----------|-------------|---------------|
| Learning Model  | 23.0383       | 1                 | 23.0383     | 3.7848    | 3.16        | $H_0$ rejected |
| Cognitive Style | 587.7431      | 1                 | 587.7431    | 96.5582   | 3.16        | $H_0$ rejected |
| Interaction     | 23.8334       | 1                 | 23.8334     | 3.9155    | 3.16        | $H_0$ rejected |
| Error           | 353.0418      | 58                | 6.0869      |           |             |               |
| Total           | 987.6567      | 61                |             |           |             |               |
From Table 4, it can be concluded that the learning model has an effect on student problem solving, because there are only two instructional models so that no comparison of mean between rows is used. Determining better model using average, so that obtained cooperative model type TTW better than cooperative type model of NHT type. Cognitive style also affects student problem solving, because there are only two types in cognitive style so no comparisons of average between columns. Determining better cognitive style using average, so that Field Independent is better than Field Dependent. There is an interaction between learning model and cognitive style to student problem solving, because there is interaction so that comparisons are made between cells in the same column and the comparisons between cells in the same line.

3.4. Test of post hoc analysis of variance
To know the interaction that exist between learning model and cognitive style, need to do further test. Further test in this research using Scheffe method, table 5 is a summary of advanced test post hoc analysis of variance.

|                      | $H_0$   | $F_{obs}$ | $F_{a}$ | Decision Test |
|----------------------|---------|-----------|---------|---------------|
| $\mu_{11} = \mu_{21}$ | 68,6936 | 13.8      |         | $H_0$ rejected |
| $\mu_{12} = \mu_{22}$ | 31,2417 | 13.8      |         | $H_0$ rejected |
| $\mu_{11} = \mu_{12}$ | 7,0485  | 13.8      |         | $H_0$ accepted |
| $\mu_{21} = \mu_{22}$ | 0,0006  | 13.8      |         | $H_0$ accepted |

Cognitive style FI type is better problem solving compared to FD type cognitive style, both in general and when viewed on each model of learning. FI is better than FD because FI has characteristics that solve problems without the help of others and are independent.

The TTW type learning model is better problem-solving than the NHT type learning model, both in general and when viewed from each type of cognitive style. The significance of TTW and NHT has little difference, resulting in TTW and NHT almost having the same problem-solving. TTW and NHT have little significance, due to the characteristics of both models that require students to be active in learning.

The impact of this research is, students can know the type of cognitive style possessed so that it can determine how to learn according to the needs of students. Teachers can improve problem solving using applied models. The teacher knows the cause of the problem solving is still low and the teacher can improve problem solving owned by students.

4. Conclusion
Giving treatment to experimental class using TTW and NHT type cooperative learning model on problem solving, so it was found that the model of cooperative learning of TTW type was better compared with NHT type cooperative learning model. While in cognitive style, field independent is better than field dependent. In an independent field type cognitive style, cooperative learning models of TTW types are better than cooperative NHT type learning models. In the cognitive field dependent style, cooperative learning models of TTW and NHT types are equally good. From this research, teachers know the cause of the problem solving is still low and teachers can improve problem solving owned by students.

5. References
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