NHT-TPS: Experimental Model Based on Scientific Approach Viewed from Learning Activeness

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ABSTRACT

The application of certain learning Models should be adapted to the characteristics of students and the environment. This quasi-experimental study aims to identify the effect of the NHT and TPS learning Models using the scientific approach on mathematics learning outcomes viewed from the student's activeness. The population was 8th-grade students in one of the public junior high schools in Sragen, Indonesia. Each class consisted of an average of 32 students. The NHT Model was applied to the experimental class, and TPS-scientific was applied in the control class which was determined using the cluster random sampling technique. The student's activeness was measured using a questionnaire distributed before the implementation of the learning. The results of the study showed that the NHT Model affected mathematical learning outcomes better than the TPS Model. The student's learning activeness did not affect mathematics learning outcomes, and there was no interaction between learning Models and student learning activities on mathematical learning outcomes.

Keywords: Learning outcomes, Learning activities, NHT, Scientific, TPS.

1. INTRODUCTION

The teaching and learning process is an activity performed by teachers and students who support each other to transfer knowledge [1]. To improve learning outcomes, teachers design activities that can facilitate students to learn new knowledge or values through a process [2]. The teacher designs a systematic learning process that covers design, implementation, and evaluation [3].

The student's learning outcome is often used as a reflection of the implementation of the learning process. Learning can be successful if students can comprehend what they have learned [4]. Indeed, one of the goals of learning is to gain new knowledge as a provision for future life.

Based on the results of observations, learning was still teacher-centered. Students still depended a lot on the teacher. When the teacher asked questions, students were often silent and less active in learning. In such a situation, learning cannot run well. Students could only learn by memorizing or imitating the ways

taught by the teacher. It is very risky for the learning process continuation. The memorization or imitation Model can make students forget easily. Besides, when faced with new questions or problems, students will find it difficult to solve them.

The government has designed a curriculum to improve the quality of learning such as the 2013 curriculum. In this curriculum, learning is expected to use a scientific approach. By using this approach, teachers are expected to be able to design learning with scientific characteristics. Through a scientific approach, learning is required to include components of observing, asking, reasoning, trying/creating, and presenting/communicating [5]. Through this approach, students are given the opportunity to experience, follow the process, observe, analyze, prove and draw their conclusions [6]. It is expected that they will build or construct their knowledge.

To apply a scientific approach to learning, a learning Model that can accommodate scientific learning is needed. A learning Model is a theoretical framework oriented towards goals, procedures, and

learning management [7]. Some learning Models that can be used to make learning meaningful are numbered heads together (NHT) and think pair share (TPS).

1.1. Scientifics Approach

Learning should build students' knowledge. Teachers have made various efforts to improve student

Scientific learning focuses on fact-based learning, teacher explanations that do not deviate from logical thinking, teaching students to have thinking skills, and simple and clear learning organization [9]. Thus, in the learning process that uses a scientific approach, students are encouraged and directed to seek information from various sources and do not depend on information from the teacher only. The procedure in the scientific approach is presented in Table 1.

Table 1. Procedures of scientific approach

Procedures	Activities
Observing	Students are encouraged to observe with their senses (reading, listening, or watching from the video provided)
Questioning	Students are directed to ask questions and discuss information that they have not understood yet.
Gathering information	Students are given the opportunity to explore, discuss, conduct experiments, collect data or read from other sources to complete the required information.
Reasoning/ Associating	Students are required to process the obtained information, analyze data, connect related phenomena/information to get conclusions
Communicating	Students present the results obtained in the form of reports or presentations that include processes, results, and conclusions.

learning outcomes including the use of certain learning Models or approaches to guide students in learning. One of the most used approaches in learning in the 2013 curriculum is the scientific approach. In this type of approach, learning emphasizes how teachers provide understanding to students to recognize and understand the material with a scientific approach. This approach teaches students that learning can be done anytime, and information can be obtained from anywhere not only from the teacher [8].

1.2. Number Head Together (NHT)

Learning with the NHT Model can provide opportunities for students to discuss with their groups to get the most appropriate answers [10]. Further, students can exchange ideas with their peers. The NHT Model is specifically designed to influence interactions between students to make learning fun and improve learning outcomes [11]. In the implementation process, this Model emphasizes

Table 2. Syntax of the NHT Model

Procedures	Learning Activities
Numbering	The teacher divides the students into some groups, and then each student is assigned a number randomly.
	Then, the teacher provides brief information about what will be learned.
Question	The teacher provides opportunities for students to ask any questions if they have not understood yet.
	The teacher gives students assignments/worksheets (LKS) to each group
Thinking together	The teacher guides each group to discuss the most appropriate answers and make sure all groups get answers.
Answering	The teacher mentions one number at random, and students with the number mentioned by the teacher are asked to present the results of their work

student-centered learning [12]. The syntax of the NHT learning Model [13] is presented in Table 2.

1.3. Think Pair Share (TPS)

The TPS learning Model has the characteristics of requiring students to sit in pairs where initially they are given questions and think about their answers and then discuss the results of their thoughts with their partners [14]. This TPS Model teaches students to collaborate with their peers, exchange ideas, and get a mutual agreement in solving the problems given [15]. The TPS learning Model is in line with the scientific approach where students are required to think by observing the given problem, in pairs to ask questions and have a discussion, and share what they get with their peers by presenting the results of the discussion. The syntax of the TPS learning Model [13] is presented in Table 3.

of the study was 260 students from 8th graders. Before the study, the population had been grouped into some classes and each class consisted of 32 students. The sample was selected using the cluster random sampling technique.

Cluster random sampling was performed by taking randomly a ball that has been labeled a class in a box. The first ball was taken to determine the experimental class and the second ball was for the control class. Before the study, both classes were confirmed to have a balanced initial ability.

The instruments in this study consisted of learning tools, learning outcomes tests, and learning activity questionnaires. Before use, all three instruments were validated. Learning tools and learning outcomes tests were validated by experts in the field of learning, namely, mathematics education lecturers. While the

Table 3. Syntax of TPS learning Model

Procedures	Learning Activities
Think	The teacher gives a problem that contains information that can be used to solve problems and gives students time to observe and think.
Pairing	The teacher asks students to pair up and discuss what they have learned. Interaction is used to gather opinions and ask questions regarding information that they have not understood.
Share	Each pair is given the opportunity to walk around and share with other pairs the results they have discussed.

1.4. Learning Activeness

The effectiveness of learning is the ability of students in compiling and building their own knowledge of the learning process [16]. Learning activeness is the result of a combination of cognitive, affective and psychomotor domains obtained from the learning process. Students can be said to be active in learning when they can work together, want to ask questions, answer questions, and express opinions [17].

Students' activeness in the learning process can stimulate and develop their talents, practice critical thinking, and solve problems in daily life. Besides, the teacher can also design the learning system systematically to stimulate the student's activeness in the learning process.

2. RESEARCH METHODS

This quantitative study used a quasi-experimental design and was conducted in one of the selected schools in Sragen District, Indonesia. The population

activity questionnaire was validated by experts in the field of educational research and evaluation. After instruments and questionnaires were declared valid, then the instrument was tested on 9th-grade students.

The learning activeness questionnaire was distributed before the treatment while the learning outcome test was given after the treatment. In this case, treatment refers to the application of the NHT learning Model in the experimental class and the application of the TPS learning Model in the control class. Both classes received treatment for three face-to-face meetings.

Table 4. Conversion using norm reference

Scores	Categories
scores $> \bar{X} + 0.5\,\sigma$	High
$\bar{X} - 0.5\,\sigma <$ scores $\leq \bar{X} + 0.5\,\sigma$	Moderate
scores $\leq \bar{X} - 0.5\,\sigma$	Low

Notes:
$\bar{X}$ = mean of all sample
σ = standard deviation of all samples

The questionnaire data obtained were then analyzed to determine the level of student's learning activeness. The level of student's learning activeness is grouped into three categories which refer to the interpretation using a reference norm involving the mean and standard deviation (Table 4).

This study proposed three hypotheses. First, there

As previously explained, the two selected sample classes were confirmed to have the same initial ability based on the final test score in mathematics. The data obtained were analyzed using parametric statistical tests, called the independent t-test. The data used were normally distributed and had the same variance as presented in Table 5 and Table 6.

Table 5. Normality test of initial data

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	Df	Sig.
Test scores	Experiment	.090	32	.200*	.984	32	.903
	Control	.203	32	.002	.942	32	.084

are differences in the effects of NHT and TPS using a scientific approach on learning outcomes. Second, there are differences in the effect of levels of learning activeness on learning outcomes. Third, there is an interaction of learning Models and learning activities on learning outcomes.

Table 5 shows sig. Shapiro Wilk's test in the experimental class reached 0.903>0.05 and in the control class reached 0.084>0.05. As all sig. > 0.05, then both classes were normally distributed based on the Shapiro-Wilk test.

Table 6. Homogeneity test of initial data

		Levene Statistic	df1	df2	Sig.
Test scores	Based on Mean	1.788	1	62	.186
	Based on Median	2.184	1	62	.144
	Based on Median and with adjusted df	2.184	1	61.478	.145
	Based on trimmed mean	1.875	1	62	.176

3. RESULT AND DISCUSSION

The learning process with the NHT and TPS was carried out for one month with three face-to-face meetings. In practice, all samples can follow well from the beginning to the end of the meeting. Learning was carried out directly because it was implemented before the COVID-19 pandemic in Indonesia. The material was related to the three-dimensional shapes of polyhedrons.

Table 6 shows the results of the homogeneity test using the Levene's Test Model. The Levene value is shown in the Value row based on Mean which is 1.788 with a p value (sig) of 0.186 where > 0.05 means that there is a similarity of variance between groups (homogeneous).

The results of the balance test using the independent t test showed that the two sample classes had the same initial ability (see Table 7).

Table 7. Output of independent t test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Test scores	Equal variances assumed	1.788	.186	.902	62	.371	2.125	2.357	-2.587	6.837
	Equal variances not assumed			.902	57.3	.371	2.125	2.357	-2.595	6.845

As the data were homogenous, then it used the first row with the t-count value of 0.902 in DF 62. This t-count value was then compared with the t-table in DF 62 with the probability of 0.05, so that the t-table was 1.670. It can be seen that t count is lower than the t table so that the two classes have no difference in ability.

3.1. Category of Learning Activeness

After knowing that the two sample classes had the same ability, a learning activeness questionnaire consisting of 40 questions was distributed to the entire sample. Based on Table 5, each sample class is heterogeneous in terms of learning activeness. It means that in each sample class there are all levels of learning activeness. Description of the level of student activity can be seen in Table 8

Table 8. Distribution of learning activeness

Class	Learning activeness	Number of students
Experiment	High	8
	Moderate	8
	Low	16
Control	High	16
	Moderate	8
	Low	8

3.2. Data Description

The data used for hypothesis testing were obtained from the assessment of student learning outcomes after the treatment. The experimental and control classes consisted of 32 students of each. Description of students' learning outcomes can be seen Table 9.

Table 9 above shows that in the experimental class, the mean value of the learning outcomes reached 78.28, while for the control class reached 67.22. The mean value of students' learning outcome with high learning activeness was 73.13, while moderate activeness and low activeness reached 73.25 and 72.04 respectively.

3.3. Hypothesis Tests

Table 9. Description of learning outcome

Learning Model	Learning activity	Mean	Std. Deviation	N
NHT-Scientific	High	74.63	14.530	8
	Medium	82.50	12.444	8
	Low	78.00	13.089	16
	Total	78.28	13.177	32
TPS-Scientific	High	78.38	11.523	16
	Medium	64.00	10.351	8
	Low	60.13	6.402	8
	Total	67.22	11.273	32
Total	High	73.13	12.330	24
	Medium	73.25	14.613	16
	Low	72.04	14.082	24
	Total	72.75	13.381	64

The hypothesis test used two-way ANOVA. The use of ANOVA is to find out whether there are significant differences in the average value of some groups of data. This study used two-way ANOVA because the independent variables consisted of two types, namely learning Models and learning activeness. While the dependent variable was only one, namely learning outcomes.

Before using the two-way ANOVA test, four requirements should be fulfilled at least:

1. The standardized residual value must be normally distributed.

2. The populations of the data variance are the same.

3. The samples used are not related to each other. It means that each population is independent in the group.

4. The data scale on the dependent variable must be an interval or ratio scale, and the data scale for the independent variable is a nominal scale.

Out of the four requirements, the third and fourth have been fulfilled.

Table 10. Results of normality test using SPSS

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Standardized Residual for Y	.101	64	.177	.968	64	.090

3.3.1. Standardized Residual Normality Test and Homogeneity Test

The normality test used the IBM SPSS Statistic 21 application and the results are presented in Table 10.

Considering the sig. value of 0.090 using Shapiro-Wilk in Table 10 above, the standard residual value was normally distributed as the sig. value is higher than 0.05. To identify whether each variant of the dependent variable is the same or homogeneous, check out Levene's output (Table 11).

Table 11. Results of homogeneity test

F	df1	df2	Sig.
1.420	5	58	.231

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + X1+X2+X1*X2

Based on Table 11, sig value. obtained is higher than 0.05, namely 0.231. It shows that the variance of the mathematics learning outcomes variable is the same or homogeneous.

3.3.2. Hypothesis Test with Two-Way Anova

Similar to the previous tests, the two-way ANOVA test also used the IBM SPSS Statistic 21 application. The output of this test is presented in Table 12.

To create an active and interactive learning atmosphere, teachers can apply the NHT and TPS learning Models. The NHT learning Model can stimulate students to be more active and creative where students have the opportunity to find solutions to problems independently through group collaboration so that they will easily understand the material [18].

The NHT learning Model is a variation of group discussion in which the teacher determines randomly who will represent the group without any prior information so that all students will try to prepare themselves as best they can. Therefore, the students become actively involved in the learning process [19].

Meanwhile, in the TPS Model, the learning process begins with the provision of questions or problems by the teacher and then students are asked to find solutions individually. The lesson ends with a discussion process in pairs. Inappropriate division of pairs can result in a misunderstanding about the materials for both students [20].

The second hypothesis that there is a different effect of levels of learning activeness on learning outcomes is rejected. It means that student learning activity does not affect learning outcomes. Today, learning is not just memorizing formulas [21] as students are required to be able to solve more complex mathematical problems. Thus, just being active will

Table 12. Results of hypothesis test using two-way anova

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3119.500^a	5	623.900	4.434	.002
Intercept	298080.225	1	298080.225	2118.578	.000
X1	2387.025	1	2387.025	16.966	.000
X2	255.144	2	127.572	.907	.409
X1*X2	858.144	2	429.072	3.050	.055
Error	8160.500	58	140.698		
Total	350004.000	64			
Corrected Total	11280.000	63			

a. R. Squared = .277 (Adjusted R Squared = .214)

The learning Model variable is symbolized by X1 and the learning activeness variable is symbolized by X2. The significance value in this study reached 5%.

Based on Table 12, the first hypothesis that there is a difference in the effect of NHT and TPS on learning outcomes is accepted. Then, based on the mean in each sample class, it can be said that the NHT learning Model is better than the TPS learning Model.

not guarantee that someone will have better learning outcomes. Indeed, other variables are needed that can make student activeness in learning more meaningful.

The third hypothesis that there is an interaction of learning Models and learning activities on learning outcomes is rejected. It means that there is no interaction between the learning Model and learning activities on learning outcomes. There is no interaction

between the NHT and TPS learning Models and student learning activities as in the learning process student activeness is not the main factor in the implementation of NHT and TPS learning Models.

Students with high learning activeness tend to be happier to learn individually than in groups [22]. One of the reasons is that they feel disturbed if other students with lower activity cannot be serious in learning in which when one initially plans a study room becomes a playroom.

4. CONCLUSION

Learning is expected to be done meaningfully in which each student can construct his/her knowledge. The scientific learning approach is one way for students to experience, observe, and summarize the material they learn for themselves to construct their knowledge. The NHT and TPS learning Models can support the scientific learning approach. The NHT learning Model requires students to collaborate with their groups so that at any time when they are asked to present, they can answer correctly. Meanwhile, in the TPS Model, students are required to think by observing, then pair up to discuss or ask questions, and then share their findings or answer. In practice, learning Models affect student learning outcomes where the NHT learning Model produces better learning outcomes than the TPS learning Model. The application of the NHT and TPS Models requires students to be active, but the results show that student activeness does not influence learning outcomes so that there is no interaction between the learning Model and learning activeness.

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