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THE EFFECT OF LEARNING MATHEMATICS WITH THE NUMBERED HEAD TOGETHER MODEL ON LEARNING OUTCOMES REVIEWED FROM STUDENTS' CREATIVE THINKING ABILITIES

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Abstract

This study aims to determine the effect of the NHT learning model on students' mathematics learning outcomes, viewed from their creative thinking abilities. The research method used was a quasi-experimental study with a two-group research design, namely the experimental class given the NHT learning model and the control class using the conventional method. The research sample consisted of grade IX students of SMP Negeri 2 Surakarta, who were selected using the cluster random sampling technique. The instruments used included learning outcome tests, creative thinking ability questionnaires, and academic documentation. The data were analyzed using normality tests, homogeneity tests, and two-way analysis of variance. F_A = 8,151 and F_{tabel} = 4,01 were obtained. Because $F_A > F_{tabel}$, Ho is rejected. Thus, it shows that there is a difference in the effect of implementing NHT and conventional strategies on mathematics learning outcomes. F_B = 5.655 and F_{tabel} = 3.16 were obtained. Because $F_B > F_{tabel}$, Ho is rejected. So it shows that there is a difference in the influence of students' creative thinking skills on mathematics learning outcomes. Obtained F_{AB} = 2.446 and F_{tabel} = 3.16. Because$F_{AB} < F_{tabel}$ then Ho is accepted. So it shows that there is no interaction between the application of NHT and conventional strategies with students' creative thinking skills on mathematics learning outcomes. So it shows that there is no interaction effect of learning models and creative thinking skills on student learning outcomes. So it can be concluded that the Numbered NHT learning model is more effective than the conventional model in improving overall student learning outcomes, and high creative thinking skills make a significant contribution to mathematics learning outcomes. However, the effectiveness of the NHT learning model is not influenced by creative thinking skills.

Keywords: Numbered Heads Together, learning outcomes, creative thinking

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran Numbered NHT terhadap hasil belajar matematika siswa, ditinjau dari kemampuan berpikir kreatif. Metode penelitian yang digunakan adalah kuasi-eksperimen dengan desain penelitian dua kelompok, yaitu kelas eksperimen yang diberikan model pembelajaran NHT dan kelas kontrol yang menggunakan metode konvensional. Sampel penelitian terdiri dari siswa kelas IX SMP Negeri 2 Surakarta, yang dipilih menggunakan teknik cluster random sampling. Instrumen yang digunakan meliputi tes hasil belajar, angket kemampuan berpikir kreatif, serta dokumentasi akademik. Data dianalisis menggunakan uji normalitas, uji homogenitas, dan analisis variansi dua jalur. Diperoleh F_A = 8,151 dan F_{tabel} = 4,01. Karena $F_A > F_{tabel}$ maka Ho ditolak. Sehingga menunjukkan bahwa terdapat perbedaan pengaruh penerapan strategi NHT dan konvensional terhadap hasil belajar matematika. Diperoleh F_B = 5,655 dan F_{tabel} = 3,16. Karena $F_B > F_{tabel}$ maka Ho ditolak. Sehingga menunjukkan bahwa terdapat perbedaan pengaruh kemampuan berpikir kreatif siswa terhadap hasil belajar matematikaDiperoleh F_{AB} = 2,446 dan F_{tabel} = 3,16. Karena $F_{AB} < F_{tabel}$ maka Ho diterima. Sehingga menunjukkan bahwa tidak terdapat interaksi antara penerapan strategi NHT dan konvensional dengan kemampuan berpikir kreatif siswa terhadap hasil belajar matematika. Sehingga menunjukkan bahwa tidak ada pengaruh interaksi secara bersama model pembelajaran dan kemampuan berpikir kreatif terhadap hasil belajar siswa. Sehingga dapat disimpulkan bahwa Model pembelajaran Numbered NHT lebih efektif dibandingkan model konvensional dalam meningkatkan hasil belajar siswa secara keseluruhan, dan kemampuan berpikir kreatif yang tinggi memberikan kontribusi signifikan terhadap hasil belajar matematika. Namun, efektivitas model pembelajaran NHT tidak dipengaruhi oleh kemampuan berpikir kreatif.

Kata kunci: Numbered Heads Together, hasil belajar, berpikir kreatif

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INTRODUCTION

Mathematics is the most crucial science in education and is the basis for various other fields of study. Almost all aspects of life require mathematics. According to Utami (2022), mathematics is not only centered on the final result, but also on the ongoing teaching and learning stages. Every level of education must understand mathematics well. With a strong understanding and creativity, students can develop the analytical and logical skills needed in various situations. In addition, mathematics also trains perseverance and accuracy in solving problems.

Students' ability to think creatively is crucial when learning mathematics because they have to solve problems related to real-world situations in addition to studying the subject matter and memorizing formulas. Referring to the Regulation of the Minister of Education and Culture No. 22 of 2016, students must be proficient in mathematics as part of life skills, which also includes the ability to solve problems in an interesting, stimulating, fun, and challenging way, actively, and provide adequate space for students to think creatively. As a result, students need to use their creativity when overcoming mathematical difficulties.

Creative thinking according to Munandar (2012) is a process in which someone develops a problem into various logical, patterned, and systematic alternative solutions. In terms of overcoming mathematical difficulties, creative thinking can provide many practical solution ideas. Guilford mentions fluency, flexibility, originality, and elaboration as markers of creative thinking capacity. Students are considered to have creative thinking skills if they are productive, innovative, have a great sense of curiosity, are confident, think optimistically, consistently handle difficult tasks, and try hard (Heris Hendriana, 2017).

Based on the results of PISA 2022 (2023), it shows that the creative thinking capabilities of Indonesian students in mathematics are still ranked quite low compared to other participating countries. The average score of Indonesian students for mathematics is 366 compared to the OECD average of 472. Although there has been significant progress from previous findings, these findings show that there is still much that must be done to raise the standard of education in Indonesia so that it can compete internationally. Teachers find it difficult to help Indonesian students develop more innovative mathematical thinking. This is intended so that educators can design lessons that encourage students to actively seek their own concepts or answers, based on their talents.

Studies show that students' mathematical creative thinking capabilities are often underdeveloped. Several aspects that contribute to this include lack of interest, limited practice time, and inadequate motivation (Huliatunisa et al., 2020). Students tend to imitate teachers passively without deep understanding and have difficulty solving problems independently (Faturohman & Afriansyah, 2020). To overcome this problem, various approaches have been suggested, such as implementing diverse and contextual learning methods, providing realistic examples, and providing frequent practice opportunities (Lathi, 2018). Learning innovations such as NHT type cooperative learning can be utilized to increase students' creative thinking capabilities.

NHT type cooperative learning can increase students' creative thinking capabilities because this technique encourages active participation and collaboration between students. In NHT, each student in the group is given a number and takes turns being responsible for answering questions or completing work given by the teacher. This creates an interactive and supportive learning environment, where students can share ideas, discuss various solutions, and learn from the perspectives of their friends. Thus, students do not only rely on individual understanding but also develop creative thinking skills through group interaction and collaboration. According to research by Nur Muhamad Irwan, Salam Moh. (2016), cooperative learning such as NHT can improve creative thinking skills because students are encouraged to think more flexibly and originally in solving problems.

According to the author, this study has the potential to significantly improve the standard of mathematics teaching in Indonesia. The NHT cooperative learning paradigm is intended to help students participate more actively and innovatively during the teaching and learning process. In addition, the author thinks that the findings of this study will be a reference for educators in creating optimal teaching methods to improve students' original thinking skills. In addition, this study is expected to provide a new perspective on the importance of creative and contextual approaches in mathematics teaching to equip students in facing problems in the future.

METHODS

This study utilized a quasi-experimental design and quantitative methodology. Two groups participated in the study: the experimental class, which was instructed utilizing the

NHT model, as well as a control class, which was instructed utilizing a traditional teaching approach.

All ninth grade students registered in the 2024-2025 academic year at SMP Negeri 2 Surakarta became the research population. Using a cluster random selection approach, the research sample was selected, with class IX D as the experimental class and class IX E as the control class. The balance test was conducted using the results of the Semester Final Exam (UAS) semester 1 to ensure that both groups had similar initial capabilities before receiving therapy.

Academic documentation, student creativity survey, and learning outcome test were used as measurement tools for the research. After the therapy, the learning outcome test was given in the form of essay questions to assess students' insight into the subject matter. The level of students' innovative thinking in mathematics learning was assessed using a questionnaire. To collect more information, including a list of grades and other student academic data, documentation was conducted. The validity and reliability of this research tool have been examined; product moment correlation was used to assess validity, while Cronbach's Alpha was used to assess reliability.

Data analysis was conducted in several steps. To ensure that the data were distributed regularly, a normality test using the Lilliefors test was conducted. In addition, the equality of variance between groups was tested using the homogeneity test based on the Levene test. The impact of the learning model and students' innovative thinking on learning outcomes, as well as communication between the two variables, was then assessed using Two-Way ANOVA. Post-hoc tests were used to test for differences between groups if there was a substantial comparison. By utilizing SPSS software, all statistical analyses were conducted at the sign level. 5% ($\alpha = 0.05$).

RESULTS AND DISCUSSION

This study was conducted at SMP Negeri 2 Surakarta in class IX of the even semester of the 2024-2025 academic year. Two classes were used as samples in this study, namely class IX D for the experimental class and class IX E for the control class. The NHT paradigm was used to teach mathematics to 32 students in the experimental class. Meanwhile, 31 students in the control group learned mathematics using a traditional approach.

The balance test was conducted on samples before treatment. The goal of the balance test was to ensure whether the initial capabilities of the experimental class and the control class were the same. The following information was collected after the balance test data was extracted from the final exam results and analyzed using SPSS.

Table 1. Initial Ability Data Balance Test

Class	N	$\bar{X}$	S^2	t_{hitung}	t_{tabel}
Experiment	32	67,250	150,645	0,320	1,999
Control	31	66,194	193,428		

Based on table 1, the results obtained t_{count} = 0,320 and t_{table} = 1,999. Because $t_{count} < t_{table}$ namely 0,320 < 1,999 then H_0 is accepted. Therefore, it can be said that before receiving therapy, the experimental class and the control class had the same initial mathematical capabilities.

Questionnaires on students' capacity for creative thinking and arithmetic learning achievement tests were used as measuring instruments in this study. In order to determine the validity and reliability of the instrument, a trial was conducted in a non-sample class before being tested in a sample class. The following are the results of the calculation of the validity test of the mathematics learning achievement test using SPSS.

Table 2. Results of Validity Test of Learning Outcome Test

Items	r_{count}	r_{table}	Test Decision
1	0,641745	0,355046	Valid
2	0,402674	0,355046	Valid
3	0,365456	0,355046	Valid
4	0,363191	0,355046	Valid

Based on the data in Table 2, it can be seen that there are 4 test questions worth more than r_{table} = 0,355 ($r_{count} \geq r_{table}$). So there are 4 items of questions that are said to be valid and can be used in the sample class.

Then, here are the findings of the calculation of the validity test of the student's creative thinking capability questionnaire using SPSS.

Table 3. Results of the Validity Test of the Creative Thinking Ability Questionnaire

No	r_{count}	r_{table}	Decision	No	r_{count}	r_{table}	Decision
1	0,64192	0,355	Valid	16	0,51949	0,355	Valid
2	0,575989	0,355	Valid	17	0,43706	0,355	Valid
3	0,507273	0,355	Valid	18	0,303038	0,355	Invalid
4	-0,36838	0,355	Invalid	19	0,429414	0,355	Valid

5	0,212108	0,355	Invalid	20	-0,26046	0,355	Invalid
6	0,26385	0,355	Invalid	21	0,668937	0,355	Valid
7	0,371227	0,355	Valid	22	0,451791	0,355	Valid
8	0,600465	0,355	Valid	23	0,603703	0,355	Valid
9	0,338046	0,355	Invalid	24	0,587309	0,355	Valid
10	0,284924	0,355	Invalid	25	0,626344	0,355	Valid
11	0,676374	0,355	Valid	26	0,439537	0,355	Valid
12	0,679786	0,355	Valid	27	0,175827	0,355	Invalid
13	0,214452	0,355	Invalid	28	0,551529	0,355	Valid
14	0,775537	0,355	Valid	29	0,623765	0,355	Valid
15	0,603774	0,355	Valid	30	0,344287	0,355	Invalid

Based on the data above, it can be seen that there are more than 20 test question items r_{table} = 0,355 ($r_{count} \geq r_{table}$). So there are 20 question items that are said to be valid and can be used in the sample class. While the 10 question items that are said to be invalid cannot be used in the sample class.

The reliability test of the students' creative thinking ability questionnaire used the Cronsbach's Alpha formula in SPSS and Microsoft Excel. Based on the calculation of the formula, a reliability value of 0.897 was obtained. This shows that the students' creative thinking ability questionnaire instrument is reliable with the highest reliability classification.

The research was then conducted, and information was collected through a questionnaire on creative thinking skills and a learning finding test for the experimental group and the control group. To ensure whether the research sample was normally distributed, the data findings were then tested for normality. By utilizing SPSS, this normality test produced the following findings.

Table 4. Normality Test

	Statistic	Sig
One-Sample Shapiro-Wilk Test	0,974	0,195

Based on the findings of the normality test calculation in Table 4. using SPSS, the sig value is 0.195 because the sig value of 0.195 > 0.05, the data is normally distributed.

To ensure whether the variation is based on a similar population or not, a homogeneity test is used. The results of the homogeneity test processed using SPSS are among others.

Table 5. Homogeneity Test

	Statistic	Sig
Lavene's Test	0,802	0,529

The sig value obtained is 0.529. The data can be said to be homogeneous because the sig value. 0.529 > 0.05. After conducting the requirement test, it is known that the research data is homogeneous and normally distributed. Hypothesis testing is the next stage.

Two-way analysis of variance with dissimilar cells at the 5% sig level is the hypothesis test used. The achievement of the two-way analysis of variance with dissimilar cells is to determine whether there is an impact of using the NHT learning paradigm on students' creative thinking capabilities in learning in traditional classes. The following data layout is presented in the following table.

Table 6. Data Layout

B		Students' Creative Thinking Ability							
A		High			Medium			Low	
Learning Model	NHT	90	95	85	95	90	90	50	
		80	55	80	75	80	85		
		90	75	85	85	95	80		
		95	90	85	85	90	85		
		80	80	90	70	95	95		
						55			
	Conventional	70		55	55	70	35	50	85
		40		80	60	55	55	75	30
		70		60	75		60	55	55
		45		85	60		65	55	40
		65		60	55		45	60	

The summary of the findings of the 2-way analysis of variance calculations includes, among others.

Table 7. Summary of 2-Way Analysis of Variance with Dissimilar Cells

Source	JK	dK	RK	F_{count}	F_{table}	Explanation
Learning Strategy (A)	1145,668	1	1145,668	8,151	4,01	Rejected

Creative Thinking Ability (B)	1589,756	2	794,878	5,655	3,16	Rejected
Interaction (AB)	687,491	2	343,746	2,446	3,16	Accepted
Error (G)	8011,964	58	140,561			
Total (T)	10182,137	63				

Based on the summary of the findings of the analysis of variance calculations of 2 dissimilar cell lines, a conclusion can then be drawn, the results of the calculations of the analysis of variance of 2 dissimilar cell lines are obtained F_A = 8,151 and F_{table} = 4,01. Because F_A > F_{table} then H_0 rejected. To show that there is a comparison of the impact of implementing NHT and conventional strategies on mathematics learning outcomes. The calculation findings from the analysis of variance of 2 dissimilar cell lines were obtained F_B = 5,655 and F_{table} = 3,16. Wherefore F_B > F_{table} then H_0 was rejected. To show that there is a comparison of the impact of students' creative thinking capabilities on mathematics learning findings. Calculation findings based on the analysis of variance of 2 dissimilar cell paths were obtained F_{AB} = 2,446 and F_{table} = 3,16. To show that there is a comparison of the impact of students' creative thinking capabilities on mathematics learning findings. Calculation findings based on the analysis of variance of 2 dissimilar cell paths were obtained F_{AB} < F_{table} then H_0 is accepted. This shows that there is no relationship between the implementation of NHT and conventional strategies with students' creative thinking capabilities in mathematics learning findings.

Based on the findings of the 2-way variance analysis with dissimilar cells, it was found that H_{0AB} accepted, this means that there is no relationship between the implementation of NHT and conventional steps with students' innovative thinking capabilities in mathematics learning findings. Obtained H_{0A} and H_{0B} rejected. Therefore, a post-ANAVA follow-up test must be carried out to understand the comparison of means between rows, namely by utilizing the mean between rows. Before, a post-mean follow-up test is carried out. The summary of the cell mean and its marginal mean is.

Table 8. Summary of Cell Mean and Marginal Mean

Learning Model	Kapabilitas Berpikir Kreatif Siswa			Marginal Average
	High	Medium	Low	
NHT	83,667	84,375	50	72,681

Conventional	58	64,167	54,643	58,936
Marginal Average	70,834	74,271	53,322	

H_{0A} and H_{0B} disqualified based on the findings of the two-way analysis of variance of non-homogeneous cells. so that the impact of using NHT and traditional tactics on mathematics learning outcomes varies. Multiple comparisons between rows are not needed for subsequent post-anava tests because this study only includes two learning strategies: conventional and NHT. Compare the marginal mean values of each learning approach to identify the most effective approach. Based on the calculation results of Table 8, the marginal mean of the conventional model is 58.936, while the NHT strategy is 72.681. Thus, it can be concluded that the NHT model outperforms the traditional paradigm in terms of mathematics learning outcomes.

After that, the data from each column is compared. The two-way analysis of variance test of dissimilar cells provides a conclusion finding of rejection. H_{0B}. Therefore, it can be concluded that there are variations in mathematics learning outcomes observed based on creative thinking capabilities. Table 9 shows the results of the comparison test between columns.

Table 9. Summary of Comparison Test of Means Between Columns

H_0	H_1	F_{count}	$2F_{table}$	Explanation
$\mu_1 = \mu_2$	$\mu_1 \neq \mu_2$	0,82	6,317	Accepted
$\mu_1 = \mu_3$	$\mu_1 \neq \mu_3$	7,29	6,317	Rejected
$\mu_2 = \mu_3$	$\mu_2 \neq \mu_3$	11,26	6,317	Rejected

In column 1 and column 2 we get F_{count} = 0,82 and F_{table} = 6,317. $F_{count} > F_{tabel}$ so H_0 accepted. It can be concluded that there is no substantial comparison between the findings of learning mathematics of students who have high innovative thinking capabilities with students who have moderate creative thinking capabilities. In column 1 and column 3, it is found that F_{count} = 7,92 and F_{table} = 6,317. Because $F_{count} > F_{table}$ so H_0 rejected. Thus, it can be stated that students with strong creative thinking capabilities and students with poor creative thinking capabilities have somewhat different findings in learning mathematics. In column 2 and column 3, it is found that F_{count} = 11,26 and F_{table} = 6,317. Because $F_{count} > F_{table}$ so H_0 rejected. The findings of mathematics learning of students with medium creative

thinking capabilities and students with low creative thinking capabilities vary greatly, so it can be concluded.

In addition, a double difference was also conducted between the average cells in similar rows and columns. There is no relationship between learning methods and creative thinking capabilities in mathematics learning findings, based on the calculation of the analysis of variance of two dissimilar cell paths, which leads to the acceptance of the decision H_{0B}. Therefore, it is not necessary to perform a mean difference between cells in similar rows and columns.

The above-mentioned arguments lead to the conclusion that students' capacity for creative thinking has varying impacts on mathematics-related learning outcomes. Compared with children with poor thinking capabilities, those with excellent innovative thinking capabilities will do better.

CONCLUSION

The research findings show that (1) student learning outcomes are influenced differently by NHT and traditional cooperative learning techniques, where the NHT learning model is much more successful than the traditional learning model; and (2) student learning findings in mathematics and creative thinking are different, where students who have great innovative thinking capabilities have optimal results compared to students who have moderate or low innovative thinking capabilities. (3) The NHT learning approach and traditional learning do not have much influence on students' original thinking abilities. Thus, it can be concluded that the NHT learning paradigm is more successful than the traditional approach in increasing overall student learning outcomes, and that strong creative thinking abilities have a large impact on mathematics learning outcomes. However, students' creative thinking capabilities do not have much influence on the success of the NHT learning approach.

When compared to traditional teaching approaches, the NHT learning model significantly improves students' learning outcomes in mathematics, according to research findings. This shows how the NHT model is more successful in improving students' understanding and mathematical abilities, making it a useful strategy for improving learning outcomes in mathematics teaching.

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