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The Effect of The *Numbered Heads Together* (NHT) Learning Model Assisted By Open Questions On Mathematics Problem-Solving Skills

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Abstract
Mathematical problem-solving skills are essential for meeting the demands of 21st-century learning. However, most fourth-grade students at Banjarsari State Elementary School have not met the Minimum Competency Criteria (KKM). This study aims to examine the effect of the Numbered Heads Together (NHT) learning model combined with open-ended questions on students' mathematical problem-solving abilities. Using a quantitative experimental design, the study involved fourth-grade students, with data collected through observation, tests, and documentation. The results show that the NHT model assisted by open-ended questions positively affected students' problem-solving skills by 69.9%. Students' average learning outcomes increased significantly, as indicated by Zhitung ≥ Ztabel and thitung ≥ ttabel, leading to the rejection of H_0. These findings demonstrate that cooperative learning with open-ended approaches effectively enhances students' mathematical problem-solving abilities.

Keywords: *Numbered Heads Together (NHT), Open-Ended Questions, Problem-Solving Skills.*

Abstrak
Kemampuan pemecahan masalah matematika merupakan kompetensi penting dalam pembelajaran abad ke-21. Namun, sebagian besar siswa kelas IV di SD Negeri Banjarsari belum mencapai Kriteria Ketuntasan Minimal (KKM). Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran Numbered Heads Together (NHT) berbantuan soal open-ended terhadap kemampuan pemecahan masalah matematika siswa. Penelitian ini menggunakan pendekatan kuantitatif dengan desain eksperimen pada siswa kelas IV, dengan teknik pengumpulan data melalui observasi, tes, dan dokumentasi. Hasil penelitian menunjukkan bahwa model pembelajaran NHT berbantuan soal open-ended memberikan pengaruh positif sebesar 69,9% terhadap peningkatan kemampuan pemecahan masalah matematika. Rata-rata hasil belajar siswa mengalami peningkatan signifikan, ditunjukkan oleh nilai Zhitung ≥ Ztabel dan thitung ≥ ttabel, sehingga H_0 ditolak. Temuan ini menunjukkan bahwa pembelajaran kooperatif berbasis soal open-ended efektif dalam meningkatkan kemampuan pemecahan masalah matematika siswa.

Kata Kunci: *Numbered Heads Together* (NHT)*, Soal Terbuka, Kemampuan Pemecahan Masalah.*

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INTRODUCTION

Education is the main pillar that contributes significantly to the development process of a nation to face the challenges of the times in the current era of globalization, especially technological developments and various innovations in learning to make it more enjoyable. According to Amadi (2022), it is explained that in the current global context, there is competition that demands adaptation and superior competence. Therefore, the world of education has a great responsibility to provide quality education. The goal is to create graduates with character and skills, and to be able to compete in a competitive global arena.

Education as a means to improve the quality of human resources. Education is not only considered as the delivery of knowledge and skill development, but also to realize one's ideals and potential so that the standard of human life is better than before (Yulaini, 2016). The quality of education is greatly influenced by the ability of teachers. Teachers ensure the implementation of learning activities according to student characteristics in order to realize educational goals effectively. With these demands, teachers must be able to understand four main competencies, namely professional, social, pedagogical, and personality competencies. One of the crucial competencies is the ability to facilitate interactive learning in the classroom.

Teachers have a central role in the educational process, so they must develop their ability to master learning materials and strategies in order to create meaningful learning. In addition, teachers must continue to keep up with the development and renewal of technology and science that develops in line with the needs of society and the development of the times. The teacher's task is to consistently improve the quality of education so that lessons become clear and easily absorbed by students (Sulastri *et al*., 2020).

Elements in education include several interrelated things such as educational goals, curriculum, students, teachers, educational interactions, educational content, and educational environment (Triwiyanto, 2014). The objectives of mathematics learning listed in the Curriculum at the Education Unit Level (2006) which were refined in the 2013 curriculum, one of which is to solve problems which include the ability to understand problems, design mathematical models, solve models and interpret the solutions obtained (Ministry of National Education, 2006).

Mathematical problem-solving skills according to Davita & Pujiastuti (2020) are efforts to solve mathematical problems that are carried out by students using their knowledge and abilities. Meanwhile, according to Pratiwi & Musdi (2021), it is explained that in the field of mathematics, students must be able to develop problem-solving skills. The more problem-solving skills a student has,

the greater their mindset. Using problem-appropriate math problem-solving skills can help students solve simpler, complex problems and make ideas concrete. This is in accordance with the opinion of Amam (2017) explaining that it is a person's ability to solve a mathematical problem in the form of non-routine problems and then presented in a contextual or textual format. These questions are designed to evaluate students' problem-solving abilities.

Currently, Indonesian students are considered to have low mathematical solving skills. PISA, organized by the OECD, evaluates the ability of 15-year-olds in mathematics, science, and reading. The 2022 PISA results show a decline in Indonesia's scores in these three areas. The 2022 exam results show reading, math, and science scores of 359, 366, and 383, respectively. This value is lower than the 2018 test scores of 371, 379, and 396, respectively (OECD, 2022).

SD Negeri Banjarsari also experienced problems related to the low level of students' understanding when solving a mathematics problem. Based on the results of interviews and the average score of the math problem-solving test, many students have not reached the minimum passing score of 70. This is due to their inability to understand the basic ideas needed to solve problems, and their focus on the end result. Another reason for the low scores of students is because conventional teaching methods have not been developed into interactive learning designs that can motivate students and make the teaching and learning process interactive. Therefore, educators must plan a learning model. One such model is the NHT model.

The NHT learning model was first developed by Kagan in 1993. This cooperative learning model asks students to compile and present their work according to their abilities. This model is characterized by student cooperation in small groups, and is typically used to engage students in improving their understanding of the subject matter or to evaluate how well they understand the material (Nisa *et al*., 2023). In line with Salsabila's opinion. *et al* (2025) explain that the NHT learning model emphasizes student involvement in identifying, analyzing, and communicating information from various sources before sharing it with the rest of the class. This approach provides students with the opportunity to actively participate in the learning process, work in groups, and take responsibility for the results of their group's work.

According to Andriawan (2022), learning NHT can increase students' cooperative attitudes, joy, courage, activeness, critical attitude, and democratic attitudes. In addition, according to Firmansyah & Solihah (2019), the NHT model has succeeded in fostering students' interest and interest in mathematics learning.

In addition to still implementing conventional learning, teachers only use available textbooks. As a result, teachers only explain the material according to the book without looking for alternative methods to optimize learning objectives. The learning process, especially for mathematics subjects, will be more meaningful if teachers use a learning model with open-ended questions.

According to Karti and Syofiana (2021), open-ended questions are questions that are not well defined with various approaches and various possible answers. This is in line with research (Yuliana, 2015) explaining that open-ended questions are intended to encourage students' increased understanding of the problem asked, improve their intellectual abilities, and improve their experience in the process of finding something new. Open-ended questions give students the freedom to use the various methods they deem most appropriate to solve the problem.

The selection of an open-question assisted NHT learning model can help students in the ongoing learning process, especially mathematics materials where many students are involved in the form of groups in collaboration and exchange ideas to study the material and understand concepts in solving an existing problem in various alternative ways.

METHODS

This study uses a quantitative method with a *one-shot case study type experimental approach*. In this design, a group of students is given treatment in the form of the application of the NHT learning model assisted by open-ended questions, then the results are observed without a comparison group. This approach aims to determine the direct impact of the treatment on the variables studied.

Figure 1 Paradigm *One-Shot Case Study* (Sugiyono, 2015).

This research will be conducted on grade IV students at SD Negeri Banjarsari. *Probability Sampling* with *Simple Random Sampling* as many as 31 students were randomly selected for quantitative analysis. The strategy used by researchers to collect research data is known as data collection techniques. In this study, the test of problem-solving ability and activity observation using the NHT learning model with open-ended questions was used to collect quantitative data. The findings of the test are supported by documentation in addition to tests and observations.

RESULTS AND DISCUSSION

The results of data analysis were obtained from 31 students of class IVA. The data was analyzed quantitatively to answer the formulation of the previous problem. The analysis was carried out through several stages, including a normality test to determine the distribution of data, a hypothesis test to test the effect of treatment, as well as individual completeness and classical completeness tests to assess the achievement of student learning outcomes both individually and as a class.

Table 1. Normality Test on Observation Values

	Kolmogorov-Smirnova		
	Statistic	df	Sig.
OBSERVATION	,084	31	,200*

Table 1. The normality test of observation values in grade 4 of SD Negeri Banjarsari with the NHT model assisted by open questions obtained data obtained 0.200 > 0.05 showed that this data was normally distributed.

Table 2. Normality Test on Posttest Scores

	Kolmogorov-Smirnova		
	Statistic	df	Sig.
Posttest	,094	31	,200*

Table 2. The normality test of the posttest value using SPSS obtained a significant value of 0.200 > 0.05 indicating that this data is normally distributed.

Table 3. Output Anova

Models		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3419,019	1	3419,019	66,058	,000b
	Residual	1500,981	29	51,758		
	Total	4920,000	30			

The data in table 3 shows that the NHT learning model assisted by open questions affects students' mathematical problem-solving ability in grade IV multiplication material at SD Negeri Banjarsari. This can be seen from the sig

value of 0.000 < 0.05, then Ho is rejected. Furthermore, the results of the regression equation can be seen in table 4.

Table 4. Output Coefficients

Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-36,831	14,433		-2,552	,016
	OBSERVATION	1,826	,225	,834	8,128	,000

To calculate simple linear regression, we used data from grade IV students of SD Negeri Banjarsari who had received certain treatment. Before performing a simple linear regression calculation, we need to first determine which are independent variables (X) and dependent variables (Y). The value of the independent variable (X) was obtained from the results of observation of the implementation of the open-question assisted NHT learning model. Meanwhile, the value of the dependent variable (Y) was obtained from the results of the posttest. These two values, X and Y, are then used to calculate the constant (a) and the regression coefficient (b). The calculation results show that constant (a) is worth -36.831 and the regression coefficient (b) is 1.826. These numbers are then fed into a simple linear regression equation, being $\hat{Y} = -36.831 + 1.826X$. From this equation, it can be interpreted that every one unit increase in the value of X will increase the value of Y by 1.826 units. This means that there is a positive influence of the NHT learning model assisted by open questions on students' mathematical problem-solving skills. To see how much of an impact it has can be seen in table 5.

Table 5. Output Model Summary

Models	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,834a	,695	,684	7,194

In table 5 it appears that the value of R square, or what is often called the coefficient of determination, is 0.695. This number, if converted into a percentage, shows how much the independent variable, namely the open-question NHT learning model, affects the dependent variable, namely the ability to solve mathematical problems. These results reveal that there is a contribution of 69.5% from the learning model and 30.5% from other external factors that have a role in influencing student learning outcomes.

Meanwhile, there are other factors outside the NHT learning model and open-ended questions that also play a role, with a contribution of 30.5% to the ability to deal with math problems.

The individual completeness test was carried out to measure the average score of mathematics learning outcomes of fourth grade students of SD Negeri Banjarsari after the implementation of the NHT learning model assisted by open questions has achieved completeness individually, on the contrary.

The hypotheses that will be tested in this study are:

H0: $\mu \leq 69.9$ (average mathematics learning outcomes have not exceeded or equal to 69.9)

Ha: > 69.9 (average math learning outcomes exceed 69.9)μ

In this study, there was an individual completeness test assessed using the t-test. The test criterion H_0 was rejected if $t_{\text{was calculated}} \geq t_{\text{table}}$ with dk = (n-1) and α = 5%. The results of the t-test from this study showed that $t_{\text{calculated}}$ as 4.39 and dk = 31-1= 30, and the value of the t_{table} was 1.697, indicating that H_0 was rejected. These results show that the average ability of students to solve math problems has increased beyond 69.9.

After knowing the individual completeness test, a classical completeness test was then carried out to determine the success of grade IV students of SD Negeri Banjarsari after being treated with the NHT learning model with open-ended questions. This test is used to determine whether the proportion of learning outcomes of mathematical problem-solving skills of 4th grade students has reached more than 69.9% or vice versa.

The statistical hypotheses to be tested are as follows:

H0: $\rho \leq$ 69.9% (the number of students who have completed has not reached 69.9%).

Ha: > 69.9% (the number of students who completed reached 69.9%). ρ

The calculation of the classical completeness test is carried out with the z-test based on a significant level of 5%. The results show that the value of Z_{is} calculated as 1.76 and the value of $Z_{\text{of the table}}$ is 0.45, so that Z calculates $\geq Z_{\text{table}}$ which is 1.76 < 0.45, then minus H_0. This shows that the percentage of students who achieve KKM classically > 69.9%.

CONCLUSION

Based on the results of research carried out at SD Negeri Banjarsari, Ajibarang District, Banyumas Regency on the influence of the open-question assisted NHT learning model on students' mathematical problem-solving ability in grade IV multiplication material, several conclusions can be drawn as follows:

1. There was a significant influence of the application of the open-question NHT learning model on the ability to solve mathematical problems in class IV, multiplication material by 69.5%, the remaining 30.5% was influenced by other variables.
2. The results of the posttest showed an increase in the average score of students, it can be seen from the initial average score of students who had reached the KKM as much as 35.5% and after the researcher gave treatment to grade IV students, the average score of students became 83.9%.

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