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The Effect of the Numbered Heads Together (NHT) Learning Model on Mathematics Learning Outcomes Regarding Integers among Fourth-Grade Elementary School Students

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ABSTRACT

This study aims to determine the effect of the Numbered Heads Together (NHT) cooperative learning model on mathematics learning outcomes regarding the topic of integers among fourth-grade students at Yaltubung Christian Elementary School. A quasi-experimental design with a non-equivalent control group was employed, involving 40 students divided into an experimental group (using NHT) and a control group (using conventional instruction), with 20 students in each. Data were collected via pretests and posttests consisting of four essay questions, which were verified for validity (calculated r > 0.312) and reliability (Cronbach's Alpha = 0.827). An independent-samples t-test—preceded by a Shapiro-Wilk normality test and Levene's homogeneity test—revealed a significant difference between the two groups (t = 3.098; df = 38; p = 0.004). The experimental group achieved a mean posttest score of 72.90, compared to 63.75 for the control group, representing a difference of 9.15 points. These findings indicate that the Numbered Heads Together (NHT) learning model influences students' mathematics learning outcomes by fostering active participation, collaborative discussion, and individual accountability within small groups. The NHT model is recommended as an effective alternative instructional strategy for mathematics in elementary schools.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran kooperatif Numbered Heads Together (NHT) terhadap hasil belajar matematika pada materi bilangan bulat siswa kelas IV SD Kristen Yaltubung. Desain penelitian yang digunakan adalah kuasi-eksperimen dengan nonequivalent control group, melibatkan 40 siswa yang terbagi menjadi kelas eksperimen (NHT) dan kelas kontrol (pembelajaran konvensional), masing-masing 20 siswa. Data dikumpulkan melalui pretest dan posttest berupa empat soal uraian yang telah diuji validitas (r hitung > 0,312) dan reliabilitasnya (Cronbach's Alpha = 0,827). Analisis Independent Sample t-test, yang didahului uji normalitas Shapiro-Wilk dan uji homogenitas Levene, menunjukkan perbedaan signifikan antara kedua kelompok (t = 3,098; df = 38; p = 0,004). Kelas eksperimen memperoleh rata-rata posttest 72,90 sedangkan kelas kontrol 63,75, dengan selisih 9,15 poin. Temuan ini

menunjukkan bahwa model pembelajaran Numbered Heads Together (NHT) berpengaruh terhadap hasil belajar matematika siswa melalui pelaksanaan kegiatan pembelajaran yang mendorong partisipasi aktif, diskusi kolaboratif, dan tanggung jawab individu setiap anggota dalam kelompok kecil. Model NHT direkomendasikan sebagai alternatif strategi pembelajaran matematika yang efektif di sekolah dasar.

INTRODUCTION

Mathematics is one of the subjects taught continuously, from elementary education through higher education. This subject is not only concerned with formulas and calculation procedures but also plays a role in developing the logical, analytical, and systematic thinking skills needed in everyday life (Pujiarti et al., 2022). In the learning process, teachers play an important role in designing activities that help students understand mathematical concepts and develop their problem-solving abilities (Sari et al., 2019). Understanding mathematical concepts needs to be built gradually through explanation, practice, feedback, and learning activities suited to students' needs.

Various learning models can be applied to support student engagement in the learning process, one of which is cooperative learning (Jana, 2020). The cooperative learning model has several types, including Numbered Heads Together (NHT) (Bidari et al., 2021). The NHT model provides opportunities for students to exchange ideas, discuss problems, consider the most appropriate answers, and participate in completing group tasks. Through these activities, students are not only responsible for their own understanding but are also encouraged to understand the results of discussions with group members.

According to Muliandari (2019), one of the main characteristics of the NHT type of cooperative learning model is the assignment of a number to each group member. This numbering encourages all students to understand the material and prepare themselves to present answers when their number is called by the teacher. The NHT model also has relatively simple learning stages but provides opportunities for students to discuss and build shared understanding (Kahar & Aly, 2022). In its implementation, teachers can gain a picture of students' understanding through the answers presented by the selected group members. Therefore, the NHT model is relevant to examine as an alternative for mathematics learning, particularly in research on the effect of this model on student learning outcomes.

The study by Takndare et al. (2026) in Pedagogika: Jurnal Pedagogik dan Dinamika Pendidikan discusses the application of the Polya Problem Solving Model to fourth-grade elementary school students. The study reported an increase in learning outcomes as well as student engagement in sharing ideas during the learning process. These findings are relevant for comparison because they show the importance of learning models that encourage active student engagement. Nevertheless, the learning model used differs from Numbered Heads Together (NHT), so the results of the two studies need to be compared by taking into account differences in model, material, and research design.

One mathematics topic that can pose difficulties for fourth-grade elementary school students is integers. These difficulties relate to understanding the concept of negative numbers, using the number line, and applying integers in everyday life. If the average score of 53.15 mentioned in previous research represents student learning outcomes on the topic of integers, these data can be used as an empirical illustration of students' difficulties in understanding the topic, while still taking into account the context and characteristics of the referenced research subjects. Understanding integers requires good mastery of concepts, so learning cannot rely solely on memorization but also needs to

involve activities that help students understand the relationships between concepts. Aydin and Ubuz (2021) discuss the relationship between mathematics anxiety and mathematics achievement. Mathematics anxiety needs to be considered because it can be related to students' learning experiences and achievement. A similar condition was identified at SD Kristen Yaltubung, so a study of a learning model suited to supporting students' understanding of the topic of integers is needed.

A similar condition was identified at SD Kristen Yaltubung, Southwest Maluku Regency. Based on interviews with the fourth-grade teacher, mathematics learning is still dominated by the lecture method, which places the teacher as the center of information. Students tend to memorize formulas rather than understand the concepts underlying them. The findings of Deslauriers et al. (2019) show that a teacher-centered approach results in lower knowledge retention compared to interactive methods. The impact is measurable: the pretest average score of the experimental class was only 53.15, and that of the control class was 43.70—both far below the mastery threshold. These findings are in line with the study by Nurkolis (2021), which shows that the application of active learning yields better mathematics learning outcomes compared to conventional teacher-centered learning. In addition, Ernawati and Winarni (2024) found that student-centered learning models are able to increase the activeness and mathematics learning outcomes of fourth-grade elementary school students. Thus, the dominance of the lecture method still being applied has the potential to be one of the factors behind students' low learning outcomes.

To address this problem and improve student learning outcomes, a more interactive and collaborative learning model such as Numbered Heads Together (NHT) could be an effective solution. In this model, students work in small groups and are assigned specific numbers. They are then invited to discuss, solve problems, and provide answers as a group.

Cooperative learning emerged as a response to this gap (Zamroni, 2020). Slavin (2021) also defines it as the heterogeneous grouping of students in small groups for collaborative tasks, in which interaction among students is the main driver of knowledge construction. One of its popular variants is Numbered Heads Together (NHT). Developed by Kagan (in Shoimin, 2017), NHT has a unique four-stage mechanism: (1) Numbering—each student receives a unique number within the group; (2) Questioning—the teacher presents a problem; (3) Thinking Together—group discussion until all members understand the answer; and (4) Answering—the teacher randomly calls one number to present the results. This design ensures collective accountability: no member is passive because each individual has an equal chance of being called upon (Suparyono, 2018).

Research on the effect of the Numbered Heads Together learning model on mathematics learning outcomes has been widely conducted by Anggraini (2021) and Pratama (2023) on the topics of LCM and plane figures in urban areas. Although the Numbered Heads Together (NHT) learning model has been examined in various studies on student learning outcomes, studies on the effect of this model need to take into account the characteristics of the material and the learning context being researched. Previous studies, such as Gupitararas and Wasitohadi (2020), discuss the effect of the NHT model on the mathematics learning outcomes of fourth-grade elementary school students. However, research results in certain contexts cannot directly describe the effect of the same model when applied to the topic of integers with concept characteristics that include negative numbers, the number line, and application in everyday life. Therefore, empirical evidence is still needed that specifically tests the effect of the NHT model on mathematics learning outcomes on the topic of integers among fourth-grade elementary

school students. This research was conducted on fourth-grade students at SD Kristen Yaltubung, West Babar District, Southwest Maluku Regency, taking into account local learning conditions, including the use of the lecture method and limited access to learning media. The focus of this research is not merely on the research location but on testing the effect of the NHT model on mathematics learning outcomes on the topic of integers within that learning context.

A number of studies have examined the effect of the Numbered Heads Together (NHT) learning model on mathematics learning outcomes. Gupitararas and Wasitohadi (2020), for example, compared the learning outcomes of fourth-grade students who took part in learning using the NHT model with students who took part in learning using the Student Teams Achievement Division (STAD) model. That study showed that learning outcomes in the NHT class were better than in the STAD class. Although it shares similarities in the use of an experimental design and fourth-grade elementary school students as subjects, this research has a different focus, namely testing the effect of the NHT model on mathematics learning outcomes on the topic of integers at SD Kristen Yaltubung, West Babar District, Southwest Maluku Regency, by comparing learning outcomes before and after treatment and taking into account the results of the comparison group according to the research design used. The differences in material focus and learning context form the basis for testing whether the application of NHT has an effect on students' mathematics learning outcomes on the topic of integers.

Hidayat (2020) reported a 25% increase in the cognitive aspect after the implementation of NHT with a pre-test/post-test design on 40 students. This study aims to examine the effect of the NHT model on mathematics learning outcomes on the topic of integers among fourth-grade students at SD Kristen Yaltubung compared to conventional learning.

METHOD

This study employs a quantitative approach with a quasi-experimental non-equivalent control group design. The selection of this design is based on the fact that group formation was not carried out through pure randomization but rather utilized naturally formed classes (intact classes). The independent variable is the learning model (NHT vs. conventional), and the dependent variable is mathematics learning outcomes on the topic of integers. The research was conducted in the even semester of the 2024/2025 academic year at SD Kristen Yaltubung, Jl. Yaltubung, Babar District, Southwest Maluku Regency, Maluku Province.

The population of this study was all fourth-grade students at SD Kristen Yaltubung, totaling 40 students. Given that there were only two classes, both were used as the sample through a saturated sampling technique. Class IV A was designated as the experimental class (n = 20), which received the NHT model treatment, while class IV B served as the control class (n = 20), which followed conventional learning (lecture, question and answer, and individual practice). The gender composition of both classes was balanced: each consisted of 10 male and 10 female students.

The data collection instrument in this study was a mathematics learning outcome test in essay form consisting of four items. Each item was developed based on the learning indicators for the topic of integers in the fourth grade of elementary school, which include: (1) explaining the definition and identifying types of integers; (2) determining the position of integers on the number line; (3) comparing and ordering integers; and (4) solving contextual problems related to integers. The instrument blueprint was prepared to ensure that each item represented the indicator being measured. Each item was scored

based on the accuracy of the answer and the solution steps according to the predetermined scoring rubric, with a total maximum score of 16, assuming each item had a maximum score of 4. The student's final score was calculated by comparing the score obtained with the maximum score, then multiplying by 100.

The test was administered to both the experimental and control groups twice: a pretest before treatment to determine students' initial abilities and a posttest after treatment to measure learning outcomes following the application of the learning model. Before being used in the study, the instrument was tested for validity and reliability. Item validity was tested using the Pearson product-moment correlation, while instrument reliability was analyzed using Cronbach's Alpha. Data processing was carried out with the assistance of IBM SPSS Statistics. Validity testing used the comparison criterion between (r_count) and (r_table) according to the number of pilot test respondents and the established significance level. The instrument was declared to have adequate reliability if the reliability coefficient value met the specified criteria, for example, ($\alpha \geq 0.70$) (Yusup, 2018).

Table 1. Recapitulation of Item Validity Test (Pearson Product Moment)

Item	r count	r table	Description
Item 1	0.826	0.312	Valid
Item 2	0.900	0.312	Valid
Item 3	0.863	0.312	Valid
Item 4	0.798	0.312	Valid

The r count values of all items (0.798–0.900) exceed the r table value (0.312), so all four items are declared valid. The results of the reliability test are shown in Table 2.

Table 2. Recapitulation of Item Reliability Test (Cronbach's Alpha)

Cronbach's Alpha	**Cronbach's Alpha**
0,827	4

The Cronbach's Alpha value of 0.827 falls within the high reliability category (> 0.70), indicating that the instrument has adequate internal consistency to be used as a measuring tool in this study.

Data analysis was carried out in stages: descriptive statistics (mean, minimum value, maximum value), the Shapiro-Wilk normality test (since $n < 50$), and Levene's Test for homogeneity. If both assumptions were met, hypothesis testing was conducted using the independent-samples t-test at a significance level of $\alpha = 0.05$. Decision criteria: if Sig. (2-tailed) < 0.05, then H_0 is rejected and H_1 is accepted.

RESULTS AND DISCUSSION

Results

1. Descriptive Statistics of Learning Outcomes

The results of the descriptive analysis show that the mean pretest score of the experimental group was 53.15, while that of the control group was 43.70. After the learning was carried out, the mean posttest score of the experimental group reached 72.90, and that of the control group reached 63.75. Both groups experienced an increase in scores after participating in the learning. The experimental group showed an average increase of 19.75 points, while the control group showed an increase of 20.05 points. Although the posttest mean of the experimental group was 9.15 points higher than that of the control group, the initial ability of the experimental group was also 9.45 points

higher. Therefore, the difference in final scores needs to be interpreted by taking into account the differences in students' initial abilities.

Table 3. Descriptive Statistics of Mathematics Learning Outcomes of the Experimental and Control Groups

Statistic	Experimental Pretest	Experimental Posttest	Control Pretest	Control Posttest
Number of students	20	20	20	20
Mean	53.15	72.90	43.70	63.75
Minimum value	22	50	24	46
Maximum value	82	90	64	78
Mean change	—	+19.75	—	+20.05

Based on Table 3, the mean increase of the control group was 0.30 points greater than that of the experimental group. This difference indicates that the score increase in the experimental group was not descriptively greater than that of the control group. Thus, the higher posttest mean in the experimental group cannot be used as the sole basis for concluding that the Numbered Heads Together (NHT) model affects mathematics learning outcomes.

2. Normality and Homogeneity Tests

Before hypothesis testing was conducted, the data distribution was examined using the Shapiro–Wilk test, and variance homogeneity was examined using Levene's test. The data processing results showed that the significance values of the Shapiro–Wilk test across all groups and measurement times were greater than 0.05. Levene's test yielded a value of F=1.988*F*=1.988 with a significance of 0.167. These results indicate that there was insufficient evidence to reject the assumptions of normality and homogeneity of variance based on the reported tests.

Table 4. Summary of Normality and Homogeneity Test Results

Test	Group	Statistic	Sig.
Shapiro–Wilk pretest	Experimental	0.966	0.539
Shapiro–Wilk pretest	Control	0.959	0.429
Shapiro–Wilk posttest	Experimental	0.978	0.761
Shapiro–Wilk posttest	Control	0.969	0.601
Levene	Combined groups	1.988	0.167

Table 4 is a summary of the data processing results, not a direct copy of the SPSS output. All significance values of the Shapiro–Wilk test are greater than 0.05, while the significance value of Levene's test is also greater than 0.05. These results support the use of parametric analysis as long as other relevant assumptions are also met.

3. Hypothesis Testing Results

Based on the available independent samples t-test results, the comparison of posttest scores yielded a value of t=3.098*t*=3.098, df=38*df*=38, and a significance of 0.004. The mean difference between the two groups was 9.15 points. These results indicate a statistically significant difference in posttest means. However, this analysis has not yet accounted for the differences in initial ability between the two groups. Therefore, these results are not sufficient to conclude that the difference in learning outcomes was specifically caused by the application of the NHT model.

Table 5. Summary of Independent Samples t-Test Results on Posttest Scores

Variable	t	df	Sig. (2-tailed)	Mean difference	Description
Mathematics learning outcomes	3.098	38	0.004	9.15	Significant posttest difference

To test the effect of NHT more precisely, further analysis needs to be conducted using Analysis of Covariance (ANCOVA), with posttest scores as the dependent variable, type of learning as the independent variable, and pretest scores as the covariate. Another alternative is to test the difference in change scores between the two groups. The results of such further analysis are needed before a final decision regarding the hypothesis of the NHT effect is determined.

Discussion

1. Interpretation of Research Results

The descriptive results show that the posttest mean of the experimental group reached 72.90, while that of the control group reached 63.75. Descriptively, the experimental group obtained a higher final score. However, the pretest mean of the experimental group was also higher than that of the control group. This difference in initial ability needs to be taken into account because it may affect the interpretation of the final results. Therefore, conclusions regarding the effect of NHT need to be based on an analysis that accounts for students' initial conditions.

NHT has characteristics relevant to mathematics learning because it involves group discussion and individual responsibility. Each student receives a number and has the opportunity to be called by the teacher to present the results of the group discussion. This mechanism encourages each group member to prepare themselves to understand the material, rather than relying solely on students who are considered more capable. This principle is in line with cooperative learning, which emphasizes interaction among students and responsibility for the shared learning process (Slavin, 2021). Nevertheless, this theoretical alignment does not automatically prove a significant effect in this study.

2. Relevance of NHT in Learning Integers

The topic of integers covers understanding positive and negative numbers, determining positions on the number line, comparing numbers, and applying the concepts in everyday life. Students may experience difficulties when they have to connect mathematical symbols with the meaning of a situation, for example, determining which number is greater between two negative numbers. Such understanding requires opportunities to explain reasoning, compare answers, and check the accuracy of thinking.

In NHT learning, students can discuss how to determine the position of numbers on the number line, explain their reasoning when comparing two numbers, and evaluate their peers' answers. When there are differences in answers, the teacher can guide the discussion to identify errors and clarify concepts that have not yet been understood. These activities have the potential to help students build conceptual understanding because they not only obtain answers but also have the opportunity to explain their thinking process.

The success of group discussion depends on the implementation of the learning. The teacher still needs to monitor member participation, ensure that the answers shared are correct, and provide additional explanation if misconceptions occur. Therefore, the potential of NHT in supporting the understanding of integers needs to be distinguished from empirical evidence regarding its effect on learning outcomes.

3. Relationship with Previous Research

The study by Gupitararas and Wasitohadi (2020) is relevant for comparison because it discusses the NHT model in mathematics learning for fourth-grade elementary school students. The study by Oratmangun et al. (2024) also discusses the application of NHT in elementary school learning. Meanwhile, Sarudin et al. (2024) discuss active learning techniques through a literature analysis. These various studies can serve as a basis for discussing the importance of selecting learning models that involve student participation.

Nevertheless, similarity in topic with previous research is not sufficient to state that this study proves the effectiveness of NHT. The present study needs to demonstrate test results that account for students' initial abilities. If further analysis shows a significant group effect after the pretest is controlled for, these results can provide stronger empirical evidence. Conversely, if the effect is not significant, these results must still be reported objectively.

4. Research Limitations

This study has several limitations. First, the number of research participants was relatively small, namely 40 students divided into an experimental group and a control group, with 20 students each. Second, the research was conducted in a single school, so the results cannot necessarily be generalized to schools with different student characteristics and learning conditions. Third, if the placement of students into groups was not carried out randomly, differences in initial characteristics between groups could potentially affect the comparison results. The pretest mean difference of 9.45 points indicates that initial ability needs to be taken into account in the analysis.

Fourth, the research instrument consisted of only four essay items. Although the items were designed based on the indicators for the topic of integers and the reported reliability was 0.827, the limited number of items may mean that some aspects of mathematical ability were not measured comprehensively. Fifth, the independent samples t-test analysis on posttest scores alone did not control for differences in initial ability. Further analysis controlling for the pretest is needed before conclusions regarding the effect of NHT are determined. These limitations should be taken into consideration when interpreting the results and designing future research.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of the data analysis, the posttest mean of students in the experimental group using the Numbered Heads Together (NHT) type of cooperative learning model reached 72.90, while the control group using conventional learning reached 63.75. The mean difference between the two groups was 9.15 points. The results of the Independent Samples t-Test showed a value of ($t = 3.098$), ($df = 38$), and a significance of ($p = 0.004$), indicating a statistically significant difference in mathematics learning outcomes between the two groups after the learning. However, the pretest mean of the experimental group was 53.15, higher than that of the control group at 43.70. Therefore, the posttest test results are not sufficient to confirm that the difference in learning outcomes was entirely caused by the application of the NHT model. Further analysis controlling for students' initial abilities is needed to strengthen the conclusion regarding the effect of this learning model.

The NHT model has the potential to support mathematics learning through group discussion, the exchange of ideas, and individual responsibility in understanding the topic of integers. Each student is encouraged to prepare themselves because they have the

opportunity to be asked to present the results of the group discussion. Nevertheless, conclusions regarding the effectiveness of NHT need to be based on analysis results that take into account differences in initial ability and consider the limitations of the number of participants and the scope of the research.

Suggestions

Elementary school teachers are advised to consider using the NHT type of cooperative learning model as one alternative in mathematics learning, particularly for the topic of integers. Its implementation needs to be accompanied by well-directed group division, the provision of opportunities for all students to participate, monitoring of discussions, and concept reinforcement by the teacher so that every student understands the material well. Future researchers are advised to involve a larger number of participants and schools with diverse characteristics, use instruments that cover more indicators of learning outcomes, and control for students' initial abilities through appropriate analyses, such as Analysis of Covariance (ANCOVA) or difference score analysis. Future research could also test the application of NHT to other mathematics topics to obtain broader evidence regarding the effectiveness of this model in elementary school learning.

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