JPPIPA (Jurnal Penelitian Pendidikan IPA)
Vol.10 No. 2 2025
http://journal.unesa.ac.id/index.php/jppipa

THE EFFECTIVENESS OF THE NUMBERED HEADS TOGETHER LEARNING MODEL ON SCIENCE LEARNING OUTCOMES OF GRADE IV ELEMENTARY SCHOOL STUDENTS

A. Muafiah Nur[1], Ulfah Rizki Afdilah[2], Nur Asmi[3]
[1,2,3] Teacher Professional Education, Faculty of Teacher Training and Education, Muhammadiyah University of Makassar, Indonesia

Abstract

This study aims to analyze the effectiveness of the Numbered Heads Together (NHT) learning model in improving science learning outcomes for fourth-grade students at SD Negeri 74 Bontorita II. The study used a quantitative approach with a One Group Pretest–Posttest design, involving 19 students as subjects. The research instrument was a learning outcome test given before and after the implementation of the NHT model. Data were analyzed using descriptive statistics and paired t-tests to determine significant differences in learning outcomes. The results showed an increase in the average score from 46.84 in the pretest to 84.42 in the posttest, this illustrates an increase in students' understanding of the material on changes in energy forms. The t-test showed a significant difference between the scores before and after the treatment, so the NHT model proved effective in improving science learning outcomes. These findings indicate that active involvement, group collaboration, and individual responsibility in the NHT model can strengthen students' conceptual understanding. This study concludes that the NHT model is suitable for use as an alternative learning strategy to improve the quality of science learning in elementary schools.

Keywords: Numbered Heads Together, Science Learning Outcomes, Cooperative Learning

Article History: Received: December 01st, 2025. Revised: December 12th, 2025. Published: December 31st, 2025

[1]**Correspondence Address:**
Teacher Professional Education, Faculty of Teacher Training and Education, Muhammadiyah University of Makassar, Indonesia
E-mail: a.muafiahnur@unismuh.ac.id

p-ISSN: 2527-7537
e-ISSN: 2549-2209

INTRODUCTION

Education is an absolute necessity for human life and must be provided. Efforts to develop quality human resources are inseparable from education, so education needs to be continuously fostered and advanced. The obligation for elementary school teachers is to transfer knowledge from the five core subjects in elementary school, one of which is science (Rezkia & Rafianti, 2024). Elementary school science learning is known as Natural Science (IPA), which remains an integrated concept because it cannot be separated from the fields of chemistry, biology, and physics. The KTSP (Curriculum for Learning) emphasizes the definition of science as a way to systematically explore nature and is not merely a collection of knowledge in the form of facts, concepts, and principles but also a process of discovery (Ertanti, 2016).

Science learning plays a crucial role in improving knowledge, skills, and attitudes. Science teaches children to think critically and objectively. True knowledge is knowledge that is justified by the standards of scientific truth, namely rationality and objectivity. Science learning guides students through the process of behavioral change as a result of interactions with their environment to achieve learning objectives (Apriyani et al., 2022). Science subjects, closely related to the natural environment, guide teachers to utilize the environment as a learning resource (Aprizan et al., 2021).

Teaching and learning activities in education, particularly those taking place in schools, involve active interaction between students and teachers. Teachers are not only the center of learning activities; active student involvement and the use of learning resources are equally important. To encourage students to actively participate in learning, teachers are required to be more creative in organizing learning activities. This includes mastering and applying various learning methods and utilizing various learning resources appropriate to the material being presented. This creates a positive learning environment in the classroom and effectively achieves the stated learning objectives (Sudewiputri & Dharma, 2021).

In the current era of globalization, human life patterns across all sectors have changed. This development has given rise to new and increasingly complex problems. To address these challenges, society is required to equip itself with knowledge, particularly in the world of education (Marut et al., 2024). Teaching science to elementary school students is different from teaching to middle school and high school students. Elementary school students have their own unique characteristics. Teachers are required to be creative in their teaching. For example, when delivering material, they must employ innovative learning strategies to prevent students from getting bored with the material being taught (Prananda et al., 2020).

Furthermore, another problem that arises is students' weak understanding of the material being taught (Umar, 2024). Students' motivation to participate in science lessons is still lacking. Students prefer to play alone and pay less attention to the lesson. When given questions, many students wander around and don't listen to the teacher's instructions. This is despite the fact that in elementary school, students are expected to master the material at each grade level (Simanjuntak et al., 2023).

Based on the results of observations during the science learning process in class IV of SD Negeri 74 Botorita II, students have problems, namely low science learning outcomes, this is because in the learning process students are less active in discussions, students' enthusiasm for learning is still lacking, learning is still focused on the teacher (teacher center), and student learning activities are more individual.

Therefore, students' critical thinking skills can be improved through a learning model that directs students to a learning process that fosters active student thinking, the learning model is the Number Head Together (NHT) model (Jariyah et al., 2025). The Numbered Head Together (NHT) type of cooperative learning model is a strategy designed to encourage effective group interaction by assigning a number to each group member and randomly appointing one student to answer questions. This model trains students to discuss, help each other, and master the material thoroughly, because each student has the possibility of being selected to represent the group (Savitri & Armiati, 2025).

One of the learning models that emphasizes student activity, student creativity, cooperation and communication between students and groups is the NHT type cooperative learning model (Firdaus, 2016). In order to encourage students to be actively involved in teaching and learning activities, teachers are required to be more creative in organizing learning activities, including by mastering and being able to apply various learning methods and using various learning resources that are appropriate to the material to be delivered, so that good learning conditions can be created in the classroom and the learning objectives that have been set can be achieved well (Aula & Elfrianto, 2025).

Saptono's (2024) research shows that the Numbered Heads Together (NHT) learning model has a significant influence on improving elementary school students' learning outcomes. The results showed that the average pretest score of students before the NHT implementation was in the moderate category, while the average posttest score experienced a significant increase after learning with the NHT approach was implemented. Inferential analysis showed that the p-sig value was 0.00, which means it is less than 0.05, so it can be concluded that the NHT model has a significant influence on student learning outcomes. This finding is reinforced by increased learning activities, student participation, and increased motivation during the learning process.

Arenita et al.'s (2018) research shows that the Numbered Heads Together (NHT) learning model has a significant effect on students' science learning outcomes. The analysis results show that students' posttest scores have increased significantly compared to their pretest scores, as evidenced by the t-test results with t count = 6.188 greater than t table = 2.085, so the alternative hypothesis is accepted. The NHT model has been proven to be able to transform science learning from being usually passive into more active, interactive, and meaningful learning, thus having a positive impact on mastery of science concepts, especially natural phenomena material.

Therefore, this study aims to measure the extent to which the NHT model can improve students' academic achievement compared to before its implementation, while also assessing the increase in students' activity, activeness, and conceptual understanding during the learning process. Thus, this study is expected to provide a clear picture of the contribution of the NHT model in improving the quality of science learning in the school. The research problem formulation that can be raised in this study is whether the Numbered Heads Together learning model is effective in improving science learning outcomes, and the extent to which the implementation of the model can improve student engagement and understanding in the learning process.

METHOD

This study employed a One Group Pretest–Posttest Design involving 19 fourth-grade students from SD Negeri 74 Bontorita II. A learning achievement test, developed based on competency indicators for the topic of energy transformation, was administered before and after the implementation of the Numbered Heads Together (NHT) learning model.

The NHT model was delivered during the regular science instructional schedule. All collected data were analyzed using descriptive statistics, normality testing, paired-samples t-tests, N-gain, and Cohen's d to determine both the significance and the magnitude of the improvement in students' learning outcomes.

Data Collection Techniques

Learning outcome data were obtained through a written test consisting of a pretest and a posttest, both assessing students' mastery of energy transformation concepts.

1. Pretest was administered prior to the NHT intervention to identify students' initial understanding.
2. Posttest was administered after the implementation to measure learning improvement.

Instrument Indicators and Item Distribution

The test items were constructed based on competency indicators relevant to the energy transformation topic. Each indicator was operationalized into measurable skills that guided the development of test items. A summary of indicators and corresponding item numbers is presented in Table 1.

Table 1. Instrument indicators and question distribution

Indicator	Ability Description	Question Number
1	Identifying the definition and various types of energy, including potential, kinetic, heat, electrical, light, and chemical energy.	1,5,11,13
2	Explaining common forms of energy transformation found in everyday situations, such as electrical energy changing into light, chemical energy becoming heat, or kinetic energy turning into sound or heat.	2,3,4,5,6,7,10,12,14
3	Recognizing real-life examples of energy transformation in tools and natural events, including stoves, lamps, fans, solar panels, and water flow in a dam.	9,15

Data Analysis Techniques

Data analysis included:

1. Descriptive statistics (mean, standard deviation, minimum, and maximum scores) to describe learning outcomes before and after the intervention.
2. Inferential statistics, including normality testing and a paired samples t-test, to examine the

significance of pretest–posttest differences. Additionally, N-Gain and Cohen’s d were calculated to assess the magnitude of improvement and the effect size of the NHT model.

RESULTS AND DISCUSSION

This study examined the effectiveness of the NHT learning model in improving students’ science learning outcomes using a One-Group Pretest–Posttest Design. This design allows direct comparison between students’ initial and final abilities to determine the impact of the instructional intervention. The participants were 19 fourth-grade students from SD Negeri 74 Bontorita II. A pretest was administered to measure their initial understanding of the science material, followed by the implementation of the NHT learning model. After the intervention, a posttest was conducted to assess the extent of improvement in students’ learning outcomes. Pretest and posttest score data, including gain values as an indicator of the effectiveness of the learning model, are presented in Table 2.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test score	19	30	70	46.84	11.572
Post-test score	19	75	95	84.42	6.086
Valid N (listwise)	19				

Descriptive statistical analysis shows a notable improvement in students’ performance following the implementation of the NHT model. The mean pretest score of 46.84 reflects low initial mastery, while the posttest mean increased significantly to 84.42. The reduction in standard deviation from 11.572 to 6.086 indicates that students’ learning outcomes became more consistent after the intervention. Analysis of the improvement in learning outcomes through the N-Gain normalization calculation showed a value of 0.71 which is included in the high category, so it can be concluded that the NHT learning model is effective in improving students’ science learning outcomes. These findings confirm that the NHT model is effective in improving understanding of science concepts, because it encourages active student involvement and cooperation in groups. Figure 1 shows a comparison of students’ average pretest and posttest scores to demonstrate changes in learning outcomes after the implementation of the NHT learning model.

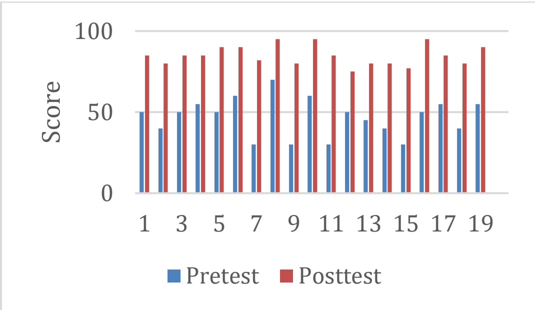

Figure 1. Comparison of pretest and posttest scores

Effect Size (Cohen’s d)

To complement the significance testing, Cohen’s d was calculated to determine the magnitude of the treatment’s impact. Using the pretest and posttest means of 46.84 and 84.42, respectively, along with a pooled standard deviation of 9.74, the resulting effect size was 3.86. This value falls within the very large effect category, indicating that the NHT model produced a substantial and meaningful improvement in students’ learning outcomes.

To ensure that the analyzed data meets the requirements for using parametric statistical tests, normality tests were first performed on the pre-test and post-test scores. A summary of the test results is shown in Table 3.

Table 3. Test of normality

Variable	Kolmogrov-Smirnov	Shapiro-Wilk		Variable
	Statistic	df	*P*	Statistic
Pre-test Score	.186	19	.176	.930
Post-test Score	.181	19	.118	.921

Table 3 shows the results of the normality test for the pre-test and post-test data analyzed using the Kolmogorov–Smirnov and Shapiro–Wilk methods. Based on the results of the Shapiro–Wilk test, which is recommended for samples of less than 50 respondents, a significance value of 0.176 was obtained for the pre-test and 0.118 for the post-test. Both values are greater than 0.05, indicating that the data are normally distributed. This finding is also supported by the results of the Kolmogorov–Smirnov test, which produced a significance value of 0.081 for the pre-test and 0.103 for the post-test, which is also above the acceptance limit of 0.05. Thus, it can be concluded that there are no significant distribution deviations in both data sets, thus fulfilling the requirements for further analysis using parametric statistical tests, in this case the paired t-test to measure the effect of implementing the Numbered Heads Together learning model on student learning outcomes.

After ensuring that the data were normally distributed, the analysis continued with a paired t-test to determine whether there was a significant difference between the pre-test and post-test scores after implementing the Numbered Heads Together learning model. The results of the t-test calculation are presented in the following table to demonstrate the level of effectiveness of the learning model used.

Table 4. Paired sample test

						95% Confidence Interval	
	Mean Difference	**Standard Deviation**	**t**	**df**	***P***	**Lower**	**Upper**
Pretest-Posttest	-38.11	8.66	-19.181	18	<.001	-42.28	-33.931

Based on the results of the Paired Samples Test, there was a significant difference between the participants' pretest and posttest scores, indicated by an average score difference of -38.105 with a standard deviation of 8.66 and a standard error of -42.28. The 95% confidence interval ranged from -33.931 to -19.181, indicating that the posttest scores were consistently higher than the pretest scores. The statistical test results showed a t-value of 18 with 18 degrees of freedom and a significance of 0.000 (<0.05), so the difference in scores was statistically significant. This finding confirms that the treatment provided had a significant effect on improving participants' learning outcomes.

DISCUSSION

The findings of this study indicate that the NHT learning model is able to provide significant improvements in the science learning outcomes of fourth-grade students at SD Negeri 74 Bontorita II. This is demonstrated by the significant difference between the average pretest and posttest scores. Before the treatment, the average student score only reached 46.84, which illustrates that initial mastery of the material was still at a low level. After NHT-based learning was implemented, the average score increased to 84.42. This significant increase proves that group work patterns and student activeness in the NHT model play an important role in deepening the understanding of science concepts. In addition, the decrease in the standard deviation from 11.572 to 6.086 indicates that student abilities after the learning process have become more uniform, which means the spread of scores is no longer too wide and the equality of learning outcomes is improving.

This effectiveness aligns with a meta-analysis conducted by Sariawan et al. (2020), which found that the NHT model had a strong influence on science learning outcomes, as indicated by an effect size of 0.984. These findings emphasize that the group discussion structure in NHT, which demands responsibility from each member, is a key factor in improving learning outcomes. In the classroom context, the numbering mechanism requires all students to understand the material because anyone can be called upon to represent the group.

Before conducting the effectiveness test, a normality test was conducted to ensure that the data met the requirements for parametric analysis. The Shapiro–Wilk test results showed that the pretest (0.176) and posttest (0.118) significance values were above the 0.05 threshold, thus concluding that the data were normally distributed. After the prerequisites were met, the analysis continued with a paired samples t-test. The results showed a t value of 18 with a significance level of 0.000, indicating a highly significant difference between pre- and post-learning scores. The confidence interval range, which was entirely negative, confirmed that the increase in posttest scores occurred consistently across all students.

The results of this study align with the findings of Widyaningsih & Estuhono (2021), who demonstrated that the application of NHT in science learning successfully increased learning completion by up to 91%. Their findings confirmed that discussions conducted in small groups, along with the equal distribution of roles for each student, helped the understanding process run more effectively. Similar empirical support is also seen in the results of Damayanti's (2025) study, which stated that students learning with the NHT model showed better academic achievement compared to conventional learning. The main strength of this model lies in student involvement in the collaborative thinking process, which allows for the exchange of ideas and reinforcement of concepts during discussions.

From a learning theory perspective, the success of NHT in this study reinforces the assumption that cooperative learning aligns with constructivist principles. In this model, students not only receive explanations from the teacher but also construct understanding through group interactions and activities. This process encourages students to help and correct each other's understanding, thereby correcting misconceptions and strengthening deeper mastery of the material.

Overall, this research indicates that the NHT model is a learning approach worthy of recommendation for improving science learning outcomes at the elementary school level. This model not only improves academic achievement but also encourages student participation, a sense of responsibility, and more active interaction in learning. Considering the research findings and findings of relevant studies, NHT can be an effective alternative learning strategy for teachers to use to improve the quality of science learning.

The findings of this study provide several important implications for science teaching practices in elementary schools. First, the significant increase in posttest scores after implementing the NHT model demonstrates that the cooperative learning approach can create a more active and participatory learning environment. Therefore, teachers should consider using the NHT model when teaching science materials that require in-depth conceptual understanding and collaboration among students. Second, the equalization of abilities, as seen in the decrease in standard deviation, indicates that NHT can help reduce learning gaps in heterogeneous classes. This model is suitable for classes with wide differences in ability because each student is involved as an integral part of the group. Third, the discussion and interaction between students during NHT learning supports the development of critical thinking, scientific communication, and problem-solving skills, which are fundamental competencies in science learning. Therefore, the results of this study reinforce the urgency of using collaborative learning strategies to comprehensively improve the quality of learning.

Furthermore, another implication of this research relates to the teacher's role as a facilitator. Teachers not only deliver material but also manage group dynamics, ensure equal role distribution, and monitor student understanding during discussions. With the increasing demands for pedagogical competence, teachers need training and guidance on the effective implementation of cooperative learning models, particularly NHT. This research also suggests that schools need to support the use of innovative learning methods by providing sufficient time, supporting learning tools, and policies that allow teachers to vary their learning strategies.

Although the findings indicate strong improvement, several internal validity threats inherent to the One Group Pretest–Posttest Design must be considered. These include the history effect, maturation, testing effect, instrumentation, and the absence of a control group. These factors may influence students' improvement beyond the treatment itself, and therefore should be acknowledged as limitations of the study.

CONCLUSION AND SUGGESTION

Conclusion

This study demonstrates that the NHT learning model is effective in improving the science learning outcomes of fourth-grade students at SD Negeri 74 Bontorita II. This is evidenced by an increase in the average score from 46.84 in the pretest to 84.42 in the posttest, as well as a decrease in the standard deviation, indicating an even distribution of student abilities. The paired t-test results also showed a significant difference between pre- and post-treatment scores, confirming that the NHT implementation consistently improved students' conceptual understanding. Thus, the NHT model successfully addressed learning challenges previously characterized by low learning outcomes, lack of engagement, and a predominance of teacher-centered learning.

Suggestion

The application of the NHT model needs to be further developed as a learning strategy in science subjects because it can encourage student activeness, collaboration, and responsibility within groups. Teachers are advised to manage groups effectively and create a conducive discussion atmosphere so that each student can participate optimally. Future research could expand the sample size, use different materials, or combine NHT with interactive learning media to obtain more diverse results and address the limitations of the single-group research design used in this study.

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