



THE EFFECT OF THE COOPERATIVE LEARNING MODEL TYPE NUMBERED HEADS TOGETHER (NHT) TO IMPROVE CRITICAL THINKING SKILL ON ECOLOGY AND BIODIVERSITY MATERIAL GRADE VII SMP

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran kooperatif Numbered Heads Together (NHT) terhadap hasil belajar dan kemampuan berpikir kritis siswa pada materi Ekologi dan Keanekaragaman Hayati kelas VII di SMP Negeri 35 Medan. Penelitian ini menggunakan metode kuasi eksperimen dengan desain nonequivalent control group yang melibatkan dua kelas dengan jumlah keseluruhan 64 siswa, di mana kelas eksperimen diajar menggunakan model pembelajaran NHT sedangkan kelas kontrol diajar menggunakan model pembelajaran konvensional yang berpusat pada guru. Pengumpulan data dilakukan melalui instrumen pretest dan posttest, sedangkan peningkatan hasil belajar siswa dianalisis menggunakan normalized gain (N-Gain). Hasil penelitian menunjukkan bahwa kedua kelas mengalami peningkatan hasil belajar, namun peningkatan pada kelas eksperimen lebih tinggi dibandingkan kelas kontrol, dengan nilai rata-rata N-Gain sebesar 0,523 pada kategori sedang, sedangkan kelas kontrol memperoleh nilai rata-rata N-Gain sebesar 0,372 yang juga termasuk kategori sedang. Selanjutnya, hasil uji independent sample t-test satu arah menunjukkan nilai signifikansi sebesar 0,000 ($p < 0,05$), yang menunjukkan bahwa peningkatan hasil belajar siswa yang diajar menggunakan model pembelajaran NHT secara signifikan lebih tinggi dibandingkan dengan siswa yang diajar menggunakan model pembelajaran konvensional. Berdasarkan hasil tersebut, dapat disimpulkan bahwa model pembelajaran Numbered Heads Together (NHT) berpengaruh positif dan signifikan terhadap hasil belajar siswa serta dapat digunakan sebagai alternatif model pembelajaran yang efektif dalam pembelajaran IPA, khususnya pada materi Ekologi dan Keanekaragaman Hayati.

Kata Kunci: *Numbered Heads Together (NHT), Pembelajaran Kooperatif, Berpikir Kritis, Ekologi dan Keanekaragaman Hayati, Pembelajaran Konvensional*

ABSTRACT

This study aims to determine the effect of the Numbered Heads Together (NHT) cooperative learning model on students learning outcomes and critical thinking skills in Ecology and Biodiversity material for Grade VII students at SMP Negeri 35 Medan. The research employed a quasi-experimental method using a nonequivalent control group design involving two classes with a total of 64 students, in which the experimental class was taught using the NHT learning model while the control class was taught using a conventional teacher-centered learning model. Data were collected through pretest and posttest instruments, and the improvement in students' learning outcomes was measured using the normalized gain (N-Gain). The results showed that both classes experienced improvement; however, the experimental class demonstrated a higher increase, with an average N-Gain score of 0.523 categorized as medium, compared to 0.372 in the control class, which was also categorized as medium. Furthermore, the results of the



onetailed independent sample t-test showed a significance value of 0.000 ($p < 0.05$), indicating that the improvement in learning outcomes of students taught using the NHT learning model was significantly higher than that of students taught using the conventional learning model. These findings indicate that the Numbered Heads Together (NHT) learning model has a positive and significant effect on students learning outcomes and can be used as an effective alternative model in science learning, particularly in Ecology and Biodiversity topics.

Keywords: *Numbered Heads Together (NHT), Cooperative Learning, Critical Thinking, Ecology and Biodiversity, Conventional Learning*

INTRODUCTION

Education plays a paramount role in human existence, serving as the primary vehicle through which individuals can optimally cultivate their inherent potential. According to national legislative frameworks, education is a conscious and meticulously planned endeavor designed to foster a learning environment that empowers students to strengthen their spiritual resilience, intelligence, and noble character (Ginting & Salim, 2024; Raharjo & Saputri, 2021; Syukur et al., 2023). In the contemporary era, educational systems are increasingly expected to produce a generation equipped with creativity, independence, and robust critical thinking skills essential for navigating the complexities of a globalized landscape. At the junior high school level, the implementation of integrated natural science learning becomes particularly crucial in helping students develop a holistic perspective. This approach facilitates a deeper understanding of natural phenomena while enhancing the practical application of scientific concepts within the context of daily life. Science, characterized by its dual nature as both a product and a process of knowledge, requires students to actively seek, process, and independently construct their own understanding. By mastering these competencies, students are better prepared for the demands of the 21st century, which prioritize high adaptability and cognitive agility (Chalermkerdsrinuansakul, 2023; Kadrija et al., 2023; Purwanto et al., 2023). However, reaching this ideal state requires a seamless alignment between curricular objectives and actual pedagogical implementation within the classroom.

Despite these high aspirations, international assessments paint a starkly different reality for learners within the Indonesian context. Based on the 2018 PISA results, Indonesia ranked 71st out of 79 participating nations, a position indicating that scientific literacy and critical thinking skills among students remain significantly low (Agustina et al., 2023). These global evaluations emphasize the necessity of problem-solving abilities and rational analysis, which are the fundamental components of the "4C" competencies. Critical thinking itself is defined as the capacity to evaluate, analyze, and derive rational conclusions based on empirical evidence and accurate information to facilitate sound decision-making. Such low rankings serve as a significant indicator that the current educational system has yet to successfully foster higher-order thinking skills across the student population. This international data underscores an urgent need to reform traditional teaching methodologies. Enhancing scientific literacy is not merely about memorizing facts; rather, it involves developing the capacity to engage meaningfully with scientific issues. Therefore, the primary focus must shift toward instructional models that challenge students to think more deeply and objectively about natural phenomena (Holley & Park, 2020; Ke et al., 2021; Kumar & Choudhary, 2024).

The discrepancy between expected learning outcomes and actual classroom conditions is particularly evident at SMP Negeri 35 Medan. Observations and interviews reveal that although teachers have attempted to implement cooperative learning models as encouraged by



the *Kurikulum Merdeka* (Independent Curriculum), students' critical thinking skills remain inadequate. Preliminary test data shows that 68.75% of students obtained scores below 40, highlighting significant difficulties in analyzing, evaluating, and drawing independent conclusions. This high percentage suggests that students are still entrenched in passive, rote-learning patterns. The instructional models previously employed have failed to optimally stimulate student activity or cultivate the higher-order thinking skills required for modern academic success. Students often appear passive and struggle to process complex scientific information without constant teacher intervention. Such conditions create a stagnation in the intellectual development necessary for advanced science learning. Addressing this issue requires a more focused intervention to break the cycle of passivity and provide students with the cognitive tools needed to engage effectively with the current science curriculum.

One cooperative learning model with the potential to bridge this identified gap is the Numbered Heads Together (NHT) model. This specific framework emphasizes individual accountability within a group discussion context, ensuring that every student is responsible for the overall performance of their team (Fauzi et al., 2020; Mauliza, 2020). By encouraging active peer interaction, NHT creates a dynamic learning environment where students must communicate and collaborate to solve various problems. In a classroom utilizing this model, students are assigned specific numbers and must be prepared to represent their group whenever their number is called, naturally increasing engagement and focus. The implementation of this model has previously been proven to significantly enhance learning outcomes and student participation across various subjects. It is particularly effective in dismantling traditional teacher-centered approaches and replacing them with a more student-centered experience (Goodwin, 2024; Kestin et al., 2025; Pan & Wang, 2024; Sinaga, 2024). By fostering a sense of shared responsibility and healthy competition, NHT encourages students to think more critically and participate more actively—essential elements in mastering complex scientific concepts.

This research offers distinct novelty by specifically integrating the Numbered Heads Together model with material on ecology and biodiversity to enhance the critical thinking skills of 7th-grade students. Topics such as environmental pollution and human impact on ecosystems are highly relevant to real-world issues, providing a perfect context for applying critical thought to solve environmental problems. By combining a structured cooperative model with contextual subject matter, this study aims to provide an effective, innovative alternative to bridge existing competency gaps. The innovation lies in the synergy between the pedagogical structure of NHT and the investigative nature of ecological science, which demands that students analyze cause-and-effect relationships in nature. This approach is expected to transform the learning experience into something more meaningful with a broad impact on students' intellectual growth. Ultimately, this research provides a strategic contribution to science education by offering a validated method to improve student performance and intellectual engagement. This alternative model is anticipated to be a practical solution for teachers at SMP Negeri 35 Medan in developing the next generation of critical thinkers.

RESEARCH METHOD

This research was conducted at SMP Negeri 35 Medan, located on Jl. Willièm Iskandar Pasar V, Medan Tembung District, Medan City, North Sumatra Province. The study was carried out in the even semester of the 2024/2025 academic year. The population of this study consisted of all Grade VII students of SMP Negeri 35 Medan in the even semester of the 2024/2025

academic year, totaling 11 classes. The sample was selected using a cluster random sampling technique. Two classes with a total of 64 students were chosen, consisting of one experimental class (Class VII-9, 32 students) and one control class (Class VII-11, 32 students). The experimental class was taught using the Numbered Heads Together (NHT) cooperative learning model, while the control class received conventional learning. This study employed a quasi-experimental method with a nonequivalent control group design. Both the experimental and control classes were given a pretest to measure students' initial abilities, followed by different learning treatments, and then a posttest to measure learning outcomes after the intervention. The independent variable in this study was the learning model, namely the Numbered Heads Together (NHT) cooperative learning model and the conventional learning model. The dependent variable was students' critical thinking skills on Ecology and Biodiversity material.

Data were collected using pretest and posttest instruments in the form of essay questions designed to measure students' critical thinking skills related to ecology and biodiversity. The test consisted of 10 essay questions developed based on critical thinking indicators, including providing simple explanations, making inferences, evaluating information, determining strategies, and making decisions or solutions. The instrument was tested for validity, reliability, level of difficulty, and discriminating power prior to its use. Data collection techniques used in this study included tests, observation, and documentation. The test technique consisted of pretest and posttest to measure students' critical thinking skills before and after the learning intervention. Observations were conducted to record student activities during the learning process using the NHT model. Documentation was used to obtain supporting data such as student lists, test results, school profiles, and learning activity documentation.

The research procedure began with selecting two sample classes using cluster random sampling. Both classes were given a pretest to identify student's initial abilities. The experimental class then received instruction using the Numbered Heads Together (NHT) learning model, while the control class was taught using conventional learning. After the learning process was completed, both classes were given a posttest. The collected data were then processed and analyzed to determine the effect of the NHT learning model on students' critical thinking skills.

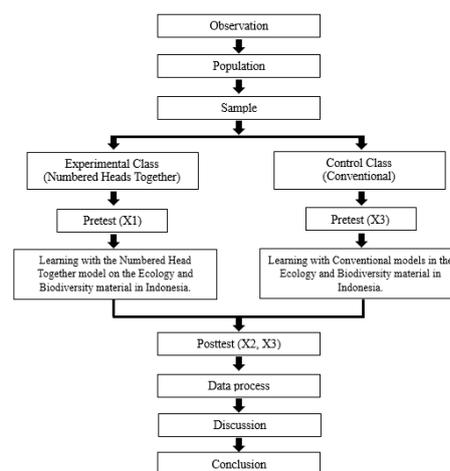


Figure 1. Research procedures

Data analysis was conducted using descriptive and inferential statistics. Prior to hypothesis testing, the data were tested for normality and homogeneity. Hypothesis testing was carried out using an independent sample t-test to compare the posttest results of the



experimental and control classes. The improvement in students' critical thinking skills was analyzed using the normalized gain (N-Gain) score to determine the level of improvement.

RESULTS AND DISCUSSION

This study analyzed student's learning outcomes in Ecology and Biodiversity through pretest and posttest assessments conducted in both the experimental and control classes. The pretest results indicate that students in the two classes had relatively similar initial abilities prior to the implementation of different learning models. This condition suggests that both groups were comparable at the beginning of the study.

After the learning intervention, posttest results showed an increase in learning outcomes in both classes. The experimental class, which was taught using the Numbered Heads Together (NHT) cooperative learning model, demonstrated a higher improvement compared to the control class that received instruction through the conventional learning model.

Results

The descriptive statistics of student's pretest and posttest scores in both classes are presented in **Table 1**.

Table 1. Descriptive Statistics of Pretest and Posttest Scores

<i>Class</i>	<i>Test Type</i>	<i>Median</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Standard Deviation</i>
<i>Experimental</i>	Pretest	50	35	65	7.25
<i>Experimental</i>	Posttest	64	50	85	9.25
<i>Control</i>	Pretest	48	37	65	6.67
<i>Control</i>	Posttest	55	32	75	8.30

Based on Table 1, it can be seen that the experimental class taught using the Numbered Heads Together (NHT) cooperative learning model obtained higher posttest scores than the control class taught using conventional learning. This indicates that the implementation of the NHT learning model had a positive impact on students' critical thinking skills. Before the treatment was applied, the pretest results showed that the initial critical thinking abilities of students in both classes were relatively equivalent. The experimental class obtained a median score of 50, while the control class obtained a median score of 48. This similarity in initial ability indicates that the differences in posttest results were influenced by the instructional treatment rather than by prior differences in students' abilities. To determine whether the difference in critical thinking skills between the two classes was statistically significant, hypothesis testing was conducted using an independent samples t-test (one-tailed). The analysis yielded a t-value of 5.214 with a significance value of 0.000 ($p < 0.05$). Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted, indicating a significant difference in critical thinking skills between students in the experimental and control classes.

Based on the normalized gain (N-Gain) analysis, the improvement in learning outcomes for each class is summarized in **Table 2**.

Table 2. N-Gain Score Results

<i>Class</i>	<i>Mean N-Gain</i>	<i>Category</i>
<i>Experimental</i>	0.523	Medium
<i>Control</i>	0.372	Medium

The N-Gain in table 2 analysis further showed that the experimental class achieved an average N-Gain score of 0.523, which falls into the medium category, while the control class achieved an average N-Gain score of 0.372, also categorized as medium. Although both classes

were classified in the same category, the improvement in the experimental class was noticeably higher. This result suggests that the NHT cooperative learning model is more effective in improving students' critical thinking skills compared to conventional learning.

Differences in the improvement of critical thinking skills were also observed across each critical thinking indicator. A comparison of the mean scores for each indicator is presented in Table 3.

Table 3. Comparison of Critical Thinking Indicators

<i>Indicator</i>	<i>Experimental</i>	<i>Control</i>
<i>Elementary Clarification</i>	78	70
<i>Basis for Decision</i>	80	72
<i>Inference</i>	85	74
<i>Advanced Clarification</i>	82	73
<i>Supposition & Integration</i>	81	71

The graphical comparison in Figure 2 and Figure 3 further strengthens this finding, as the experimental class consistently shows greater improvement across all measured indicators. This improvement can be attributed to the structure of the NHT model, which encourages equal participation, group responsibility, and active discussion among students.

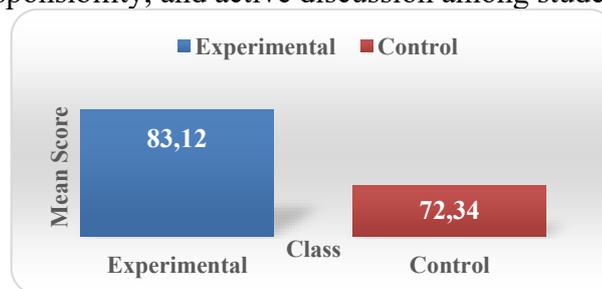


Figure 2. Comparison of Posttest Mean Scores

The bar chart shows that the experimental class outperformed the control class in terms of average posttest performance. Students who learned through the Numbered Heads Together (NHT) cooperative learning model demonstrated better achievement than those who were taught using a conventional approach. This pattern indicates that the NHT model provides a more effective learning environment by encouraging active participation, collaboration, and shared responsibility among students, which in turn supports improved learning outcomes.

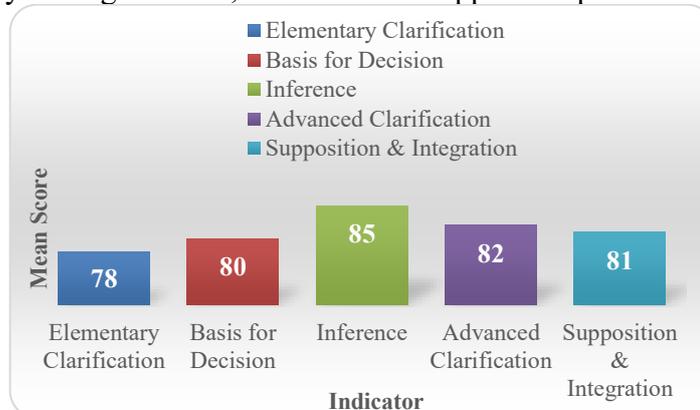


Figure 3. Comparison of Critical Thinking Indicators

The comparison of critical thinking indicators shows that the experimental class consistently demonstrated stronger performance across all assessed aspects than the control



class. Students who learned through the Numbered Heads Together (NHT) cooperative learning model exhibited better abilities in providing clear explanations, making informed decisions, drawing logical inferences, offering deeper clarification, and integrating ideas. This overall pattern suggests that the NHT model effectively supports the development of critical thinking skills by fostering active discussion, shared reasoning, and collaborative problem solving, which are less emphasized in conventional learning environments.

Discussion

An in-depth analysis of the research data indicates that the implementation of the Numbered Heads Together (NHT) cooperative learning model significantly impacts the improvement of student learning outcomes in Ecology and Biodiversity. Based on descriptive statistical tests, a positive shift in scores is evident; at the pretest stage, the initial capabilities of students in both the experimental and control classes were relatively equivalent, with median values of 50 and 48, respectively. This initial equivalence suggests that the differences emerging at the end of the study are purely attributable to the learning model intervention. Following the treatment, the experimental class recorded a surge in posttest median scores to 64, substantially higher than the control class, which only reached 55. The significance of this difference was confirmed through an independent samples t-test, yielding a t-value of 5.214 with a significance probability of 0.000. As this probability falls well below the 0.05 significance threshold, the null hypothesis is statistically rejected, confirming that the NHT model is markedly more effective in boosting academic performance compared to conventional teacher-centered methods (Pahmi et al., 2021; Pency & Mbagho, 2020; Putra & Rahayu, 2021; Reskiah & Syah, 2020).

The effectiveness of the learning model in this study is also clearly illustrated through normalized gain (N-Gain) analysis, which measures the efficiency of the increase in student understanding. Data shows that the experimental class achieved an average N-Gain score of 0.523, while the control class lagged behind with a score of 0.372. Although both results qualitatively fall into the "moderate" category, there is a substantial numerical gap between them. The superior figures in the experimental class indicate that the NHT learning syntax—which emphasizes individual accountability within a group framework—is capable of facilitating better information retention. In this process, students do not merely receive information passively but are required to process, discuss, and verify their understanding before answering questions. The "numbering" mechanism forces every group member to remain alert, thereby eliminating opportunities for students to remain passive or act as "free riders," a common occurrence in standard group work. This mechanism serves as the key factor in why the improvement of learning outcomes in the experimental class was more optimal than in the control class (Hastuti, 2022; Ibrahim & Rashid, 2022; Kahar et al., 2020; Sembiring, 2021; Utami et al., 2021).

The positive impact of this cooperative model was also observed in detail across every measured indicator of critical thinking skills. Consistently, the experimental class dominated average scores over the control class across all five indicators. The highest score in the experimental class was found in the "inference" indicator, reaching 85, compared to 74 in the control class. Furthermore, in the "providing basic explanations" indicator, the experimental class excelled with a score of 78 versus 70, and in the "bases for decision making" aspect, they led with a score of 80 against 72. Superiority was also evident in the "advanced clarification" and "strategies and tactics" indicators, with scores of 82 and 81, respectively. The dominance



of these figures across all indicators proves that the dynamic interaction within the NHT model stimulates higher-order cognitive processes. The discussions that occur during the "heads together" phase allow students to mutually correct and enrich each other's perspectives, thereby sharpening their ability to analyze arguments and draw conclusions more effectively than in conventional learning (Ananda et al., 2020; Mawardi et al., 2024; Sa'adah, 2020; Susanti, 2025; Utami et al., 2021).

These empirical findings align with the theoretical frameworks proposed by educational experts regarding the relationship between cooperative learning and cognitive development. The results support Ennis's (2019) view that critical thinking requires a series of logical abilities to make rational decisions. In this context, the NHT model provides a conducive environment for students to practice these skills through academic dialogue. Moreover, these findings validate the theories of Slavin (2015) and Trianto (2017), which emphasize that individual accountability in group work is the key to successful cooperative learning. The structure of NHT ensures that group success depends heavily on the mastery of material by each individual, thereby triggering intrinsic motivation to study harder. This synergy between personal responsibility and peer social support creates a productive learning ecosystem, enabling students to construct a deeper understanding of complex ecological concepts that are difficult to achieve through one-way lecture methods (Amelia & Rusman, 2022; Asriyati & Widana, 2022; Daulay et al., 2024; Putri et al., 2025; Simarmata & Habeahan, 2025).

The implications of this research suggest that the integration of the Numbered Heads Together model is highly recommended for science education, particularly for topics requiring conceptual understanding and environmental analysis such as Ecology and Biodiversity. Nevertheless, this study has limitations, notably that the N-Gain achievement remains in the moderate category, indicating room for optimization—perhaps in terms of discussion duration or the depth of teaching materials. Another limitation may lie in the adaptation of students who are not yet accustomed to cooperative models, necessitating more time during initial meetings. Therefore, educators wishing to implement this model are advised to provide brief training on NHT procedures before starting the core material. Future research is expected to broaden the scope of the subject matter or combine this model with digital media to determine if the learning outcome improvement can be pushed to a high level, as well as to measure long-term retention of student understanding.

CONCLUSION

Based on the results of the research conducted at SMP Negeri 35 Medan, it can be concluded that the Numbered Heads Together (NHT) type cooperative learning model has a significant influence on students' critical thinking skills in Ecology and Biodiversity material for Grade VII in the 2024/2025 academic year. The results of the independent sample t-test showed a Sig. (2-tailed) value of 0.000 ($p < 0.05$), indicating that there was a significant difference in critical thinking skills between students in the experimental class and those in the control class. This finding confirms that the application of the NHT learning model effectively enhances students' critical thinking skills compared to conventional learning methods. Furthermore, among the aspects of critical thinking, the inference aspect showed the most significant improvement in the experimental class. This indicates that the NHT learning model is particularly effective in developing students' ability to draw conclusions and make logical decisions through collaborative group discussions, thus answering both research questions of this study.



Based on the conclusions, it is recommended that teachers apply the Numbered Heads Together (NHT) cooperative learning model as an alternative instructional strategy, particularly in science learning, to promote active participation, collaboration, and deeper understanding. Students are encouraged to actively engage in discussions, share ideas, and work collaboratively during NHT-based learning to enhance their critical thinking skills and learning outcomes. Schools are expected to support the implementation of innovative learning models such as NHT by providing adequate facilities and encouraging the development of active and cooperative learning practices. Furthermore, future research may extend this study by applying the NHT model to different subjects or grade levels and by examining additional variables such as learning motivation, student engagement, or long-term learning achievement.

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