



Enhancing Students' Learning Activities and Learning Outcomes in Relations and Functions Through the Numbered Heads Together (NHT) Learning Model

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Abstract

Students' learning activities and learning outcomes in mathematics, particularly on the topic of Relations and Functions, were still below the expected level in Class VIII-B of SMP Negeri Kota Baru. This study aimed to improve students' learning activities and learning outcomes through the implementation of the Numbered Heads Together (NHT) cooperative learning model. The study employed Classroom Action Research (CAR) based on Kurt Lewin's model, consisting of four stages: planning, acting, observing, and reflecting. The research was conducted during the first semester of the 2025/2026 academic year and involved 25 students of Class VIII-B. Data were collected through classroom observation sheets to assess students' learning activities and achievement tests to measure learning outcomes. The success indicators were determined based on the achievement of the predetermined criteria for students' learning activities and learning outcomes. The results showed that students' learning activities increased from 62.14% in Cycle I to 84.28% in Cycle II, while the mean learning outcome score increased from 72.84 in Cycle I to 82.48 in Cycle II. These improvements across cycles indicate that the implementation of the NHT cooperative learning model improved students' learning activities and learning outcomes in mathematics. Therefore, the NHT learning model can be used as an alternative instructional approach to promote active and collaborative learning in teaching Relations and Functions.

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Introduction

Students' learning activities and mathematics achievement in the topic of Relations and Functions remain important challenges in mathematics learning. In classroom practice, some students tend to be less active in participating in discussions, expressing ideas, asking questions, and solving mathematical problems collaboratively. These conditions may affect their understanding and achievement of the concepts of Relations and Functions. Previous empirical studies have also reported that students experience difficulties in understanding Relations and Functions, particularly in representing relationships, interpreting mathematical concepts, and applying them to problem-solving. Therefore, there is a need for an instructional approach that can actively engage students and improve their mathematics learning outcomes in this topic.

One of the key factors in improving educational quality is the availability of high-quality human resources, which can only be achieved through effective learning processes. According to (Abramovich

et al., 2019; Altafiana et al., 2025; Henderson & Cunningham, 2023), in implementing educational process standards, teachers are required to design learning strategies that align with the intended learning objectives and competencies. Teachers are expected not only to deliver instructional content but also to serve as facilitators who create an active, dynamic, and meaningful learning environment. In this context, selecting an appropriate instructional model is essential to foster students' logical, critical, and creative thinking skills while promoting collaboration among learners.

Mathematics is often perceived by students as a difficult subject, particularly when learning requires them to understand abstract concepts and apply them to problem-solving. Based on initial observations conducted in Class VIII-B of SMP Negeri Kota Baru during the first semester of the 2025/2026 academic year, students' learning activities and mathematics achievement, particularly in the topic of Relations and Functions, were still below the expected level. Several students were passive during classroom discussions, showed limited participation in asking and answering questions, and had insufficient opportunities to actively engage in solving mathematical problems. The initial learning outcomes also indicated that some students had not yet achieved the predetermined learning mastery criterion. These conditions suggest the need for an instructional approach that can increase student participation and improve learning outcomes. Therefore, the implementation of a cooperative learning model, particularly the Numbered Heads Together (NHT) model, is considered an appropriate strategy because it encourages students to participate actively, collaborate with their peers, discuss mathematical problems, and take individual responsibility for group learning.

One cooperative learning model that is particularly relevant is the Numbered Heads Together (NHT) model. This model emphasizes group collaboration and the active participation of all group members. Each student is assigned a number, and students take turns answering questions according to their assigned numbers. According to (Olo et al., 2023), the NHT model promotes deeper conceptual understanding and enhances students' collaborative skills. Furthermore, this model improves students' cognitive abilities, sense of responsibility, and learning motivation by providing clearly defined roles and responsibilities within each group (Hidayat et al., 2020; Simarmata & Hijriani, 2020; Steinberg et al., 2024).

Furthermore, (Aulia & Lena, 2023; Syahputri & Ananda, 2025) findings demonstrate that the implementation of the NHT learning model significantly improves students' learning activities and academic achievement. The model provides opportunities for students to engage in discussions, exchange ideas, and actively present the outcomes of their group work. In mathematics education, particularly in the topic of Relations and Functions, the NHT model is considered effective in maximizing student engagement and participation throughout the learning process (Akuba et al., 2025).

Based on the identified classroom problems, this study aims to examine the implementation of the Numbered Heads Together (NHT) cooperative learning model in improving students' learning activities and learning outcomes on the topic of Relations and Functions. Specifically, the study

examines changes in students' learning activities and learning outcomes from Cycle I to Cycle II based on predetermined success indicators. The study also seeks to determine whether the implementation of the NHT model enables students to achieve the established criteria for learning activity and learning outcome mastery.

Methods

This study employed Classroom Action Research (CAR) because it was appropriate for identifying and addressing problems in the actual classroom learning process through systematic cycles of action and reflection. The research was conducted in Class VIII-B of SMP Negeri Kota Baru during the first semester of the 2025/2026 academic year. The researcher acted as the teacher who implemented the Numbered Heads Together (NHT) cooperative learning model, while a collaborating mathematics teacher served as an observer who monitored students' learning activities and the implementation of the learning process using predetermined observation instruments. The research followed Kurt Lewin's CAR model, which consists of four stages: planning, acting, observing, and reflecting (Hidayah et al., 2025). In the planning stage, the researcher and collaborating teacher prepared the lesson plans, learning materials, observation instruments, and achievement tests. In the acting stage, the researcher implemented the NHT learning model according to the planned procedures. During the observing stage, the collaborating teacher recorded students' learning activities and the implementation of the learning process, while students' learning outcomes were measured through achievement tests. At the end of each cycle, the researcher and collaborating teacher conducted a collaborative reflection by analyzing the observation results and students' learning outcomes against the predetermined success indicators. The reflection results were used to identify weaknesses and determine improvements for the subsequent cycle. Permission to conduct the research was obtained from the school administration before data collection. The study was conducted in accordance with the school's procedures for student participation, and students' identities and personal information were kept confidential throughout the research and reporting process.

The participants in this study were 25 students from Class VIII-B, comprising 13 males and 12 females. The study utilized primary data collected directly from the research participants through classroom observations and achievement tests. Observation sheets were used to assess students' learning activities, while achievement tests were administered to measure students' learning outcomes.

The study was conducted in two cycles over a period of two weeks, comprising four meetings. During the first meeting of Cycle I, the researcher implemented learning activities aimed at achieving the indicator of identifying relations and functions, including the concepts of domain, codomain, and range. At the second meeting, the Cycle I achievement test was administered. During the third meeting (Cycle II), instruction focused on enabling students to represent relations and functions using arrow

diagrams, tables, sets of ordered pairs, and graphs. At the fourth meeting, the Cycle II achievement test was conducted.

The data were analyzed using the following procedures.

a. Analysis of Students' Learning Activities

According to (Aulia & Lena, 2023), the analysis of students' learning activities was conducted through the following steps:

1. Assigning scoring criteria for each descriptor within every observed aspect of learning activity.
2. Summing the scores obtained for each observed aspect.
3. Calculating the percentage score for each observed aspect using the following formula:

$$\text{Achievement Percentage} = \frac{\text{Total Score for Each Aspect}}{\text{Maximum Score}} \times 100\%$$

After calculating the percentage, students' learning activities were categorized into four performance levels based on the established criteria, as presented in Table 1.

Table 1. Achievement Percentage Scale		
Achievement Percentage	Score Scale	Interpretation
70-100%	4	Very Good
56-69%	3	Good
40-55%	2	Fair
0-39%	1	Poor

b. Analysis of Learning Outcome Test Data

The achievement test data collected in each cycle were analyzed to determine students' learning mastery, both individually and collectively.

1. Individual Mastery

A student was considered to have achieved learning mastery if they obtained a minimum score of 75, which corresponds to the Minimum Mastery Criterion (MMC) established by the school. The formula used was:

$$\text{Individual Mastery Percentage} = \frac{\text{Student/s Score}}{\text{Maximum Test Score}} \times 100\%$$

2. Classical Mastery

A class was considered to have achieved classical mastery if at least 75% of all students obtained scores equal to or above the Minimum Mastery Criterion (MMC). The percentage of classical mastery was calculated using the following formula:

$$\text{Classical Mastery Percentage} = \frac{s}{t} \times 100\%$$

where:

s = the number of students who achieved learning mastery;

t = the total number of students in the class.

Result and Discussion

Result

This study was conducted at SMP Negeri Kota Baru in Class VIII-B, involving 25 students, through the implementation of the Numbered Heads Together (NHT) learning model over two instructional cycles. The implementation of the learning process in each cycle is described as follows.

1. Cycle I

The implementation of Cycle I consisted of two meetings. The first meeting was conducted on Monday, July 28, 2025, for three lesson periods (3×40 minutes), from 07:30 a.m. to 09:30 a.m. (WITA), With all 25 students in attendance. The learning materials covered in this meeting included identifying relations and functions and explaining the concepts of domain, codomain, and range of a function. The second meeting was held on Tuesday, July 29, 2025, for two lesson periods (2×40 minutes), with all 25 students present. At this meeting, the researcher administered the Cycle I achievement test to assess students' learning outcomes. The test consisted of four essay questions, which students completed individually. After completing the test, all answer sheets were collected for evaluation. The implementation of Cycle I consisted of the following stages.

a) Planning

During the planning stage, the researcher prepared all instructional materials and research instruments, including the syllabus, lesson module, teaching materials, achievement test, and observation sheets for assessing students' learning activities.

b) Action

At this stage, the learning process involved interactions between the researcher (teacher) and the students through the implementation of the Numbered Heads Together (NHT) cooperative learning model. The instructional activities were carried out as follows.

1. Preliminary Activities

The lesson began with classroom preparation, greetings, and a prayer before the learning activities commenced. The researcher then conducted attendance to confirm students' presence and asked students to prepare their notebooks and writing materials. An apperception and motivational session was conducted to connect the lesson with students' everyday experiences related to the topic being studied. Finally, the researcher explained the learning objectives.

2. Main Activities

The researcher introduced the Numbered Heads Together (NHT) cooperative learning model and implemented the following instructional procedures:

- 1) The lesson began with an explanation of the fundamental concepts of relations and functions, including the definitions of domain, codomain, and range, accompanied by relevant examples.
- 2) Students were organized into learning groups.

- 3) The researcher divided the class into five heterogeneous groups and assigned each student a number according to the NHT procedure.
- 4) Student worksheets containing discussion questions were distributed, and students were instructed to work collaboratively to solve the problems.
- 5) Students worked cooperatively with their group members according to the NHT procedure. The learning activities of each group were continuously observed and assessed. The researcher reminded students that every group member was responsible for understanding the group's work because any member could be randomly selected to present the group's answers.
- 6) The researcher randomly called a specific number from one of the groups.
- 7) The student whose assigned number was called presented the group's answers to the class.
- 8) The researcher summarized the presentation, provided feedback, and encouraged students to ask questions about concepts they had not yet understood.

3. Closing Activities

The lesson concluded with the researcher motivating students to study more diligently so that they would be better prepared for subsequent learning activities. Finally, the lesson was closed with a farewell greeting.

c) Observation

Observations were conducted collaboratively by the researcher and the classroom teacher throughout the learning process to collect data on students' learning activities and to document all events that occurred during Cycle I. The observation results from the first meeting indicated that the implementation of the Numbered Heads Together (NHT) learning model had not yet achieved the expected level of effectiveness. Several students did not pay sufficient attention to the researcher's explanations and instructions during the lesson. In addition, student participation within the learning groups remained relatively low. Many students sought assistance from members of other groups rather than discussing difficulties with members of their own groups. Consequently, communication and collaboration among group members were still limited. These findings are presented in the observation results shown in the following table.

Table 2. Observation Results of Students' Learning Process in Cycle I

No	Name	Learning Activity Indicators						
		1	2	3	4	5	6	7
1	Group 1	3	1	2	2	1	2	3
2	Group 2	3	3	3	2	2	3	3
3	Group 3	3	3	3	3	2	4	4
4	Group 4	4	2	3	2	1	2	3
5	Group 5	3	2	2	2	1	2	3
		16	11	13	11	7	13	16
Total		0,8	0,55	0,65	0,55	0,35	0,65	0,8

The students' learning outcomes in Cycle I were measured using an achievement test administered at the end of the instructional activities. The test was designed to evaluate students' understanding of the concepts of relations and functions taught during the first cycle. The results were analyzed to determine both individual and classical learning mastery and to evaluate the effectiveness of implementing the Numbered Heads Together (NHT) learning model in improving students' academic achievement. A summary of the students' learning outcomes in Cycle I is presented in Table 3.

Table 3. Cycle I Achievement Test Results

No	Student Initials	Score	Remarks
1	AGU	72	NM
2	LA	73	NM
3	AS	78	M
4	DVA	82	M
5	DS	72	NM
6	ARP	70	NM
7	AT	77	M
8	EA	74	NM
9	DRB	76	M
10	LRT	84	M
11	FFB	70	NM
12	GCN	76	M
13	MKE	70	NM
14	RDK	82	M
15	YSF	52	NM
16	SAN	68	NM
17	GAK	74	NM
18	NN	70	NM
19	GN	75	M
20	LMPB	50	NM
21	YRB	82	M
22	YB	70	NM
23	YJN	84	M
24	RVA	70	NM
25	JKA	70	NM
Total		1.821	
Mean Score		72,84	
Students' Mastery		40%	

As shown in Table 3, the results of the Cycle I achievement test indicated that 10 out of 25 students achieved the Minimum Mastery Criterion (MMC), resulting in a classical learning mastery rate of 40%. Students were considered to have achieved learning mastery if they obtained a minimum score of 75, in accordance with the school's Minimum Mastery Criterion (MMC). However, the classical learning mastery rate was still below the predetermined target of 75%. Therefore, the learning process required further evaluation to identify the factors that contributed to students' limited understanding of the material and to determine appropriate improvements for implementation in the subsequent cycle.

d) Reflection

Based on the analysis of the observation data on students' learning activities and the achievement test results in Cycle I, the average level of students' learning activities was 62.14%, which had not yet met the predetermined success indicator. In terms of learning outcomes, 10 out of 25 students achieved the

Minimum Mastery Criterion (MMC), resulting in a classical learning mastery rate of 40%, which was still below the predetermined target of 75%. Therefore, the study was continued to Cycle II, as the expected level of classical learning mastery had not yet been achieved. Following a discussion with the collaborating teacher, several aspects requiring improvement were identified: The implementation of group work using the Numbered Heads Together (NHT) learning model had not yet been carried out effectively, as some group members focused only on completing their individual tasks rather than collaborating.

1. When encountering learning difficulties during group discussions, several students still asked the teacher directly for assistance instead of first discussing the problems with their own group members.
2. Some students remained dependent on higher-achieving classmates to complete group tasks or sought assistance from members of other groups.
3. Students who were randomly selected to present their group's answers still lacked the confidence to present the results of their group discussions in front of the class.

2. Cycle II

The implementation of Cycle II followed the same procedures as those in Cycle I. During this cycle, the researcher delivered the instructional materials in accordance with the learning objectives outlined in the lesson module, with particular emphasis on improving the aspects of students' learning activities that had not yet reached the expected level in Cycle I. Cycle II consisted of two meetings: one meeting for the learning activities and one meeting for the achievement test. The first meeting was conducted on Monday, August 4, 2025, for two lesson periods (2×40 minutes) from 07:30 to 08:50 WITA, with all 25 students in attendance. The second meeting was held on Tuesday, August 5, 2025, for two lesson periods (2×40 minutes) from 08:00 to 09:20 WITA, with all 25 students present. The implementation of Cycle II consisted of the following stages.

a) Planning

At this stage, the researcher prepared the instructional materials and research instruments, including the syllabus, lesson module, teaching materials, achievement test, and observation sheets for students' learning activities. The learning objective for Cycle II was to enable students to represent relations and functions using arrow diagrams, tables, and sets of ordered pairs (see Appendix II: Cycle II Lesson Module).

b) Action

The learning activities were conducted using the Numbered Heads Together (NHT) cooperative learning model as follows.

1. Preliminary Activities

The lesson began with classroom preparation, greetings, and a prayer before the learning activities commenced. The researcher then conducted attendance to confirm students' presence and asked them to prepare their notebooks and writing materials. Subsequently, the learning objectives were explained. To address the shortcomings identified in Cycle I, the researcher repeated key explanations at a slower pace, ensured that all students paid attention to the instructions, and reminded students of the aspects that needed improvement so that their learning activities could proceed more effectively.

2. Main Activities

The researcher implemented the Numbered Heads Together (NHT) cooperative learning model through the following procedures:

- 1) The lesson began with an explanation of how to represent relations and functions using arrow diagrams, tables, and sets of ordered pairs.
- 2) The researcher provided relevant explanations and illustrative examples.
- 3) Students were organized into learning groups.
- 4) The researcher divided the students into five heterogeneous groups and assigned each student a number according to the NHT procedure.
- 5) Student worksheets containing discussion questions were distributed, and students were instructed to discuss the answers collaboratively. The researcher visited each group individually while they worked, provided guidance on effective problem-solving strategies, demonstrated appropriate solution methods when necessary, and assisted students who encountered difficulties.
- 6) Students worked collaboratively with their group members in accordance with the NHT learning procedure, and the learning activities of each group were observed and assessed. Students were encouraged to discuss the questions, exchange ideas, reach a consensus on the answers, and ensure that every group member understood the group's solutions. During this stage, the researcher continuously provided motivation and guidance, emphasizing that every student had an active role within the group and should communicate effectively with other group members. The researcher also reminded students that any member could be randomly selected to present the group's work; therefore, all members were expected to understand the discussion results.
- 7) The researcher randomly called a specific number from one of the groups. At this stage, the classroom atmosphere became highly engaging, as students enthusiastically competed for the opportunity to present their group's answers.
- 8) The student whose assigned number was called presented the group's answers to the class.

- 9) The researcher summarized the presentations, provided feedback, and gave students to ask questions about concepts they had not yet fully understood.

3. Closing Activities

The lesson concluded with the researcher encouraging students to study more diligently and participate actively in future learning activities. Finally, the learning session was closed with a farewell greeting.

c) Observation

Observations were conducted collaboratively by the researcher and the classroom teacher throughout the learning process to collect data on students' learning activities and to document all events that occurred during Cycle II. The observation results indicated a substantial improvement in the implementation of the Numbered Heads Together (NHT) learning model compared with Cycle I. Students participated actively throughout the learning process, paid close attention to the researcher's explanations and instructions, demonstrated a better understanding of the learning materials, and collaborated effectively within their groups. These improvements were attributed to the implementation of the NHT learning model, as students had become familiar with its learning procedures and expectations. The improvement in students' learning activities is presented in the following table.

Table 4. Observation Results of Students' Learning Activities in Cycle II

No	Name	Learning Activity Indicators						
		1	2	3	4	5	6	7
1	Group 1	4	3	3	3	3	4	4
2	Group 2	3	3	3	3	3	3	4
3	Group 3	4	4	4	4	3	4	4
4	Group 4	4	3	4	3	3	3	4
5	Group 5	3	2	3	3	3	4	4
Total		17	15	17	16	15	18	20
		0,85	0,75	0,85	0,8	0,75	0,9	1

The second meeting of Cycle II was conducted on Tuesday, August 5, 2025. During this meeting, the researcher administered an achievement test to evaluate students' learning outcomes after the implementation of the Numbered Heads Together (NHT) learning model in Cycle II. Students were instructed to complete the test individually and were not permitted to collaborate while answering the test questions. Upon completion of the test, all answer sheets were collected for evaluation. The results of the Cycle II achievement test are presented in Table 5.

Table 5. Data of Test Results in Cycle II

No	Student Initials	Score	Remarks
1	AGU	76	M
2	LA	78	M
3	AS	82	M
4	DVA	100	M
5	DS	80	M
6	ARP	75	M
7	AT	82	M
8	EA	86	M
9	DRB	80	M
10	LRT	100	M
11	FFB	76	M
12	GCN	85	M
13	MKE	78	M
14	RDK	100	M
15	YSF	72	NM
16	SAN	75	M
17	GAK	78	M
18	NN	80	M
19	GN	85	M
20	LMPB	70	NM
21	YRB	95	M
22	YB	75	M
23	YJN	100	M
24	RVA	80	M
25	JKA	74	NM
Total		2.062	
Mean Score		82,48	
Students' Mastery		88%	

As presented in Table 5, 22 of the 25 students attained the Minimum Mastery Criterion (MMC), whereas the remaining three students did not achieve the required level of mastery. In this study, students were considered to have achieved learning mastery if they obtained a score of at least 75, as stipulated by the school's Minimum Mastery Criterion (MMC). Consequently, the classical learning mastery rate reached 88%, with a mean achievement score of 82.84. These findings demonstrate that the implementation of the Numbered Heads Together (NHT) learning model effectively enhanced students' academic achievement and enabled the class to exceed the predetermined criterion of 75% classical learning mastery.

d) Reflection

Based on the analysis of the observation data on students' learning activities and the achievement test results in Cycle II, students' learning activities achieved and exceeded the predetermined success indicators, with an average score of 84.28%. A comparison of students' learning activity indicators between Cycle I and Cycle II is presented in Table 6.

Table 6. Comparison of Students' Learning Activity Indicators Between Cycle I and Cycle II

No	Learning Activity Indicator	Cycle I (%)	Cycle II (%)
1	Students' enthusiasm in participating in learning activities	80%	85%
2	Paying attention to the teacher's/researcher's explanations and instructions	55%	75%
3	Interacting actively with peers and the teacher/researcher	65%	85%
4	Completing individual and group tasks effectively	55%	80%
5	Participating actively in group discussions	35%	75%
6	Demonstrating responsibility by presenting the group's work	65%	90%
7	Completing assigned tasks within the allocated time	80%	100%

As presented in Table 6, students' learning activities showed consistent improvement across all observed indicators from Cycle I to Cycle II, with the average learning activity score increasing from 62.14% to 84.28%. These findings indicate that the implementation of the Numbered Heads Together (NHT) learning model successfully promoted greater student participation and engagement during the learning process. Furthermore, the results of the Cycle II achievement test demonstrated that the mean achievement score reached 82.48, exceeding the school's Minimum Mastery Criterion (MMC) of 75. Students were considered to have achieved learning mastery if they obtained a score of at least 75. In addition, 22 out of 25 students achieved learning mastery, resulting in a classical learning mastery rate of 88%, which exceeded the predetermined success criterion of 75%. Compared with Cycle I, these findings indicate a substantial improvement in students' learning outcomes. Since both the students' learning activities and learning outcomes met and exceeded the established success indicators, the implementation of the Numbered Heads Together (NHT) learning model was considered successful. Therefore, the classroom action research was concluded in Cycle II, and no further instructional cycles were required.

Discussion

The classroom action research was conducted in accordance with the planned procedures over two instructional cycles spanning approximately two weeks. Overall, the findings indicate that implementing the Numbered Heads Together (NHT) learning model effectively enhanced both students' classroom engagement and their mathematics achievement on the topic of relations and functions.

The observation results revealed a substantial improvement in students' classroom engagement, with the average learning activity score increasing from 62.14% in Cycle I to 84.28% in Cycle II. Likewise, students' academic achievement improved considerably. The mean achievement score increased from 72.84 in Cycle I to 82.48 in Cycle II. In addition, the number of students who met the Minimum Mastery Criterion (MMC) increased from 10 students (40%) in Cycle I to 22 students (88%) in Cycle II. Since the classical learning mastery rate exceeded the predetermined success criterion of 75%, the implementation of the NHT learning model was considered successful.

The relatively low levels of classroom engagement and academic achievement observed during Cycle I may be attributed to students' unfamiliarity with the NHT learning model. As this instructional approach was newly introduced, many students were still adapting to its procedures and collaborative learning environment. Consequently, classroom participation was limited, group discussions were not yet effective, and some students experienced difficulties in understanding the concepts and solving the assigned problems. These factors contributed to the relatively low learning outcomes achieved during the first cycle.

Based on the reflection conducted after Cycle I, several improvements were introduced in Cycle II. Clearer instructions were provided, more intensive guidance was given during group discussions, and all students were encouraged to participate actively and assume responsibility for their assigned roles within the group. As a result, students became more actively engaged in discussions, collaborated more effectively with their peers, paid closer attention to classroom explanations, and demonstrated greater confidence when presenting and defending their group responses. These improvements were reflected in the increase in the classical learning mastery rate from 40% in Cycle I to 88% in Cycle II.

Several factors may explain the improvement in students' classroom engagement and learning outcomes. First, the NHT learning model requires every group member to participate actively because any student may be randomly selected to represent the group. This procedure encourages students to master the learning material, strengthens their sense of individual responsibility, and enhances their confidence in expressing ideas during classroom discussions. These findings are consistent with those reported by Syahputri & Ananda (2025), who concluded that the NHT learning model improves students' self-confidence in expressing their opinions while simultaneously enhancing mathematics learning outcomes.

Second, the NHT learning model promoted more effective collaboration among students. Through structured group discussions, students exchanged ideas, considered different perspectives, solved problems collaboratively, and assumed shared responsibility for completing learning tasks. These collaborative learning experiences facilitated deeper conceptual understanding while also strengthening students' communication and interpersonal skills. This finding is consistent with the study by (Hasibuan & Wahyudin, 2023), which reported that the NHT learning model creates an engaging learning environment that encourages active participation and greater responsibility for learning.

Third, students demonstrated a better understanding of the concepts because they actively constructed knowledge through discussion rather than relying solely on teacher explanations. By explaining concepts to their peers, evaluating alternative solutions, and clarifying misconceptions during group discussions, students developed a deeper conceptual understanding of relations and functions. This active learning process ultimately contributed to the improvement of their academic achievement (Dewi & Wulandari, 2025).

Overall, the findings of this study provide empirical evidence that the Numbered Heads Together (NHT) learning model is effective in enhancing both students' classroom engagement and academic achievement. The improvements in learning activity, mean achievement scores, and classical learning mastery demonstrate that the model successfully created a more active, collaborative, and student-centered learning environment. Therefore, the implementation of the NHT learning model in teaching relations and functions to Grade VIII-B students at SMP Negeri Kota Baru during the 2025/2026 academic year successfully achieved the predetermined instructional objectives, with the classical learning mastery rate exceeding the school's Minimum Mastery Criterion (MMC) of 75%.

Conclusion

The findings of this classroom action research demonstrate that the Numbered Heads Together (NHT) learning model effectively enhanced students' learning activities and learning outcomes in mathematics, particularly in the topic of relations and functions, among Grade VIII-B students at SMP Negeri Kota Baru during the first semester of the 2025/2026 academic year.

Students' learning activities improved substantially, with the average activity score increasing from 62.14% in Cycle I to 84.28% in Cycle II. Likewise, students' learning outcomes showed marked improvement, as indicated by the increase in the mean achievement score from 72.84 in Cycle I to 82.48 in Cycle II. Moreover, the classical learning mastery rate increased from 40% to 88%, exceeding the predetermined success criterion of 75%.

These findings suggest that the NHT learning model promotes active participation, collaborative learning, and greater individual responsibility, thereby contributing to improved understanding of mathematical concepts and higher learning achievement. Therefore, the NHT learning model can be considered an effective instructional strategy for enhancing students' learning activities and learning outcomes in mathematics, particularly in teaching relations and functions.

Recommendation

Based on the findings of this study, future research is recommended to examine the effectiveness of the Numbered Heads Together (NHT) cooperative learning model using a quasi-experimental design with a comparison group. Such a design would provide stronger evidence regarding the effectiveness of NHT by comparing learning outcomes between students who receive the NHT intervention and those who receive another instructional approach. Future studies should also use validated research instruments, equivalent achievement tests, and a longer intervention period to obtain more reliable evidence of the model's effectiveness. Further research may investigate the implementation of NHT across different mathematics topics, grade levels, and school contexts to examine the consistency of its effects. In addition, comparative studies involving other cooperative learning models, such as Jigsaw, Student Teams Achievement Divisions (STAD), and Think–Pair–Share (TPS), may provide further insights into

the relative effectiveness of different instructional approaches. For teachers, the findings suggest that NHT can be considered a practical alternative for increasing students' participation, collaboration, and learning outcomes in mathematics, particularly when learning activities are designed to encourage active discussion, individual accountability, and peer interaction. Teachers are encouraged to adapt the NHT procedures to students' characteristics, learning objectives, and classroom conditions to maximize its practical benefits.

References

- Abramovich, S., Grinshpan, A. Z., & Milligan, D. L. (2019). Teaching mathematics through concept motivation and action learning. *Education Research International*, 1–13. <https://doi.org/10.1155/2019/3745406>.
- Akuba, W., Machmud, T., & Takaendengan, B. R. (2025). Pengaruh Model Pembelajaran NHT Berbantuan Media Pembelajaran Interaktif Terhadap Kemampuan Pemecahan Masalah Matematika Siswa. *Jambura Journal Of Mathematics Education*, 6(1), 34–45. <https://doi.org/10.37905/jmathedu.v6i1.33414>
- Altafiana, Z., Zulkarnain, I., & Amalia, R. (2025). Meta Analisis: Pengaruh Model Pembelajaran Problem Based Learning dan Discovery Learning terhadap Hasil Belajar Matematika Siswa SMP. *JURMADIKTA*, 5(1), 25–33. <https://doi.org/10.20527/jurmadikta.v5i1.2842>
- Arikunto, S. (2006). *Penelitian tindakan kelas*. Jakarta: Bumi Aksara.
- Aulia, F., & Lena, M. S. (2023). Improving integrated thematic learning outcomes using the numbered head together (NHT) cooperative mode. *Jurnal Inovasi Teknologi Pendidikan*, 10(3), 255–264. <https://doi.org/10.21831/jitp.v10i3.60057>
- Dewi, I. P., & Wulandari, N. F. (2025). Guided Discovery Learning Integrated with Numbered Heads Together: Effects on Mathematical Problem-Solving and Student Engagement. *Jurnal Pendidikan MIPA*, 26(4), 2382–2402. <https://doi.org/10.23960/jpmipa.v26i4.pp2382-2402>
- Hasibuan, J. B., & Wahyudin, D. (2023). Implementation of the NHT type cooperative learning model to improve mathematics learning outcomes. *Sukma: Jurnal Pendidikan*, 7(2), 117–146. <https://doi.org/10.32533/07201.2023>
- Henderson, R. W., & Cunningham, L. (2023). Creating Interactive Sociocultural Environments for Self-Regulated Learning. In *Self-regulation of Learning and Performance* (1st Edition, p. 27). Routledge. <https://doi.org/10.4324/9780203763353>
- Hidayah, A., Wibawa, K. A., & Simons, M. (2025). Enhancing Students' Learning Outcomes through the Guided Inquiry Learning Model in Trigonometry. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 5(3), 1266–1276. <https://doi.org/10.51574/kognitif.v5i3.3083>
- Hidayat, R., Suryadi, D., & Prabawanto, S. (2020). Improving students' mathematical reasoning ability through problem-based learning. *Journal of Physics: Conference Series* 1521(3), 032060. <https://doi.org/10.1088/1742-6596/1521/3/032060>
- Olo, M. R., Simarmata, J. E., & Mamoh, O. (2023). Meningkatkan Kemampuan Berpikir Kritis Siswa Melalui Penerapan Model Pembelajaran Think Pair Share. *MATH-EDU: Jurnal Ilmu Pendidikan Matematika*, 8(3), 213–224. <https://doi.org/10.32938/jipm.8.3.2023>
- Simarmata, J. E., & Hijriani, L. (2020). IMPROVING STUDENTS' COMPETENCY ON FINANCIAL MATHEMATICS LEARNING BY APPLYING POLYAS' MODEL HEURISTIC STRATEGY. *Kalamatika: Jurnal Pendidikan Matematika*, 5(2), 143–154. <https://doi.org/10.22236/KALAMATIKA.vol5no2.2020pp143-154>

- Steinberg, O., Kulakow, S., & Raufelder, D. (2024). Academic self-concept, achievement, and goal orientations in different learning environments. *European Journal of Psychology of Education*, 39(4), 3893–3917. <https://doi.org/10.1007/s10212-024-00825-6>
- Syahputri, D., & Ananda, R. (2025). The Influence of Learning Models Cooperative Type Numbered Heads Together (NHT) on Learning Outcomes of Mathematics Students SMP Muhammadiyah 01 Medan. *Journal of Mathematics Instruction, Social Research and Opinion*, 4(3), 959–970. <https://doi.org/10.58421/misro.v4i3.730>