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The Effect of Numbered Heads Together Cooperative Learning on the Collaborative Skills of Early Grade Students in Learning Multiplication

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ABSTRACT
Collaborative skills are essential for early grade students as part of 21st-century competencies, yet they are often overlooked in traditional mathematics classrooms. This study aims to examine the effect of the Numbered Heads Together (NHT) cooperative learning model on the collaborative abilities of early grade students in learning basic multiplication. The research was driven by the low level of student engagement observed during conventional group work. A quantitative approach was used, employing a quasi-experimental design with a posttest-only control group. The participants consisted of 30 second-grade students at MIS Istiqomah, divided equally into experimental and control groups. The intervention was conducted over several sessions using structured NHT activities to enhance peer interaction and shared problem-solving. Data were gathered through a student-completed collaborative skills questionnaire and teacher observation sheets. Results indicated that the experimental group scored an average of 72.53 on collaboration measures, while the control group scored 39.07. An independent t-test revealed a significance value of 0.000 ($p < 0.05$), confirming a statistically significant difference. The findings demonstrate that the NHT model is effective in improving young learners' collaboration during mathematics learning. Therefore, it can be recommended as a viable strategy to cultivate teamwork skills from an early stage of schooling.

Keywords: Numbered Heads Together, Collaborative Skills, Basic Multiplication, Early Grade Students

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INTRODUCTION

Mathematics learning at the primary school level plays a vital role in developing young children's understanding of fundamental concepts that will support their future learning (Barmby et al., 2025; Liu et al., 2025; Zuliana et al., 2025). One of the essential topics introduced in the early grades, such as Grade 2, is the concept of multiplication. This foundational skill serves as a building block for more advanced mathematical topics, including algebra, geometry, measurement, and data analysis (Sofiyah et al., 2024). Therefore, introducing multiplication through age-appropriate and engaging learning strategies is crucial to ensure meaningful understanding among young learners.

The topic of multiplication operations begins to be introduced to second-grade elementary school students. According to the 2007 statement by the National Education Standards Agency (Badan Standar Nasional Pendidikan), one of the expected competencies

for students in grade 2 is the ability to perform multiplication and division of two numbers, including mastering basic competencies such as calculating two-digit multiplication results and executing two-digit division (Revina, 2017). The fundamental idea of multiplication is essentially repeated addition involving identical numbers (Natali Amelia et al., 2025). Mastery of multiplication serves as an early foundation for students to understand other mathematical domains (Anyelir et al., 2025). Beyond that, multiplication remains relevant in everyday life situations. At the primary school level, children are first introduced to conceptual understanding of multiplication (Haq et al., 2025). In this context, learning approaches that encourage student interaction and active participation are needed to help young learners build a deeper understanding of multiplication concepts.

Multiplication is one of the fundamental mathematical concepts that should be introduced early to support the learning of more advanced mathematical topics in later stages. However, in practice, many students struggle to grasp the concept of multiplication. According to Suarti et al. (Suarti et al., 2022), these difficulties are influenced by several factors, including limited numeracy skills, challenges in knowledge transfer, difficulties in language comprehension, and issues related to visual perception. In addition to difficulties in understanding mathematical concepts, students' low engagement in mathematics learning is also attributed to the limited implementation of instructional models that promote peer collaboration. In fact, mathematics learning should not focus solely on computational skills, but also aim to foster collaboration and critical thinking skills that are essential in everyday life (Fitri & Nuh, 2025). When instruction is predominantly lecture-based and individual in nature, students are deprived of opportunities to exchange ideas, engage in discussion, and learn from their peers within a group setting.

A strong understanding of multiplication is an essential foundation for young learners to succeed in higher levels of mathematics (Imara et al., 2025; Wijaya et al., 2023; Wulandani et al., 2022). However, many second-grade students at MIS Istiqomah Medan Helvetia continue to struggle with grasping basic multiplication concepts. Preliminary interviews with the homeroom and mathematics teachers revealed that most students had not yet mastered multiplication and showed low levels of engagement during lessons. The learning process tended to be individual, resulting in underdeveloped collaborative skills. Observations further indicated that students rarely participated in group discussions or cooperative activities.

To address students' difficulties in understanding multiplication concepts, an instructional strategy is required that not only strengthens conceptual comprehension but also fosters cooperative learning skills namely, the implementation of a cooperative learning model (Masykuroh & Kurnia, 2025; Rahma & Haviz, 2022; Zativalen et al., 2016). Cooperative learning is an instructional approach that facilitates active student engagement directly within the learning process (Fadillah, 2018). This approach aligns with the principles of social constructivism, which emphasize the importance of social interaction in constructing knowledge. Through peer collaboration and guided instruction from the teacher, a process of meaning negotiation occurs that enables students to overcome learning obstacles and deepen their conceptual understanding (Jardinez & Natividad, 2024; Warmansyah et al., 2023).

Collaborative learning in this context offers substantial opportunities to enhance students' engagement and participation throughout the learning process. This idea is

consistent with Vygotsky's learning theory, which posits that social interaction serves as the foundation of cognitive development (Mardiana & Suharyanto, 2024). One of the instructional models relevant to this framework is the cooperative learning model known as Numbered Heads Together (NHT).

The NHT method, introduced by Spencer Kagan in 1993, was designed to enhance student participation in exploring subject matter and to assess the extent of their understanding (Pendy & Mbagho, 2021). As described by Kagan, this model involves students working in small groups where they can engage in discussion, share ideas, and collaboratively complete tasks (Khodarasih et al., 2025; Royani et al., 2023). In light of this, the implementation of a cooperative learning model such as Numbered Heads Together is considered appropriate, as it encourages all students to actively engage in group work. This approach also enables teachers to monitor participation more comprehensively, ensuring that every student—not just the outspoken ones contributes to the learning process.

The NHT model promotes active involvement from every group member and fosters a sense of shared responsibility for the group's output. This occurs because any member may be called upon to present the group's answer. In addition to improving comprehension of academic content, NHT fosters students' collaborative abilities (S. A. Putri & Suriansyah, 2021). Siregar et al., (2024) observed that this model facilitates active discussion and idea exchange among students, ultimately strengthening collaborative competence. According to Laela et al., (2024), collaborative models such as NHT support the development of social skills, communication abilities, and a sense of shared accountability within group settings.

Collaborative learning approaches underscore the importance of student cooperation in achieving shared academic objectives. Within this process, all group members are encouraged to engage actively (Sulistyowaty et al., 2019; Warmansyah et al., 2024). Collaboration-based learning fosters critical thinking, the ability to express opinions, attentiveness to others' perspectives, and evaluative thinking. Usman et al., (2024) emphasized that active interaction within student groups is a key determinant in shaping collaborative skills. Mathematics instruction designed with such collaborative frameworks tends to enhance the quality of peer interaction and facilitates deeper conceptual understanding.

A growing body of prior research has confirmed the effectiveness of the NHT model in cultivating students' collaborative skills. Astasari (2022) found that this model increases student engagement in group discussions, promotes idea-sharing, and strengthens team dynamics, all of which contribute to the development of collaborative competencies. According to Aulia et al. (2023), collaborative approaches like NHT foster positive student dispositions, such as responsibility, mutual respect, and empathy values that are integral to effective group learning. Hasibuan (2024) asserted that the success of learning processes and student engagement in teamwork are highly influenced by the choice of instructional model, with NHT being one of the most effective.

Puspitasari et al., (2018) explained that collaborative skills are nurtured through group-based instruction, which trains students to share tasks and work together toward a common goal. Sari et al., (2024) likewise noted that group-based learning enhances communication skills an essential component of collaboration. Supiah & Lubis (2016)

highlighted that cooperative learning helps students learn to appreciate differences, which is crucial for fostering effective group interaction.

Furthermore, Zativalen et al. (2016) noted that the NHT model trains students to exchange ideas, listen actively, and collaborate, as each student is expected to take turns in presenting the group's responses. Antika et al. (2024) also found that NHT encourages students to communicate, share opinions, and assume responsibility for the group's outcomes. The model improves collaborative skills, especially in fostering active participation, mutual respect, and group accountability.

Research conducted by Fauziah & Sudibyo (2023) likewise demonstrated that the NHT learning model has a positive impact on students' collaborative skills. This model trains students to contribute actively to group tasks, articulate ideas, listen to peers, and engage in collaborative problem-solving. Based on these previous studies, the NHT model is considered appropriate for this study, as it is expected to enhance collaborative skills, particularly in mathematics instruction for second-grade students.

According to Amri (2020), the NHT model consists of four key stages: (1) Numbering, in which the teacher divides students into groups of three to five and assigns each member a number; (2) Asking Questions, where the teacher poses thought-provoking questions; (3) Group Discussion, during which students collaborate to formulate answers and ensure mutual understanding; and (4) Answering, where the teacher randomly selects a number, and the student assigned that number responds on behalf of the group.

Beyond enhancing academic learning, the NHT model also strengthens collaboration skills, such as idea-sharing, cooperative behavior, and valuing others' input (Hafza & Wandini, 2023). Developing collaborative skills from an early age is crucial, as it fosters positive social attitudes, including mutual respect, accountability, and cooperative problem-solving (Royani et al., 2023). Efendi & Maharani (2023) proposed five key indicators for assessing collaboration effectiveness: active contribution, which measures the extent of student participation in group discussions; task productivity, which assesses students' ability to complete group tasks accurately and punctually; flexibility, which refers to students' openness to peers' ideas during discussions; responsibility, which gauges their involvement in task completion; and mutual respect, which reflects their ability to value the opinions and contributions of fellow group members.

Purwati & Putri (2024) observed that the implementation of collaborative learning can positively affect student motivation and classroom participation. Through collaboration, students learn from their peers, creating a more enjoyable and dynamic learning atmosphere. This aligns with the findings of Diah & Siregar (2023), who reported that many students struggle with mathematics due to its perceived difficulty and lack of engagement. Consequently, the application of the cooperative learning model NHT is expected to offer an effective solution for improving both students' collaborative skills and their conceptual understanding of basic multiplication.

Based on the studies reviewed, the NHT model has consistently proven effective in enhancing students' collaborative abilities. Accordingly, this model was selected by the researchers to investigate its impact on the collaborative skills of second-grade students in learning basic multiplication. The aim of this study is to further examine how the

implementation of the cooperative learning model NHT influences the development of collaboration skills among second-grade elementary students. The findings are expected to contribute significantly to the development of more effective and engaging mathematics instruction strategies at the elementary level.

RESEARCH METHODOLOGY

Research Approach and Design

This study employed a quantitative approach to examine the effect of the cooperative learning model *Numbered Heads Together* (NHT) on the collaborative skills of second-grade students in mathematics, particularly in learning basic multiplication. The research design used was a quasi-experimental design with the posttest-only control group design type. This design involves two groups—an experimental group receiving the treatment (NHT model) and a control group receiving conventional instruction. This design was chosen because the group assignment was not randomized, yet it still allows for the measurement of treatment effects through posttest comparisons.

Population and Sample

The population in this study consisted of all second-grade students at MIS Istiqomah Medan Helvetia, totaling 30 students. Due to the relatively small and accessible population size, the total sampling technique was used, meaning that the entire population was included as the sample. The students were then divided into an experimental group and a control group.

Research Variables

This study included two main variables. The independent variable was the learning model (NHT vs. conventional), and the dependent variable was the students' collaborative skills, measured after the learning activities concluded.

Research Design Structure

The structure of the experimental design is presented in Table 1 below:

Table 1. Posttest-Only Control Group Research Design

Group	Treatment	Measurement
Experimental Group	Learning with NHT model	Posttest: Questionnaire & Observation
Control Group	Conventional instruction	Posttest: Questionnaire & Observation

Research Instruments

Two instruments were used in this study: a collaboration skills questionnaire and an observation sheet. The questionnaire, completed by students after the learning session, was developed based on five key indicators of collaboration outlined by Efendi & Maharani (2023), namely: active contribution, work productivity, flexibility, responsibility, and mutual respect. The questionnaire used a five-point Likert scale and consisted of 20 statement items. The collaborative skills questionnaire used in this study was tested for both validity and reliability. Item validity was assessed using Pearson Product Moment correlation with 30

respondents, and all items showed correlation values above the critical r value (0.361) with a significance level below 0.05, indicating that all items were valid. The instrument's reliability was evaluated using Cronbach's Alpha, yielding a coefficient of 0.976, which indicates a very high level of reliability.

Data Analysis Techniques

The collected data were analyzed using descriptive and inferential statistical techniques. Descriptive analysis was used to calculate the mean, standard deviation, and data distribution for each group. Inferential analysis was conducted using an independent sample t-test to determine whether there were significant differences in collaborative skills between the experimental and control groups.

Prior to conducting the t-test, assumption testing was carried out. Normality testing was conducted using the Kolmogorov–Smirnov test, and homogeneity testing was performed using Levene's test. All data analyses were carried out using the latest version of SPSS.

Research Hypotheses

The research hypotheses were formulated as follows: 1) Null Hypothesis (H_0): There is no significant difference in collaborative skills between students taught using the NHT model and those taught using conventional instruction; 2) Alternative Hypothesis (H_1): There is a significant difference in collaborative skills between students taught using the NHT model and those taught using conventional instruction.

Research Ethics

This study was conducted with official permission from the head of MIS Istiqomah and with the consent of the students' parents. Participation was voluntary, and the confidentiality of all data collected was ensured. Learning activities followed the regular school schedule and did not interfere with the standard curriculum.

RESULTS AND DISCUSSION

The results of data analysis revealed that the experimental group achieved a mean collaborative skill score of 72.53 with a standard deviation of 3.36. In contrast, the control group obtained a significantly lower mean score of 39.07 with a standard deviation of 7.27. The substantial difference between these two means indicates a strong tendency for the *Numbered Heads Together* (NHT) model to be associated with improved collaborative skills among students.

Table 1. Collaborative Skills Questionnaire Scores

Group	Number of Students	Total Score	Mean Score	Standard Deviation
Experimental	15	1,088	72.53	3.36
Control	15	586	39.07	7.27

The results of the independent samples t-test indicated a t-value of 16.196 with degrees of freedom (df) = 19.716 and a significance level (Sig. 2-tailed) of 0.000. Since the significance value is less than 0.05, it can be concluded that there is a statistically significant

difference in collaborative skills between the experimental and control groups. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. This finding implies that the implementation of the cooperative learning model NHT has a significant effect on students' collaborative skills in mathematics learning, particularly in basic multiplication material.

These findings support Vygotsky's socio-constructivist theory, which posits that cognitive development is influenced by social interaction, especially when learners engage with more capable peers within their Zone of Proximal Development (ZPD). In the NHT model, students are guided by both the teacher and their peers to co-construct understanding, making the learning process more meaningful and dynamic (Vygotsky, 1978). Mardiana & Suharyanto (2024) emphasize that cooperative learning environments provide space for deep interaction and foster active student participation, which are essential for meaningful learning.

The structure of NHT encourages every group member to engage actively in the learning process and to take responsibility for the group's collective output. During the implementation of the research, students became aware that they could be randomly selected to represent their group in answering questions, which contributed to increased focus and active engagement. This aligns with Kagan's theory, as cited in Pendy & Mbagho (2021), which highlights that NHT fosters a collaborative and interactive classroom climate through structured phases: numbering, questioning, group discussion, and individual response.

The observed collaborative skills were based on five indicators, namely: active contribution, task productivity, flexibility, responsibility, and mutual respect (Efendi & Maharani, 2023). Observational data showed that these five indicators were more evident in the experimental group compared to the control group. Students in the experimental class demonstrated cooperative behavior in problem-solving, distributed tasks equitably, and showed genuine concern for their team's success. Conversely, students in the control group tended to work individually with limited peer interaction.

This finding is consistent with prior research by Fauziah & Sudibyo (2023), who stated that the NHT model improves students' ability to express opinions, listen to others, and complete tasks collaboratively. Laela et al., (2024)also highlighted that collaborative approaches foster students' social responsibility and empathy. Additionally, Hasibuan (2024) stressed that the success of group learning largely depends on the instructional model applied, and NHT has been proven to support teamwork effectively. Putri et al. (2024) further asserted that collaborative learning enables students to develop social skills from an early age, including appreciation for diversity and positive communication.

Moreover, Siregar et al. (2024) pointed out that NHT facilitates active discussion and idea exchange among students, which are core components of collaborative competence. Antika et al. (2024) found that the model strengthens students' sense of accountability and encourages them to engage respectfully and constructively within groups. Zativalen et al. (2016) emphasized that by ensuring every student participates in reporting group outcomes, NHT reinforces both individual and collective responsibility. This study also affirms the view of Supiah & Lubis (2016), who explained that cooperative learning helps students learn to respect differences, which is vital in establishing effective group interaction. The

implementation of NHT in the current study created such a collaborative culture, enabling students to not only engage academically but also to grow socially.

The findings underline that structured and socially grounded learning strategies do more than enhance academic achievement they also nurture character development, particularly in terms of collaboration. Mathematics learning designed through a cooperative lens such as NHT serves as an effective platform for developing group problem-solving skills, fostering collective responsibility, and encouraging mutual accountability.

CONCLUSION

The findings of this study indicate that the cooperative learning model Numbered Heads Together (NHT) has a significant effect on the collaborative skills of second-grade students in learning basic multiplication at MIS Istiqomah. The difference in collaborative skill scores between the experimental and control groups, as confirmed by the t-test results with a significance value of 0.000, demonstrates that the NHT model contributes positively to the development of teamwork skills among elementary school students. Students who participated in learning through the NHT model showed active engagement in group discussions, increased responsibility, and the ability to respect and cooperate with their peers in completing tasks collectively. The implementation of this model not only supports conceptual understanding of multiplication but also offers meaningful learning experiences that foster collaborative character from an early age. Therefore, the Numbered Heads Together model may be considered an effective alternative cooperative learning strategy to enhance students' social skills at the primary education level.

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