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THE EFFECT OF NUMBERED HEADS TOGETHER (NHT) AND PROBLEM CARDS ON 10TH-GRADE STUDENTS' COLLABORATION AND COMMUNICATION SKILLS

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Abstract
This study aimed to determine the effect of the Numbered Heads Together (NHT)-type cooperative learning model assisted by Problem Card media on the collaboration and communication skills of class X students of SMA Negeri 10 Semarang. The type of research used is a quasi-experimental with a Posttest-Only Control Group Design. The research sample consisted of students in classes X-9 (control class) and X-10 (experimental class), each totaling 35 students. Data were collected using an observation sheet and a questionnaire. Data analysis used the Independent Sample t-Test. The results obtained were an Asymp. Sig. (2-tailed) value on the observation sheets and questionnaires of 0.000 < 0.05. Therefore, Ha is accepted, which indicates that the NHT type cooperative learning model assisted by Problem Card media has an effect on the collaboration and communication skills of class X students in biology learning at SMA Negeri 10 Semarang. Further researchers can examine the comparative effectiveness of the NHT learning model assisted by problem cards with other cooperative models on students' collaboration and communication skills in other materials or lessons.

Keywords: collaboration skills, communication skills, numbered heads together (NHT), problem cards.

Introduction

Collaboration and communication skills are two of the four key competencies of the 21st century, known as the 4Cs, namely communication, collaboration, critical thinking, and creative thinking. Collaboration and communication skills are basic skills that every individual must possess in order to more easily adapt to future global competition (Dhitasarifa et al., 2023).

Collaborative skills refer to the ability of individuals to work together effectively to achieve desired goals. Collaborative skills play an important role in improving learning effectiveness. Students will find it easy to share knowledge and experiences, support each other, and solve problems wisely if they have good collaborative skills (Thahir et al., 2024). Afelia et al. (2023) revealed that 10th-grade students at SMAN 1 Bangorejo had low collaboration skills in biology learning. This was evident during ineffective group discussions, where only one out of five groups was able to divide tasks and discuss well. Meanwhile, other groups showed less collaborative work patterns, with two groups being worked on by one

individual, one group working independently, and another group exceeding the specified time limit. Collaboration skills can be effective if communication between students is also clear and open. This makes communication skills important for students to have in the learning process.

Good communication skills enable a person to convey ideas clearly, interact effectively, and form strong relationships (Miranda & Wahyudin, 2023). Hamia (2021) revealed that effective communication skills are important for student learning success because they make it easier for them to communicate various material issues, both verbally and in writing. Nashiruddin et al. (2024) stated that PAI learning in class XII at SMA N 5 Padang did not facilitate students' communication skills. This was evident from the lack of active participation of students in asking and responding to questions, resulting in passive learning and low curiosity among students. Tauzirie and Nurhadi (2025) also revealed that the communication skills possessed by 10th-grade students at Darussalam Wanaraja High School were ineffective due to a lack of experience speaking in public and a fear of receiving unpleasant feedback from others.

This condition was also identified in 10th-grade students at SMA Negeri 10 Semarang in biology lessons. Based on the results of preliminary research conducted by the researcher, it was found that students did not contribute much to group assignments, as they were busy with their own activities, paid little attention when the teacher was explaining, and had poor time management, so that assignments were often not completed on time. During discussions, students tended to remain silent, rarely expressed their opinions, and some groups were late in submitting or had difficulty presenting their assignments. In addition, the lack of focus among students resulted in a lack of questions or responses to the teacher, making the learning process less interactive. Therefore, students need to be trained to optimize their collaboration and communication skills.

Collaboration and communication skills can be optimized through a learning model approach that not only makes it easier for students to understand the material but also encourages cooperation and effective interaction. One learning model that can train students' collaboration and communication skills is the cooperative learning model. The cooperative learning model emphasizes cooperation and active student participation. Kurniasih (2023) explains that cooperative learning is a way for students to work together in small groups and support each other during the learning process. One effective cooperative learning model that fosters cooperation and active student participation is Numbered Heads Together (NHT).

The NHT cooperative model is a learning method that involves grouping students to solve problems and assigning different identification numbers to each group member, who are then randomly selected to present the results of their discussion in front of the class (Asmoro et al., 2023). This model can help students develop their communication skills in sharing information, speaking in a structured manner, and listening carefully, thereby increasing their learning effectiveness (Karmila & Mawardi, 2020). The NHT model is also capable of supporting students' collaboration skills by increasing their engagement when answering questions, interactions between students, accountability, and individual responsibility within the group.

The learning model will be successful if combined with learning media to increase student motivation and learning interaction (Situngkir et al., 2023).

Learning media is essentially a means of conveying information from the communicator (teacher) to the communicant (student). Its main function is to create an environment that enables students to understand knowledge accurately and deeply, improve their thinking skills, and shape their attitudes and personalities (Saleh et al., 2023). One type of media that is effective in assisting the learning process is problem cards.

Problem cards are a type of visual media that contain problems to encourage students to actively speak and become interested in the topic of the material (Tohari, 2021). Himmawati (2022) revealed that this media not only presents problems related to lessons but also effectively trains students' communication skills through active discussion. Problem cards are used as additional activities and group assignments that must be completed and presented with solutions (Dewi et al., 2020). Research by Ahtina et al. (2024) shows that card-based learning media using the STEM approach is effective for training students' collaboration skills. Alfira and Izzah (2024) stated that the use of problem cards can significantly develop students' communication skills in the context of science learning, marked by an increase in the ability to construct arguments, present information, and respond to questions with more confidence and clarity.

Research by Nurjannah and Djumadi (2023) shows that the application of the NHT learning model combined with question cards is considered capable of stimulating student activity, creating a pleasant learning atmosphere, and triggering competitive spirit among groups to solve problems. Nourhasanah and Aslam (2022) further explain that the application of the NHT model specifically encourages students to be active, creative, and able to explore their understanding. This model not only affects learning outcomes but also increases interaction among peers in discussions, thereby directly training and developing students' collaboration and communication skills.

Based on this description, the purpose of this study is to analyze the effect of the NHT cooperative learning model assisted by problem cards on the collaboration skills of 10th-grade students at SMA Negeri 10 Semarang. The results of this study are expected to provide an overview of the effect of implementing the NHT cooperative learning model supported by problem cards in optimizing students' collaboration and communication skills.

Method

This study used a quantitative approach, with a quasi-experimental design and a posttest-only control group design. The research design is presented in the following table.

Table 1. Research Design

Class		Treatment
Experimental	X1	O1, O2
Control	X2	O1, O2

Data collection for this study was conducted at SMA Negeri 10 Semarang in the even semester of the 2024/2025 academic year. The population in this study consisted of all 10th-grade students, comprising 10 classes with a total of 355 students. Sampling was conducted using non-probability sampling with purposive

sampling. The control and experimental classes were determined based on the results of the ANOVA test on the students' Final Semester Assessment (PAS) scores to ensure the similarity of academic abilities and initial skills between the two classes. The sample used as the control class was X-9, which applied the discovery learning model, and the experimental class was X-10, which applied the NHT model assisted by problem cards. The considerations of the 10th grade Biology teacher were also taken into account in determining the sample.

The instruments used to measure students' collaboration and communication skills are non-test instruments, including observation sheets and questionnaires. The content validity of the observation sheets and questionnaires was tested by experts and found to be valid and suitable for use in research. The research data were then analyzed using the Independent Sample t-Test (IBM SPSS 24, $\alpha = 0.05$), after ensuring that the data were normally distributed and had a homogeneous variance.

Findings and Discussion

Findings

The data from the descriptive statistical analysis of the collaboration and communication skills of students in the control and experimental classes based on observation sheets and questionnaires are presented in Table 2.

Table 2. Descriptive Statistical Results of Collaboration Skills Based on Observation Sheets and Questionnaires

Data Source	Class	N	Minimum	Maximum	Mean	Std. Deviation
Observation	Control	35	36	95	66,51	13,373
	Experiment	35	57	98	83,51	9,373
Questionnaire	Control	35	56	84	70,00	6,691
	Experiment	35	65	97	81,20	7,776

Table 2 shows that the results of observations and questionnaires in the experimental class had a higher average score than the control class in terms of collaboration skills.

Table 3. Descriptive Statistics Results for Communication Skills Based on Observation Sheets and Questionnaires

Data Source	Class	N	Minimum	Maximum	Mean	Std. Deviation
Observation	Control	35	27	96	67,20	14,142
	Experiment	35	50	100	82,29	10,191
Questionnaire	Control	35	51	80	64,51	6,409
	Experiment	35	62	84	71,20	5,263

Table 3 shows that the results of observations and questionnaires on communication skills in the experimental class had a higher average score than the control class. After obtaining these data, the analysis then continued with prerequisite tests consisting of normality tests, homogeneity tests, and independent

sample t-tests. The data from the normality tests of students' collaboration and communication skills are presented in Tables 4 and 5.

Inferential Statistical Analysis

Normality Test

Normality tests are conducted to determine whether the distribution of the data obtained is normal or not (Khudriyah, 2021). Data normality was tested using Kolmogorov Smirnov through IBM SPSS version 24 application. The condition is that if the Sig. value is > 0.05, it can be interpreted that the data is normally distributed, while if the Sig. value is < 0.05, the data is not normally distributed. The results of the normality test are presented in Table 4.

Table 4. Results Of Normality Test for Observation Sheets on Collaboration and Communication Skills

	Kolmogorov-Smirnov	
	Class	Sig.
Collaboration Skills	Kontrol	.074
	Eksperimen	.200
Communication Skills	Kontrol	.115
	Eksperimen	.139

Table 4 shows the results of the normality test of the observation sheets for collaboration and communication skills in the control and experimental classes, which overall have a Sig. value > α = 0.05, so the data is said to be normally distributed.

Table 5. Normality Test Results for The Collaboration and Communication Skills Questionnaire

	Kolmogorov-Smirnov	
	Class	Sig.
Collaboration Skills	Kontrol	.130
	Eksperimen	.200
Communication Skills	Kontrol	.200
	Eksperimen	.155

Table 5 shows the results of the normality test of the questionnaire sheets for collaboration and communication skills in the control and experimental classes. The overall significance value of the data obtained is greater than α = 0.05, indicating that the data is normally distributed. Thus, it can be continued with the homogeneity test as presented in Tables 6 and 7.

Homogeneity Test

The homogeneity test was conducted to determine whether the data variance of each group was the same or not. This calculation used the One-Way Anova test with the help of IBM SPSS version 24. Decisions with a Sig. value > 0.05 were declared homogeneous, and those with a Sig. value < 0.05 were declared non-homogeneous.

Table 6. Results of the Homogeneity Test for the Collaboration and Communication Skills Observation Sheet

	Test of Homogeneity of Variances			
	Levene Statistic	df1	df2	Sig.
Collaboration Skills	2.023	1	68	.159
Communication Skills	2.169	1	68	.145

Table 6 presents the results of Levene's homogeneity test on the observation sheet, which shows that the significance value for each skill is greater than 0.05. This indicates that the variance between learning models for both skills is homogeneous.

Table 7. Results of the Homogeneity Test for the Collaboration and Communication Skills Questionnaire Sheet

	Test of Homogeneity of Variances			
	Levene Statistic	df1	df2	Sig.
Collaboration Skills	.647	1	68	.424
Communication Skills	1.234	1	68	.270

Table 7 presents the results of Levene's homogeneity test on the questionnaire, which shows that the significance value for each skill is greater than 0.05. This indicates that the variance between learning models for both skills is homogeneous. If the data meet the assumptions of normality and homogeneity, the analysis will continue with the Independent Samples t-Test presented in Tables 8 and 9.

Independent Sample t-Test

Table 8. Results of Independent Sample t-Test Analysis of Collaboration and Communication Skills Observation Sheet

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Collaboration Skills	Equal variances assumed	2.023	.159	-6.159	68	.000	-17.000
	Equal variances not assumed			-6.159	60.908	.000	-17.000
Communication Skills	Equal variances assumed	2.169	.145	-5.120	68	.000	-15.086
	Equal variances not assumed			-5.120	61.813	.000	-15.086

Table 8 shows the results of the Independent Sample T-Test based on the observation sheet, in the Equal variances assumed row, obtaining a Sig. (2-tailed) value of 0.000. The significance value of 0.000 < 0.05, so H0 is rejected, and Ha is accepted. This shows that there is an effect of the NHT learning model assisted by problem cards on the collaboration and communication skills of grade X students at SMA Negeri 10 Semarang.

Table 9. Results of Independent Sample t-Test Analysis of Collaboration and Communication Skills Questionnaire

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Collaboration Skills	Equal variances assumed	.647	.424	-6.459	68	.000	-11.200
	Equal variances not assumed			-6.459	66.520	.000	-11.200
Communication Skills	Equal variances assumed	1.234	.270	-4.769	68	.000	-6.686
	Equal variances not assumed			-4.769	65.518	.000	-6.686

Table 9 shows the results of the Independent Sample T-Test based on the questionnaire, in the Equal variances assumed row, obtained a Sig. (2-tailed) value of 0.000. The significance value of 0.000 < 0.05, so H0 is rejected, and Ha is accepted. This shows that there is an effect of the NHT learning model assisted by problem cards on the collaboration and communication skills of grade X students at SMA Negeri 10 Semarang.

The results of observations of each indicator of collaboration and communication skills in the control and experimental classes are presented in Tables 10 and 11 below.

Table 10. Results of Observations of Collaboration Skill Indicators in the Control and Experimental Classes

Collaboration Skills Indicators	Average Score	
	Control Class	Experimental Class
Contribute actively	59,5	75,4
Work productively	52,1	85
Be responsible	69,3	88,6

Show flexibility and compromise	62,9	78,2
Respecting Others	74,3	88,6

Based on the results of the observation sheet analysis in Table 10, it shows that each indicator of collaboration skills in the experimental class obtained a higher average score than the control class.

Table 11. Observation Results of Communication Skills Indicators in the Control and Experimental Classes

Communication Skills Indicators	Average Score	
	Control Class	Experimental Class
Openness	67,1	81
Empathy	62,5	84,6
Supportive behavior	54,3	75,4
Positive behavior	71	85,5
Similarity	75,5	83,1

Based on the results of the observation sheet analysis in Table 11, it shows that each communication skill indicator in the experimental class obtained a higher average score than the control class.

Discussion

The results of this study indicate that the NHT cooperative learning model assisted by problem cards affects students' collaboration and communication skills. This is based on hypothesis analysis using the Independent Sample t-Test, which obtained a Sig. (2-tailed) value of 0.000 ($\alpha < 0.05$) for both skills, thus accepting the alternative hypothesis (Ha). Therefore, it can be concluded that there is a difference in students' collaboration and communication skills between the experimental class (using the NHT model assisted by problem card media) and the control class (using the discovery learning model).

The NHT learning model is a learning model that emphasizes student activity and trains them to interact with their peers and teachers (Iskandar & Leonard, 2019; Kusnadi & Kusumawati, 2020) This learning model can train students to be responsible, communicate effectively, and collaborate in problem solving (Manafe et al., 2022). The NHT learning model applied in this study was combined with problem cards, which were useful as tools to help students learn to collaborate, argue, and convey ideas. The problem cards were used as discussion material to focus students' attention on the material. This encouraged them to be more active in discussions and increased their interest in learning about the topics discussed.

The collaboration and communication skills of students in the experimental class using the NHT learning model, assisted by problem cards, obtained higher average scores than the control class. Based on the results of observations and questionnaires in the experimental class, both obtained higher average scores than the control class, as shown in Tables 2 and 3. This shows that the NHT learning model supported by problem cards can further optimize students' collaboration and communication skills. This is in line with the research by Tharihk et al. (2025), which explains that the NHT type of cooperative learning model is able to optimize

the collaboration skills of 10th-grade high school students. Nashiruddin et al. (2024) also stated that the NHT type of cooperative learning model is able to optimize the learning outcomes of Islamic Education and the communication skills of 12th-grade high school students.

The collaboration skill indicators analyzed based on the observation results in Table 10 show that the experimental class with the NHT learning model assisted by problem cards has good and very good categories. The collaboration skill indicators in the experimental class that are classified as very good are being responsible and respecting others, each with an average score of 88.6. Another indicator that is also classified as very good is working productively, with an average score of 85. The indicators of contributing actively and showing flexibility and compromise are classified as good, with average scores of 75.4 and 78.2, respectively.

The communication skills indicator, analyzed based on the observation results in Table 11, also shows that the experimental class with the NHT learning model assisted by problem cards has a good and excellent category. The communication skill indicators in the experimental class that were classified as excellent were openness with an average score of 81, empathy 84.6, positive behavior 85.5, and similarity 83.1. The indicators classified as good were supportive behavior with an average score of 75.4.

The results of field observations are consistent with these findings, namely that students are very good at exchanging opinions and accepting feedback during group discussions, reflecting indicators of openness and positive behavior. However, weaknesses are indicated by the lack of assistance from students in clarifying information conveyed by their peers, which is an indicator of supportive behavior. This condition may be influenced by various factors, such as a lack of insight, an inability to ask questions, shyness or fear of speaking, and a lack of time for discussion.

In line with the research by Anggraini and Nuraeni (2023), low student participation in expressing opinions during learning is caused by students' lack of courage to speak in public, distrust in the ideas they want to convey, and fear of negative responses from friends, such as being ignored or ridiculed. Anggraini and Nora (2024) also analyzed this phenomenon based on Vygotsky's theory, which indicates that the lack of student participation is caused by a lack of interaction and social support needed to bring them out of their comfort zone. However, the media-assisted NHT learning model using problem cards has been proven effective in optimizing students' communication skills, supported by the syntax in the model. The following is the NHT syntax that effectively optimizes students' collaboration and communication skills (Tharihk et al., 2025):

1. Numbering and questioning stages: Students are given numbers and equal opportunities to convey their discussion findings and perspectives on an issue. The numbering stage requires students to work productively according to the specified portions so that the collaborative discussion results are maximized (Yusup, 2021). In the questioning stage, students are encouraged to express their opinions based on their understanding through problem cards provided by the teacher.
2. In the head together stage, students discuss in groups to work on the problem cards given. This stage requires them to exchange ideas, give advice, and

decide on the right solution. This stage can optimize collaboration skills, particularly in terms of active contribution, flexibility, and compromise. This stage also optimizes students' communication skills, particularly in terms of openness, empathy, similarity, and positive behavior in expressing thoughts and understanding other perspectives.

3. Answering stage, students are randomly selected based on their ID numbers to present the results of their group discussions in front of the class (Khumaidah et al., 2023). This stage optimizes collaboration skills in terms of respecting others and being responsible. It also honors students' courage to speak in public, convey ideas clearly and structurally, and respond to questions. This stage trains students to be supportive of one another and to help clarify each other's answers.

The syntax of the NHT learning model effectively optimizes students' collaboration and communication skills through structured stages. The Numbering and Questioning stages ensure equal participation and responsibility, while encouraging students to express their perspectives. Furthermore, the Head Together stage encourages intensive discussion that instills active contribution, flexibility, compromise, openness, and empathy through the exchange of ideas and decision-making on appropriate solutions. The final Answering stage, with random calling, reinforces individual responsibility, hones the courage to speak, and trains students to convey ideas clearly and behave supportively in front of the class.

The use of problem cards in the NHT model also greatly supports the success of the research because it not only provides visual stimuli and relevant problems but also effectively facilitates the distribution of tasks and responsibilities among group members, so that each student can fully participate in the learning process (Yusriah, 2024). This media motivates students when faced with real-life problems, triggers focused discussions, and trains them to convey ideas in a structured manner. Thus, problem cards encourage more communicative and varied interactions, which is supported by the findings of Alfira and Izzah (2024) that this medium improves students' communication skills in constructing arguments and responding to questions, while also increasing student participation and engagement in discussions.

The discovery learning model implemented in the control class also encouraged group work to discover concepts, but its internal mechanism was not like NHT, which had to ensure that each group member contributed or understood equally. Collaboration may have occurred, but participation may not have been evenly distributed among members. The main focus of discovery learning was on the process of discovering concepts independently or in groups. Collaborative discussions may occur, but they are more about searching for information or experimenting, rather than building a deep shared understanding or agreeing on solutions as in the NHT model. This is consistent with the findings of Mukaramah et al. (2020), which explain that the discovery learning model is more efficient in developing conceptual understanding, but is less adequate in optimizing skills and emotions holistically.

Conclusion

The conclusion drawn from the findings and discussion is that there is an effect of the NHT cooperative learning model assisted by problem cards on

students' collaboration and communication skills in 10th-grade biology lessons at SMA Negeri 10 Semarang. This is evidenced by the results of the analysis of observation sheets and questionnaires on collaboration and communication skills, both of which show a Sig. (2-tailed) value of 0.000 < 0.05. The syntax of the NHT learning model supports students' collaboration skills through the stages of numbering, questioning, and head together, while students' communication skills are supported by the stages of head together and answering.

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