

APPLICATION OF THE NUMBERED HEADS TOGETHER LEARNING MODEL WITH VIRTUAL LABORATORY SUPPORT ON WRITTEN COMMUNICATION

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ABSTRACT

Science education is now adapting to 21st-century skills. One rarely implemented stage is the ability of students to communicate in writing because the lack of attention given by teachers. This study addresses the issue of how the implementation, whether there are differences, and the improvement of cooperative learning model type NHT assisted by virtual laboratories affect written communication on the topic of simple machines for eighth-grade junior high school students. This research aimed to investigate the implementation of the NHT learning model supported by virtual laboratory tools in improving written communication skills. The research method used is descriptive quantitative research, employing a quasi-experimental design, specifically the matching only posttest group design. The study was conducted at Class VIII of State Junior High School 5 Tandun. The sample consists of two eighth-grade classes: Class VIII-1 with 23 students as the experimental group and Class VIII-2 with 23 students as the control group. The results of the study revealed that the overall average score for all aspects in the NHT class with virtual laboratory support was 88%, indicating a "very good" performance category. On the other hand, the average score for all aspects in the scientific class was 82%, falling into the "good" category. The t-test results indicated a significance value (2-tailed) of 0.037, indicating a significant difference in the written communication abilities of students between the class using the NHT learning model with virtual laboratory support and the scientific class, specifically in the context of simple machines.

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1. INTRODUCTION

The era of globalization has prompted the Indonesian nation to adapt to the changing times. If Indonesia fails to keep up with the advancements in science and technology, it will be left behind by the rapid progress. Education in Indonesia is synergistic in the current era of globalization. Education must be able to answer the interests and needs of society in living life now and in the future (Septikasari & Frasandy, 2018; Sunardi, 2019). Indonesia recognizes the external challenge posed by globalization in the field of education. Indonesia's participation in TIMSS and PISA studies has revealed that the academic achievements of Indonesian students are unsatisfactory. This is primarily due to the fact that many test materials used in TIMSS and PISA are not included in the Indonesian curriculum (*Lampiran Permendikbud No. 35, 2018*).

Lampiran Permendikbud No. 35, 2018 states that the improvement of mindset includes: strengthening learner-centered instructional approaches, interactive learning methods, self-directed and group learning (team-based), and enhancing multimedia-based learning. Through the implementation of these mindset improvements, it is expected that schools in Indonesia can effectively adopt the 2013 curriculum. One of the subject areas in the 2013 curriculum for junior high schools (SMP/MTs) is Natural Sciences. Natural Sciences is a structured effort to create, combine, and integrate knowledge about observable natural phenomena surrounding the learners. In the teaching and learning process of Natural Sciences, a scientific approach is employed through scientific activities such as observation, questioning, data collection, association, and communication (Widodo et al., 2013).

Science education in the era of globalization now adapts to the 21st-century skills, known as the 4C's: 1) Creativity and innovation, 2) Critical thinking and problem solving, 3) Communication, and 4) Collaboration. 21st-century learning has the following principles: learner-centeredness, effective communication and collaboration, contextual learning, and integration with the surrounding environment. One characteristic of 21st-century learning is the ability to communicate. Students are expected to communicate effectively, both in writing and verbally. They are given time to interact, express ideas, and solve everyday problems they encounter (Imanulloh, 2021).

The implementation of science education using the 2013 curriculum, which includes observing, questioning, experimenting, reasoning, and communicating, has not been fully effective. One aspect that is often overlooked is the communication part, especially when it comes to students' writing skills. The main reason for this is that teachers don't pay enough attention to improving students' writing abilities. They may not be used to giving writing assignments or have limited time to assess students' writing skills. However, it is important to include written communication in teaching because it helps students understand abstract concepts better. If this issue is ignored, the learning process will suffer, and students' writing skills will not improve (Yusefni & Sriyati, 2016).

To improve students' written communication skills, cooperative learning can be implemented. One type of cooperative learning is the Numbered Heads Together method. According to Firdaus (2016), the Numbered Heads Together cooperative learning model involves assigning a number to each student, then the teacher asks a question for the students to think about together in their groups. The teacher then calls out a specific number, and the student with that number answers the question for the whole class. The Numbered Heads Together model, students are responsible for completing a task assigned by the teacher, which corresponds to their assigned number. Students must be able to understand and solve all the given questions. Although, at times, they may be asked to work on questions assigned to other numbers (Trianto, 2007). Previous research has emphasized the NHT learning model on mathematical or scientific communication skills. My research emphasizes the NHT learning model on written communication skills.

Efforts are needed to create enjoyable learning, one of which is by using the Numbered Heads Together model, which is a cooperative learning model that involves grouping in the learning process. The Numbered Heads Together learning model involves assigning numbers to group members, making it similar to a game that suits the characteristics of early adolescent learners. The NHT learning model can be combined with practical activities. Practical activities are often carried out in science lessons. The implementation of science learning to facilitate

understanding of learning materials requires a supporting facility in the form of a laboratory. If a physical laboratory is not available, practical activities can be carried out with the assistance of a virtual laboratory application. The virtual laboratory can run simulations operated through Android devices in the form of interactive software that enables practical activities to be conducted as if in a real laboratory at school (Latief, 2020).

Most students already have an Android device. The virtual laboratory application can be installed on each student's Android device. The virtual laboratory used is V-Lab, developed by the Ministry of Education and Culture, which can be downloaded through the students' Android devices, allowing access anytime and anywhere. The virtual laboratory application to be used is the Simple Machinery Virtual Application. In addition to being used for virtual experiments on simple machinery, this application also provides simple illustrations and summaries of various types of simple machineries, which help students in better understanding the learning materials.

This research aims to investigate the implementation of the Numbered Heads Together learning model with the assistance of a virtual laboratory on written communication skills regarding the topic of simple machinery among 8th-grade junior high school students. This study encourages students to participate in cooperative learning using the NHT method with the support of virtual laboratories to facilitate the training of written communication skills and understanding of the material in learning. Students can be more motivated to participate in learning activities, thus achieving the learning objectives.

2. METHOD

The method used in this research is a quasi-experimental design. According to Rusdi (2020), a quasi-experimental design is a research design in which treatments are not randomly assigned to participants (non-random assignment). Participants between groups can be matched for potential dominant variables that may influence the cause-effect relationship between the treatment variable and the outcome variable. This study uses The Matching-Only Design, which involves matching participants between groups on specific variables. The model used is a posttest only control group design with matching.

Table 1. *The Matching Only Posttest Only Control Group Design*

Treatment Group	<i>Matching</i>	X	O
Control Group	<i>Matching</i>	C	O

Source: Rusdi (2020)

Note:

- X represents the The Classes of NHT Learning Model Aided by Virtual Laboratories.
- C represents the The Classes of Saintific.
- O represents the Posttest measurement.

The implementation of the Numbered Head Together Learning model was conducted in the 8th-grade classes of SMP Negeri 5 Tandun during the first semester of the 2022/2023 academic year. The research was conducted from September to November 2022. The sample consisted of two classes, namely Class VIII-1 with 23 students as the experimental group, and Class VIII-2 with 23 students as the control group.

Researcher develop the instrument used to measure written communication skills refers to previous research. The instrument used to measure written communication skills was adapted from the studies conducted by Ningrum (2017) and Alfatihah (2022), and it consisted of indicators of written communication abilities.

Table 2. Aspects of Written Communication Skills

Aspect	Indicator
Modifying the Data Presentation Format:	Changing the data presentation format into a table
Accuracy in the use of notation, vocabulary, graphic sketches, tables, or images.	Using graphs, diagrams, models, with appropriate labels and suitable scales
Appropriateness of the writing steps in solving the problem.	Explaining the events or experimental results according to the problem being solved.
Making conclusions	Summarizing the presented experiment results or phenomena

Source: Adaptation Ningrum (2017) dan Alfatihah (2022)

The criteria for scoring the accuracy of written communication skills can be seen in Table 3.

Table 3. Criteria for Scoring the Accuracy of Written Communication Skills

Score	Criteria	Scoring Scale
4	- Able to provide 4 correct answers according to the rubric	
3	- Able to provide 3 correct answers according to the rubric	
2	- Able to provide 2 correct answers according to the rubric	
1	- Able to provide 1 correct answer according to the rubric	

The technique for quantitative analysis of written communication can utilize percentage analysis using the formula:

$$P = \frac{F}{N} \times 100\% \quad (1)$$

Source: Arikunto (2010)

Where:

P = percentage score of written communication

F = frequency of appearing written communication indicators

N = maximum score count

The inferential analysis of students' written communication skills is conducted using the independent sample t-test in SPSS 26. This test is performed to determine the difference in mean written communication skills between the experimental and control groups of students (Nuryadi et al., 2017).

The research hypothesis is stated as follows:

H_{0A} : $\mu_1 = \mu_2$; (there is no significant difference in written communication skills between the experimental and control groups).

H_{1A} : $\mu_1 \neq \mu_2$; (there is a significant difference in written communication skills between the experimental and control groups).

Testing criteria:

If the p-value (significance) > 0.05 , H_0 is accepted and H_a is rejected.

If the p-value (significance) < 0.05 , H_0 is rejected and H_a is accepted

3. RESULTS AND DISCUSSION

After conducting the learning process in both classes, a post-test was conducted during the final session to measure the written communication skills. The percentage results of the written communication test can be observed in the following Figure 1.

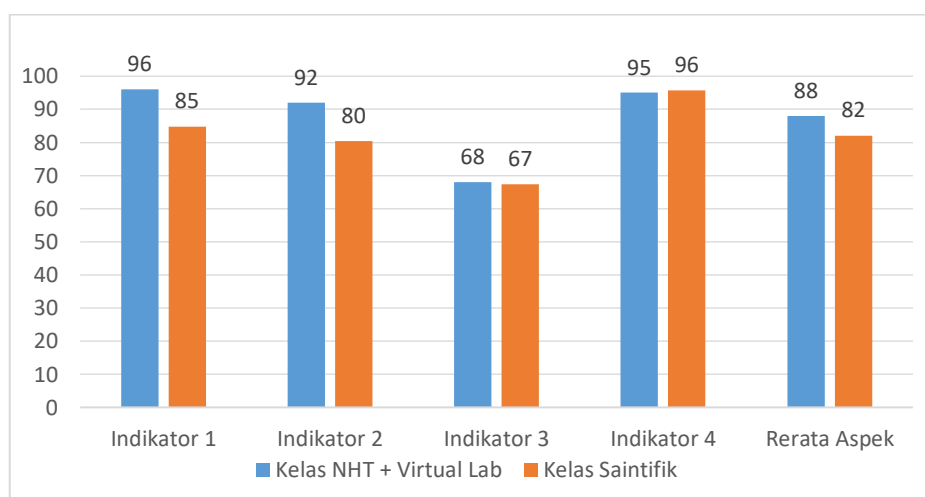


Figure 1. Persentation Result Written Communication Test

Notations:

Indicator 1: Transformation of data presentation into tables.

Indicator 2: Utilization of graphs, diagrams, and models with appropriate labels and suitable scales.

Indicator 3: Explanation of events or experimental outcomes in accordance with the addressed problem.

Indicator 4: Summarization of experiment results or presented phenomena.

Average Aspect: The mean score of the four indicators in each class.

The above graph provides a visual representation of the written communication skills test outcomes in the class through the application of the Numbered Heads Together learning model, augmented by virtual laboratories and scientific classes. In detail, the results of the written communication test can be described as follows:

3.1. Indicator 1: Transforming Data Presentation Into Tables

The classes of Numbered Heads Together learning model aided by virtual laboratories and scientific classes, students were trained to complete worksheets by filling in observation tables tailored to their respective treatments. During the final session, both classes were given a task consisting of experimental information, including equipment and materials, experimental procedures, and experimental results related to work and power. Students were asked to convert this experimental information into table format, with scoring criteria for creating tables, accurately filling in distance, force, and work columns.

The test results showed that the classes of Numbered Heads Together learning model aided by virtual laboratories achieved a percentage of 96%, indicating an excellent category, while the scientific class achieved a percentage of 85%, also indicating an excellent category. This difference occurred because in the classes of Numbered Heads Together learning model aided by virtual laboratories, it was easier to obtain data that directly appeared on the screen of the Android application, while in the scientific class, students had to search for data to be entered into the observation table. This had an impact on students' understanding and ability to fill in the observation tables.

This finding aligns with the research conducted by Alfatihah (2022), where the indicator of transforming data presentation into tables in written communication showed an improvement from 70.5% to 75%. Meanwhile, Yusefni & Sriyati (2016) conducted research on the indicator of reading tables, which showed 88% for the experimental class and 84% for the control class.

Based on these results that students in both the NHT class aided by virtual laboratories and the scientific understand to complete worksheets by filling in observation tables tailored to their respective treatments. Based on these results, it can be concluded that students in both the NHT class aided by virtual laboratories and the scientific class were able to perform excellently in the given indicator tasks.

3.2. Indicator 2: Utilizing graphs, diagrams, models, with appropriate labels and suitable scales

The classes of Numbered Heads Together learning model supported by virtual laboratories and scientific classes, students were provided with exercises in the form of worksheets to develop their skills in creating graphs, providing accurate labels, and using appropriate scales. These exercises were tailored to the specific instructional treatments in each class.

Each class was presented with the same task, which involved experimental measurement data related to wheel radius, axle radius, and mechanical advantage. The students were required to construct graphs based on this information, ensuring the inclusion of precise labels and selecting scales that were suitable for the data presented. The scoring rubric encompassed aspects such as variable descriptions, graph scaling, coordinate positioning, and accurate connecting of coordinate points.

The classes of Numbered Heads Together learning model with virtual laboratory assistance achieved a percentage of 92%, indicating a highly commendable performance, while the scientific class attained a percentage of 80%, indicating a good level of proficiency. The disparity in performance can be attributed to the ease with which data could be obtained and clearly read in the classes of Numbered Heads Together learning model with virtual laboratory support. This

facilitated the accurate translation of data into the table, resulting in a comprehensive understanding of the information and consequently enabling the creation of precise graphs. Conversely, the scientific class faced challenges in acquiring and entering data into the table, leading to a lower level of comprehension and affecting their ability to construct graphs accurately.

Relevant prior studies conducted by Alfatihah (2022) on the indicator of using notations effectively, such as graphs and diagrams, demonstrated an improvement from 69.5% to 74%. Similarly, Yusefni & Sriyati (2016) conducted a research study on the indicator of reading graphs, revealing a success rate of 89% in the experimental class compared to 76% in the control class.

Based on these findings, it can be concluded that students in the The classes of Numbered Heads Together learning model supported by virtual laboratories excelled in performing the indicator tasks. The scientific class demonstrated a good level of proficiency.

3.3. Indicator 3: Explaining events or experimental results according to the problem being solved

The The classes of Numbered Heads Together learning model supported by virtual laboratories and scientific classes, students were given exercises in the form of worksheets that involved various everyday scenarios related to simple machines. These scenarios included activities such as drawing water from a well, using a ladder in the school yard, pedaling a bicycle, weighing palm oil fruit bunches, and performing a jump during a badminton game.

The questions presented in the exercises depicted images and phenomena related to the activities of palm oil farmers during the weighing process of their harvest. The students were required to explain the components of a sliding balance based on the concept of a lever. The scoring rubric assessed their ability to correctly identify the position of the load, fulcrum, effort, load arm, and effort arm.

The classes of Numbered Heads Together learning model with virtual laboratory assistance achieved a percentage of 68%, indicating a satisfactory performance, while the scientific class obtained a percentage of 67%, also falling within the satisfactory category. This can be attributed to the limited direct involvement of students in weighing palm fruit harvests due to the lack of opportunities provided by parents to observe the harvest in the plantation and the increasing use of digital scales by palm oil agents during the weighing process.

Similar findings were observed in a study conducted by Alfatihah (2022) on the indicator of appropriateness in problem-solving explanations, which showed an improvement from 37% to 65%. Based on the results of the aforementioned research, it can be concluded that students in both classes were able to perform the indicator tasks to a satisfactory level.

3.4. In indicator 4: Summarizing the description of experiment results/phenomena presented in the learning process of

The The classes of Numbered Heads Together learning model using virtual laboratories and scientific classes, students were given exercises in LKPD to conclude the observations or experiments they had conducted. This activity aims to train students to make accurate conclusions. A test was conducted at the end of the learning session.

The test question consisted of a picture of a bicycle's front and rear gears, as well as the phenomenon of pedaling a bicycle. Students were asked to write about the cause-and-effect relationship of the combination of front and rear gears on the speed of the bicycle. The assessment rubric focused on the ability to correctly describe the relationship of two causes and their effects. Based on the results, it can be said that students in both classes were able to perform the test indicator very well. This is because students in both classes were directly involved in the activity of riding bicycles, allowing them to experience the impact of the combination of front and rear gears on the feeling in their legs while pedaling and the resulting speed of the bicycle.

The test results showed a percentage of 95% for the The classes of Numbered Heads Together learning model using virtual laboratories, indicating an excellent category, while the scientific class showed a percentage of 96% with an excellent category. This is consistent with the research conducted by Alfatihah (2022) on the indicator of making conclusions, which showed an improvement from 59.5% to 80%. Meanwhile, Ika (2018) conducted a study using the conclusion-making indicator in written communication and obtained a result of 97%.

3.5. Overall, the average of all aspects in the The classes of Numbered Heads Together

Learning model using virtual laboratories shows a percentage of 88% in the excellent category, while the average of all aspects in the scientific class shows a percentage of 82% in the good category.

The written communication test results from both classes were then subjected to an Independent Sample T-Test. The difference in average scores of written communication skills between the experimental and control classes, along with the significance values, can be seen in Table 4.

Table 4: Results of Independent Sample T-Test for Written Communication

No	Description	Score
1	Levene's Test Significance	0,706
2	t-Test Significance	0,037

The t-test results indicate that the p-value (2-tailed) is 0.037. Therefore, based on the decision rule for the independent sample t-test, if the p-value is less than 0.05, the null hypothesis (H_0) is rejected. This means that there is a significant difference in the written communication skills of students between the class that used the Numbered Heads Together learning model with virtual laboratories and the class that did not use it, specifically in the topic of simple machines.

This significant difference is caused by the students in the class that implemented Numbered Heads Together learning model with virtual laboratories. Each student is required to be ready to answer questions when their assigned number is called by the teacher. The students seem to engage in thorough discussions. Students who have more advanced abilities can act as peer tutors for their group members. Zuhdi (2010) states that one of the advantages of the Numbered Heads Together learning model model is that it keeps students prepared, encourages serious discussions, and enables capable students to act as peer tutors. Makarao (2009) also states that peer tutoring is a learning method that allows students to transmit and share knowledge or skills with other students. Research conducted by Fadhilah (2018) states that when implementing the ELPSA-

based NHT model, students at each meeting can maximize learning discussions in each group. When the teacher called numbers randomly and was asked to present the results of the discussion, the students looked confident in answering and explaining to other friends. This results in students continuing to show competitiveness during the learning process. In line with research conducted by Sari (2020) shows that the NHT learning model is effective for improving mathematical communication skills. NHT learning is implemented by involving students playing an active role in discovering concepts. The teacher asks questions that encourage student activity. Apart from that, teachers also often provide guidance or direction and provide reinforcement to students during the discussion process. Students are involved in learning and direct them to discover concepts based on the knowledge they have so that better understand the subject matter.

In this class, the learning process is complemented by a virtual laboratory that is easily accessible on the students' android devices. The virtual laboratory serves as a substitute for a physical laboratory since the school does not have a dedicated laboratory room and equipment. Latief (2020) states that virtual laboratories can be conducted through observation or experimentation using computer applications. With the advancement of technology, virtual laboratories can be installed on android devices or other gadgets. The virtual laboratory used is an application called M-Edukasi, specifically the V-Lab Simple Machines developed by BPMPK Ministry of Education and Culture (M-Edukasi, 2020). Students can install this application on their respective android devices to assist them during practical activities. The observations or experiments conducted in the virtual laboratory can be recorded in each student's LKPD (Student Worksheet). In line with research conducted by Majda, et al (2023) stated that learning using virtual laboratories provides a new atmosphere for students so that they can increase their understanding. Virtual laboratory based learning media can be used to carry out practically effective practicum activities so as to improve students' psychomotor skills (Arafah, et al , 2022)

The learning in this class is also equipped with worksheets (LKPD) aimed at training written communication skills adapted to the learning model. In the class that applies the Numbered Heads Together learning model with the support of a virtual laboratory, students find it easier to complete the worksheets because it is easier to obtain data that appears on the virtual laboratory application interface. Students can write down the data that appears on the virtual laboratory interface and then interpret the data. Students are able to present their learning outcomes well. The presence of the virtual laboratory makes learning more enjoyable for students.

On the other hand, in the class that implements scientific learning, students conduct experimental simulations according to the given subject matter by the teacher. In the implementation, students face difficulties in obtaining data due to limited equipment and materials for experiments, which are done in rotation and therefore take longer. This has an impact on entering data into observation tables and processing data taking more time. When students struggle to interpret the data and present their learning outcomes, they are not as smooth. This can be seen in the results of the written communication skills test in both classes, where there is a significant difference.

4. CONCLUSION

Based on the research results, it can be concluded that the overall average of all aspects in the classes of Numbered Heads Together learning model class with the support of a virtual

laboratory shows a percentage of 88% in the very good category. The average of all aspects in the scientific learning class shows a percentage of 82% in the good category. Based on the data analysis from the t-test results, the significance value (2-tailed) is 0.037, which means there is a significant difference between the class that uses the Numbered Heads Together learning model with the support of a laboratory and the scientific learning class in terms of students' written communication skills in the subject of simple machines. From this research, it is expected that Numbered Heads Together learning model learning with the support of a virtual laboratory can be implemented in other science subjects.

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