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ENHANCING JUNIOR HIGH SCHOOL STUDENTS' MATHEMATICS COMMUNICATION SKILLS THROUGH RODE LEARNING MODEL

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Abstract

This study aims to determine the influence of the RODE learning model on the mathematical communication skills of junior high school students on data presentation materials. A quasi-experiment with a pretest-posttest control group design was applied to 60 students selected using a simple random sampling technique, 30 in the experimental and control classes. Data on students' mathematical communication skills were collected using four questions each for pretest and posttest. The results of the descriptive analysis showed that the average score of mathematical communication skills of students in the experimental class was higher than that of the control class. The results of the t-test showed a t_{count} of 4.503 with a t_{table} of 1.671 with a significance value of 5% because $t_{count} \geq t_{table}$, H_0 (the average communication skills of students in the experimental class was lower than the average of the control class) was rejected. Thus, it was concluded that the RODE learning model influenced the mathematical communication skills of junior high school students on the data presentation material. The results of this study are coherent and empirical evidence of the effectiveness of the RODE learning model in affecting students' communication skills.

Keywords: *Data Presention, Mathmetic Comunication Skills, RODE Learning Model*

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran *RODE* terhadap keterampilan komunikasi matematika siswa Sekolah Menengah Pertama pada materi penyajian data. *Quasi Experiment* dengan desain *Pretest-Posttest Control Group design* diterapkan kepada 60 orang siswa yang dipilih dengan teknik *simple random sampling*, 30 siswa pada kelas eksperimen dan kontrol. Data keterampilan komunikasi matematika siswa dikumpulkan menggunakan 4 soal masing-masing untuk *pretest* dan *posttest*. Hasil analisis deskriptif menunjukkan skor rata-rata keterampilan komunikasi matematika siswa kelas eksperimen lebih tinggi daripada kelas kontrol. Hasil uji t menunjukkan nilai t_{hitung} 4,503 dengan t_{tabel} 1,671 dengan nilai signifikansi 5%, karena $t_{hitung} \geq t_{tabel}$ maka H_0 (rata-rata keterampilan komunikasi siswa kelas eksperimen lebih rendah dari pada rata-rata kelas kontrol) ditolak. Dengan demikian disimpulkan bahwa terdapat pengaruh model pembelajaran *RODE* terhadap keterampilan komunikasi matematika siswa Sekolah Menengah Pertama pada materi penyajian data. Hasil penelitian ini koheren dan menjadi bukti empirik keefektifan model pembelajaran RODE yang berpengaruh terhadap keterampilan komunikasi siswa.

Kata kunci: Keterampilan Komunikasi matematika, Model Pembelajaran *RODE*, Penyajian Data

INTRODUCTION

Education is the process of changing the attitude and behavior of a person or group through teaching and training to mature human beings. The importance of learning mathematics is compulsory at the elementary to secondary levels. In line with The National Council of Teachers of Mathematics, one of the most crucial abilities students need to possess is mathematical communication skills, allowing them to share their ideas with peers and teachers (Dewi et al., 2020; Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, 2003).

In the Industrial Revolution 4.0 (4IR) era, the 21st-century learning framework requires students to have knowledge, skills, expertise, and proficiency. The learning process must involve learners and equip them with life and work skills, including the communication skills needed to meet the demands of the 21st century. Communication has an important role in learning because it can improve the learning situation and explore the skills that students already have. Mathematical communication skills are one type of communication skill that students need to develop. This communication helps students convey written ideas and facilitates interaction with teachers and friends. Mathematical communication skills are essential in solving everyday problems through analysis and mathematical models (Dewi et al., 2020; Harianja & Susianna, 2022; Kusuma et al., 2022b).

Mathematical communication is the ability of a learner to express mathematical ideas through language, notation, or symbols, which allows them to understand, interpret, characterize relationships, and use written and spoken mathematical models to solve real-world issues. Mathematics as a language and mathematics education as a social activity are the two factors that make mathematical communication urgent. As a language, mathematics serves as a means of precisely communicating various ideas and being a tool for problem-solving and thought processes. The phrase "mathematics learning as a social activity" refers to anything involving interaction between students or teachers. Students must have strong mathematical communication abilities to comprehend the study material in this interaction. Students with strong mathematics communication abilities will be able to articulate the challenges they face when learning a material (Anisa et al., 2023; Hani et al., 2024; Nisdawati & Handican, 2022; Nurun et al., 2024; Rahmasuri et al., 2022).

The mathematics minimum success criteria score only guarantees achieving some mathematical skills, such as problem-solving, reasoning, concept understanding, and mathematical communication. Mathematics serves as a language, not only to think or solve problems but also to communicate ideas clearly and concisely. In addition, mathematics learning is a social activity that involves interaction between teachers, students, and teaching materials to develop students' potential (Purba, 2020). Data presentation is one of the materials in mathematics learning that requires communication skills to solve. Data presentation is part of the mathematics lesson for grade VII, semester II, and is available at every level of education. Statistics includes data collection, presentation, processing, and analysis, which are necessary to understand and make decisions. Students are required to present data so that it is easy to read, understand, and analyze.

Researchers also observed mathematics in conventional learning with limited teacher-centred methods, which makes students seem passive. Students only pay attention to the teacher delivering the subject matter and writing in the notebook, reluctant or not daring to ask questions and/or express what concepts they have understood from the teacher's delivery. These situations do not involve students asking questions or giving opinions. Boredom and a lack of variety in the classroom can also contribute to students' poor mathematical communication abilities (Dewi et al., 2020; Fitria & Handayani, 2020; Hanipah & Sumartini, 2021; Lu'luilmaknun et al., 2022; Ramadiani, 2022). This situation is one reason students' communication skills still need to improve, especially the skill of explaining relationships in writing clearly and using illustrative examples. In order to solve problems, it is also important to have discussion and listening skills. Only some students can ask the teacher questions if they need help understanding them during mathematics learning.

To solve the issues above, innovative teaching techniques that strengthen students' mathematical communication abilities and raise learning standards are required. One such strategy is the *RODE* learning model (Kusuma et al., 2022a, 2024). The RODE learning model is an innovative learning model prepared by paying attention to the weaknesses of the problem-solving and project-based learning models. The RODE learning model has the support of learning theories and empirical support from previous research in compiling each syntax (Kusuma et al., 2020). The RODE model also meets the validity test criteria and is declared to meet practical criteria as a learning model (Kusuma et al., 2022b, 2023). The RODE learning model consists of four syntaxes: Read, Outline, Discussion, and Evaluation. It has proven to be effective in training students' communication skills (Kusuma et al., 2022a) Moreover, in further trials on junior high school students, the RODE model can also improve student learning outcomes in science (Kusuma et al., 2024). Unlike the previous study, this study was conducted based on recommendations to test *the RODE* learning model at the high school level and on teaching materials other than science. Consequently, the researcher is keen to apply and evaluate how the RODE learning model affects MTs students in Tarakan's mathematical communication abilities regarding data presentation materials.

METHOD

The method employed in this research is a quasi-experimental research method. The research design utilized a pretest-posttest control group design. The population used in this study consists of all the 7th-grade students at MTs Negeri Tarakan (one of the Islamic public junior high schools in North Kalimantan Province, Indonesia). The sample, which consisted of 60 students (30 from each class), was chosen using a simple random sampling technique. Class VII-B served as the experimental class, and class VII-E was the control class.

The data collection technique in the form of tests that will be used in this study is in the form of *pretest and posttest questions* given in the experimental class and control class with as many as 4 questions to measure three indicators of communication skills, namely (1) writing *(written text),* which is explaining the idea or solution of a problem or picture using one's language. (2) Drawing, i.e., presenting a mathematical problem's concept or solution as an image. (3) A mathematical expression states everyday problems or events in the language of mathematical models. The test items' validity and reliability were calculated using the SPSS 26.0 for Windows application, maintaining a significance level of 5%. The results, shown in Table 1, demonstrate the strong validation and reliability of the test questions used in this study, ensuring their effectiveness in measuring the intended constructs.

Table 1
Validity and Realibility of Item Test Of Mathematics Communication Skills

Number of Item	Mathematics Communication Skills Indicator	Item Test Indicator	Validity	Realibility
1	Writing (*written text*) is explaining ideas or solutions to a problem or picture using one's own language.	Students were given a bar chart showing the amount of production between January and June. Then, they were asked to determine which month saw a decrease in production.	Valid	Reliable
2	*Drawing* is the process of explaining ideas or solutions to mathematical problems in the form of drawings.	Students were presented with a pie chart of drinking water sources consumed by residents of Central Java, a total population of 34,000,000, in 2020. Then, students were asked to explain the idea/solution to the problem by calculating how many people consumed well water in the pie chart.	Valid	Reliable
3	*Mathematical expressions*, express everyday problems or events in the language of mathematical models.	Students are presented with a bar diagram of Mr Tani's harvest, and then they state the problem in the language of a mathematical model by calculating the amount of Mr Tani's potato harvest.	Valid	Reliable
4	*Mathematical expressions*, express everyday problems or events in the language of mathematical models.	Students are presented with data and then determine the mean, mode, and median.	Valid	Reliable

The research data was analyzed descriptively, which was used to describe the study's results in the form of *mean and* standard *deviation* from the data obtained using *SPSS 26.0* to conduct further tests.

The inferential analysis of this study is a parametric statistical analysis used to draw conclusions that apply to the population because the data taken are interval data, data from measurements with the same unit. The inferential statistical analysis technique used is the assumption test (prerequisite). Hermawan & Amirullah (2016) that the prerequisite assumption test determines whether the sample meets the specified conditions so that the data analysis is unbiased. In this study, the assumption test includes normality and homogeneity tests.

Testing Criteria:

If $W_{hitung} < W_{tabel}$ then H_0 accepted

If $W_{hitung} > W_{tabel}$ then H_0 rejected

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Sugiono (2018).

This step's hypothesis test offers a tentative solution to the problem formulation. A parametric test, specifically an independent sample t-test with a significance level ($\alpha = 0.05$), is used to assess the impact of the RODE learning model on students' mathematical communication skills compared to traditional learning if the sample is typically distributed and homogeneous. This study has two hypothesis tests, namely the initial condition hypothesis test (*pretest*) and the final condition hypothesis test (*posttest*).

The initial condition hypothesis test (pretest) determines whether the experimental and control classes have the same initial conditions. It is performed using independent sample t-tests with SPSS 26.0 and pretest scores. This test is suitable for comparing the average of two groups. Furthermore, the experimental and control groups' posttest results offer the data required to test the final condition hypothesis, which is carried out to address the study's problem formulation. Then, find the level of significance.

Determining α, the significant level used is 5%. Calculating if the variance similarity test shows that both groups have the same variance, then the hypothesis is tested using the t-test formula:

$t_{Count} = \frac{\underline{\times}_1 - \underline{\times}_2}{\sqrt{\frac{(n_1-1)S_1^2 \ (n_1-1)S_2^2}{n_1+n_{2-2}} \left(\frac{1}{n_1}+\frac{1}{n^2}\right)}}$. Determining decisions, Hypothesis testing criteria:

$t_{hitung} \leq t_{tabel}$ then H_0 accepted

$t_{hitung} > t_{tabel}$ then H_0 rejected

The RODE learning model was found to have no effect, regardless of whether H_0 was accepted, because the experimental class's average communication skills were either lower or comparable to those of the control group. Meanwhile, if rejected, the average communication skills of the experimental class students were higher than the average of the control class, so it was collected that there was an influence of *the RODE* learning model.

RESULT AND DISCUSSION

Mathematical communication skills are the ability to organize mathematical thoughts, communicate mathematical ideas logically and clearly, analyze and evaluate how others use mathematical minds and use mathematical language to express ideas appropriately (Dewi & Nuraeni, 2022; Supratman et al., 2023). The ability of students to communicate ideas with symbols, tables, diagrams, graphs, or drawings is called mathematical communication ability. Mathematical communication skills are the ability to communicate ideas, describe and discuss mathematical concepts coherently, and explain and justify procedures and concepts orally and in writing. Mathematical communication skills help teachers understand students' ability to interpret and express the mathematical concepts and processes they are learning (Nuraeni & Afriansyah, 2021; Purnamasari & Afriansyah, 2021).

There are two reasons why mathematical communication is crucial. First, mathematics is invaluable for conveying ideas precisely and concisely but clearly. Mathematics is also a tool to help think, solve problems, or draw conclusions. Because math learning is a social activity, it allows interaction between students and teachers and between students (Anggraeni & Sundayana, 2021; Lu'luilmaknun et al., 2022; Supratman et al., 2023).

This study used four descriptive questions on the data presentation material to test three indicators of mathematical communication skills: written text, drawing, and mathematical expressions. The results of the data analysis are presented below.

1). Findings

a. Descriptive analysis in this study to find out the mean and standard deviation of the two classes. The results of the descriptive analysis in the experimental class and the control class can be seen in the following table 1:

Table 2

Results of Descriptive Analysis of Students' Mathematical Communication Skills Test

Data	Number of Students	Class	Minimum Score	Maximum Score	Average	Standard Deviation
Pre-Test	30	Experiment	30.00	80.00	55.83	13.438
Post-Test	30	Experiment	50.00	100.00	79.83	14.941
Pre-Test	30	Control	35.00	75.00	54.10	11.453
Post-Test	30	Control	45.00	90.00	64.66	10.822

Table 2 shows that students have the same ability in the pretest. However, after treatment, the average score of the experimental class with *the RODE* learning model was higher than that of the control class with conventional learning. Figure 1 and Figure 2 show the answer sheets of students in the experimental classes and the control classes.

Figure 1

Answers of Students with the Highest Posttest Scores in Experimental Classes

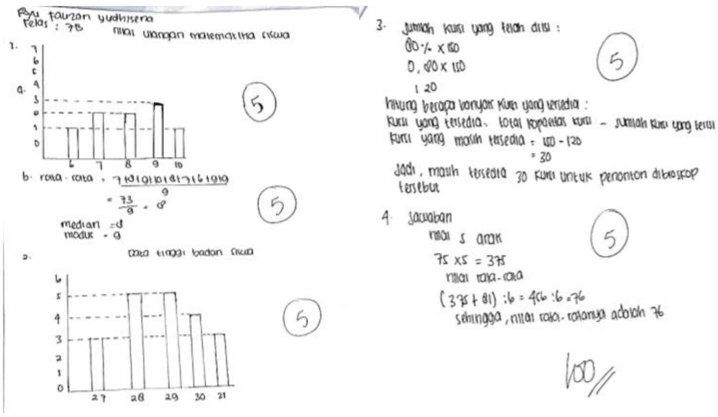
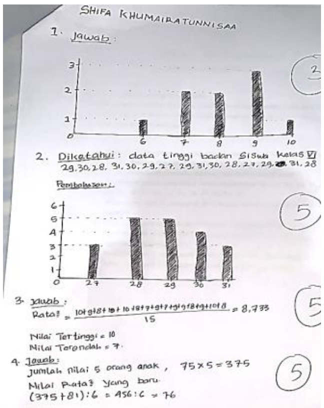


Figure 2
Answers of Students with the Highest Posttest Scores in Control Classes



b. This study's Assumption Test (Prerequisite) includes a normality test and a homogeneity test.

1. This study employed the normality test to ascertain whether the data was normal, Shapiro-Wilk statistics with SPSS 26.0 to search for significance, and Microsoft Excel to compute the calculation. The form of a testable hypothesis is as follows:

   Testing Criteria:

   If $W_{Count} < W_{Table}$ then H_0 accepted

   If $W_{Count} > W_{Table}$ then H_0 rejected

Table 3 shows the results of the normality test of students' mathematical communication skills in the *pretest* and *posttest.*

Table 3
Results of the Normality Test using Microsoft Excel and SPSS

Group	Data	W_{Count}	W_{Table}	Result	Conclusion
Experiment	*Pretest*	0.948	0.927	Accepted	Normal
Experiment	Posttest	0.938	0.927	Accepted	Normal
Control	*Pretest*	0.945	0.927	Accepted	Normal
Control	Posttest	0.955	0.927	Accepted	Normal

Table 3 of the W_{Count} experimental and control classes shows that the W_{Table} is greater than the W_{Count}, which suggests that the student's communication abilities are normally distributed. Thus, H_0 is accepted.

2. The homogeneity test is used by the researcher using the *statistical Levene* test with *SPSS 26.0* to test the homogeneity of students' mathematical communication skills data in the experimental and control groups, with a significant level of 5%. The Levene *Test* formula is as follows:

   $$F = \frac{(n-k}{(k-1} \frac{\Sigma_{i=1}^{k} n_1 (\bar{z}_l \_ \bar{z}_{l\ldots})^2}{\Sigma_I^K = \Sigma_{1=1}^{n_i} (Z_{ij} - \bar{z}_{l\ldots})^2}$$

   Testing criteria :

   If $F_{Count} > F_{Table}$ then H_0 rejected

   If $F_{Count} < F_{Table}$ then H_0 accepted

Table 4 shows the homogeneity test results for students' mathematical communication skills, including the *pretest* and *posttest scores*.

Table 4
Homogeneity Test Results

	F_{Count}	F_{Table}	Condition	Results	Conclusion
Pretest	0.249	4.007	$F_{Count} < F_{Table}$	Accepted H_0	Homogeneous
Post test	2.568	4.007	$F_{Count} < F_{Table}$	Accepted H_0	Homogeneous

According to Table 4, the communication skills of students in the experimental and control classes are the same or homogeneous. The homogeneity test was carried out with SPSS 26.0 and manual calculation using microsoft excel. Once the normality and homogeneity tests are fulfilled, hypothesis testing can be continued.

c. Hypothesis testing using the *Independent Sample t-test:* This test aims to determine the average difference in students' mathematical communication skills based on the learning model applied.

Initial condition hypothesis testing *(Pretest),* this test is carried out to determine whether the experimental and control classes have the same initial conditions, using pretest values and t-tests with *SPSS Version 26.0.*

Table 5
Independent Sampel T-Test Prestest Scores Result

Independent Sample Test	t_{count}	t_{table}	Conclusion
Pretest Scores	0.465	1.671	Accepted H_0

Table 5 shows the $t_{count} < t_{table}$ was found to be 0.465 < 1.671. The hypothesis testing criteria H_0 were accepted, and the hypothesis that reads "there is no difference in the average mathematical communication skills of students in the control and experimental classes" is acceptable.

The final condition hypothesis *(Posttest)* answers the research problem's formulation. The data tested are the posttest scores of the experimental and control classes, using the t-test and SPSS Version 26.0.

Table 6
Independent Sample T-Test Posttest Scores Result

Independent Sample Test	t_{count}	t_{table}	Conclusion
Posttest Scores	4.503	1.671	Rejected H_0

Table 6 present a value of $t_{count} > t_{table}$, 4.503 > 1.671 is obtained, then H_0 is rejected and H_1 is accepted so that H_1: $\mu_1 \neq \mu_2$. Therefore, the hypothesis that reads "there is an influence of the learning model on students' mathematical communication skills" is acceptable. It was concluded that there was an influence of the RODE learning model on students' mathematical communication skills.

2). Discussion

This research was conducted in two classes, VII MTs Tarakan, with class VII B as an experimental class using the RODE model and class VII E as a control class using a conventional learning model. The research findings based on the analysis are discussed below.

The descriptive analysis showed that 30 students from the experimental and 30 from the control classes took the pretest and posttest of mathematical communication skills. The RODE model in the experimental class and the conventional model in the control class had a treatment difference contributing to the average score variation. However, this descriptive analysis is insufficient for general conclusions, so inferential statistical analysis is needed.

Inferential statistics include prerequisite tests and hypothesis tests. The prerequisite test, which consists of normality and homogeneity tests, assures whether the data is feasible for hypothesis testing. SPSS version 26.0 was used to conduct the t-test after determining that the data were homogeneous and normally distributed. The findings indicate that the RODE learning model significantly impacts students' mathematical communication abilities compared to the traditional learning model. According to the findings, MTs Negeri Tarakan performed better with the RODE learning model. This condition aligns with research conducted by Kusuma et al. (2022a) state that the RODE learning model influences communication skills.

In the RODE learning model, students can collaborate, exchange answers, discuss differences, help each other, and ask teachers questions if they encounter difficulties. It is essential to fostering creativity in problem-solving. Students work together to solve the given problems, so each student must master the material individually. This condition aligns with the findings of Hani et al. (2024) and Wahyuni et al. (2024), which indicate that student-centered learning enabled by learning resources such as student worksheets will enable students to practice communication, problem-solving, and critical thinking skills through group discussions and idea sharing during group assignments.

The RODE learning model encourages students to communicate mathematical ideas orally and in writing to develop understanding, build knowledge, and relate learning experiences to mathematical concepts. Kusuma et al. (2022a, 2024) claim that the RODE learning model is an innovative approach aiming to improve students' learning efficiency and communication skills. These findings align with the study by Anggraeni dkk., (2022) , which states that students are essential in acquiring knowledge and skills to achieve learning goals while being encouraged to demonstrate active and collaborative performance that integrates various skills.

According to research by Simamora et al., (2022) and Andini et al., (2019), the best way to improve students' mathematical communication skills is to use an effective learning model that is student-centered rather than teacher-centered and based on real-world problems so that students themselves solve the problems they encounter. This condition aligns with the effectiveness of the four steps of the RODE learning model's implementation in improving students' communication skills in mathematics learning (Kusuma et al., 2024).

The control group uses the conventional lecture-based learning model. The teacher explains the material and provides sample questions, followed by exercises. Researchers observed that students appeared less active, with only a few out of 30 students asking questions. Since students must participate actively in learning activities, there is no way to maximize the improvement of the indicators of mathematical communication skills in this model.

On the other hand, in the control class, the conventional learning model is applied as a lecture method, where the teacher explains the material and gives sample questions to students. Then, to continue it, practice questions were given. The researcher observed that the learning activities were less active during the learning process. Only a tiny percentage of the thirty students present asked questions during the learning process. This condition aligns with Hanipah & Sumartini (2021) finding that tend to listen and understand what the teacher is saying. Sometimes, when asked if they understand or not, students tend to be silent. The silence of students, whether it shows that they understand or not, cannot be ascertained. Most students feel reluctant to ask questions if they do not need help understanding. The traditional learning model process does not allow for direct training of students' indicators of mathematical communication skills. The teacher explained that all students were interested in and should participate actively in class activities. So, in his conventional learning model, communication skills indicators cannot be improved optimally.

Based on the description above, the average mathematical communication skills of students in the experimental class are higher than those of students in the control class. Therefore, the RODE learning model (Read, Outline, Discussion, Evaluation) learning model influences students' mathematical communication skills in data presentation material at junior high school level.

CONCLUSION

The Read, Outline, Discussion, Evaluation (RODE) learning model is expected to enhance the mathematical communication abilities of MTs Negeri Tarakan students in the 2023–2024 academic year. The independent sample t-test results of inferential statistical analysis, which yielded a count of 4.503 and a total of 1.671, validate these claims. The t-table exceeds the t-count, leading to the rejection of H0 and the acceptance of H1 at a significance level of 0.05. This opens up exciting possibilities for further research, which could explore the application of the RODE model to develop other 21st-century skills such as collaboration, creativity, critical thinking, and problem-solving, thereby offering a promising future for education.

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