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The Influence of Realistic Mathematics Education (RME) on Mathematical Communication Skills of Tenth-Grade Students at SMAN 1 Kuok

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ABSTRACT

This study was sparked by the inadequate mathematical communication abilities observed in tenth-grade learners at SMA Negeri 1 Kuok. An effective method to address this issue is implementing a Realistic Mathematics Education approach. The primary objective of this study is to assess whether the Realistic Mathematics Education approach affects the mathematical communication skills of tenth-grade students at SMA Negeri 1 Kuok. This investigation employed a quasi-experimental framework, specifically a post-test control group design. The participants comprised students from classes X.1 and X.2, with each class including 23 students. A simple random sampling method was utilized for this study. Data were collected using observation sheets and tests aimed at evaluating mathematical communication skills. Before being used, the assessment tool underwent validation through two methods: validity testing and reliability testing. The results of the validity test showed that of the four items assessed, all were considered valid because the calculated r value exceeded the table r value. Consequently, these items serve as an effective means for assessing students' mathematical communication skills pertaining to the System of Linear Equations in Three Variables. In accordance with the results of the validity test, the reliability assessment also showed that the calculated r value was 0.808, which was greater than the r table value of 0.443, confirming that all test questions on mathematical communication skills were reliable. For data analysis, prerequisite tests including homogeneity and normality tests were conducted. After the prerequisite conditions were met, the T test was run. The prerequisite test indicated that the data were normally distributed and exhibited homogeneity. The T test revealed a t value of 2.343 with a significance level (2-tailed) of 0.024, which was less than 0.05, indicating a significant effect. The analysis of the data yielded that the RME approach can positively influence and improve mathematical communication skills, thereby facilitating the achievement of educational goals. Consequently, it is imperative to make additional efforts, including the continued implementation of the RME approach to influence other dimensions of mathematical proficiency.

Keywords: Mathematical Communication Skills; Realistic Mathematics Education; Approach

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Introduction

Mathematical communication skills relate to one's capability to convey mathematical thoughts or principles through spoken and written language. These abilities encompass the capacity to comprehend and assess the mathematical thoughts or concepts presented by others, involving careful consideration, analysis, critical reasoning, and assessment to improve comprehension (Yuliani, 2020). The National Council of Teachers of Mathematics (NCTM) highlights five core mathematical competencies, including

problem-solving, reasoning and proof, communication, connections, and representation. Therefore, having strong communication skills in mathematics is essential for students' growth in this area of study (Armania et al., 2018)

Communication refers to the method by which individuals exchange information among themselves, leading to a mutual relationship. It is a skill that involves the ability to express or understand concepts, enabling students to enhance their creativity in both spoken and written forms (Anggriani et al., 2023). According to Firdaus & Rosyidah (2021) communication abilities are crucial during group discussions among students, as they are instructed in skills such as explaining, describing, listening, articulating, inquiring, and collaborating. This approach helps them grasp the educational content by developing their understanding alongside the teacher.

Mathematical interaction refers to a conversation occurring within a classroom that involves mathematical content being explored by learners, including ideas, equations, or techniques for addressing a challenge (Fitria & Handayani, 2020). Lestari et al (2022) assert that mathematical communication skills involve the capacity to articulate mathematical concepts or ideas, whether spoken or written, to others in a comprehensive, analytical, critical, and evaluative manner, aimed at enhancing understanding. As a result, one can deduce that the skill to converse in mathematics involves articulating one's comprehension of mathematical ideas of others or peers through spoken or written forms, utilizing mathematics as a tool for dialogue. This skill of communication can also be viewed as the capacity to share thoughts or concepts with others, intending for the recipient to grasp the intended message clearly, whether spoken or written.

The findings of a global study carried out by PISA (Program for International Student Assessment) regarding mathematical communication skills reveal that Indonesia consistently ranks very low (OECD, 2023). This is attributed to a lack of enthusiasm for learning among children, which is influenced by socio-economic conditions. In Indonesia, the mathematical capabilities of students are still deemed extremely poor, placing the country among the bottom seven worldwide (Bunga et al., 2016). This low ranking is likely due to the inadequate development of students' mathematical thinking skills, which may also point to the math textbooks not adequately addressing the enhancement of these skills. Therefore, it can be determined that the mathematical communication skills of Indonesian students are still considerably behind those of students from other countries (Kusmaryono, 2018)

A contributing element to the poor mathematical communication abilities among students is their insufficient capability in executing these skills. This aligns with the findings from observations conducted by researchers, which indicate students' underdeveloped communication skills necessitate targeted pedagogical interventions.

As per the findings from a study carried out by Memen Permata Azmi (2017), the ability to communicate mathematically is challenging since the thought processes of students cannot be directly perceived through their senses. Instead, they need to develop their skills to express mathematical ideas both verbally and in written form. This conclusion is drawn from research carried out at a SMPN in Kampar, which showed that learners possessed insufficient communication abilities throughout during math lessons. Pupils frequently struggle to grasp the content since they tend to solely memorize equations, and the instruction provided by the educator remains largely procedural (Putri, 2018).

Drawing from the outcomes of studies conducted by researchers at SMAN 1 Kuok, the findings indicate that abilities in communication are a mathematical challenge that requires a resolution to tackle this issue. To put it differently, the mathematical communication abilities of students are still lacking. Figure 1 presented below illustrates the responses from students regarding the questions related to their mathematical communication skills:

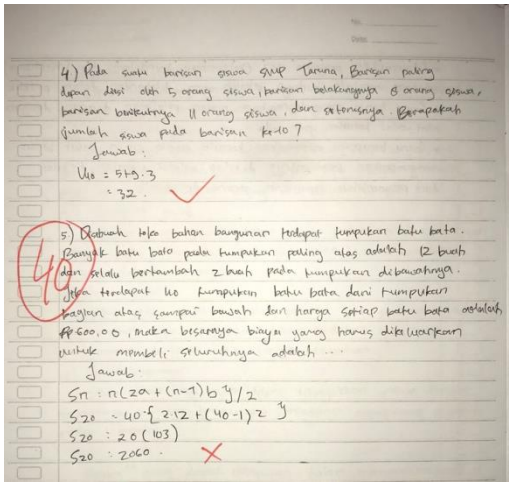

Figure 1. Average Student Answer Results

From the image shown, it is evident that students perform poorly in responding to questions about mathematical communication skills, failing to meet minimum criteria assessment standards, where the minimum score that students must achieve is 75. To address the issues outlined, it's essential to implement strategies to enhance students' mathematical communication abilities. The researcher has decided to adopt a suitable educational method. A useful strategy to address the difficulties students encounter with their abilities in mathematical communication is the RME (Realistic Mathematics Education) approach. The RME (Realistic Mathematics Education) approach involves utilizing practical scenarios that are connected to actual life occurrences, made them relatable and significant for students so they can easily visualize these concepts (Purwati, 2016).

Realistic Mathematics Education describes a approach of instructed mathematics based on the concepts introduced by Frudenthal (Yuliani, 2020) specifically designed for mathematics instruction. Through the introduction of actual scenarios, learners are slowly led to grasp mathematical ideas. Furthermore, learners should demonstrate the ability to apply their reasoning abilities to address the assigned challenges. Consequently, the role of a math educator becomes particularly significant when they can connect the teaching and learning of mathematics to real-life situations (Rosneli et al., 2020)

After that, learners are provided the chance to autonomously create concepts, ideas, and mathematical notions grounded in real-life scenarios that students can envision. It can be deduced that the RME approach is a theory concerned the tauhgt of mathematics, which is grounded in mathematical principles derived from human experiences that are closely linked to the everyday lives of students. Additionally, RME focuses on the development of mathematical skills, promoted discussion and teamwork, as well as debate among peers, enabled them to independently uncover mathematical concepts.

Based on the concept of interaction in practical mathematics education, learners share their thoughts with one another through social engagement, led to a more efficient and effective learning experience. When there is encouraged interaction, students with varying skill levels, particularly those who struggle, tend to feel more inspired to enhance their learning when they observe peers successfully tackled math challenges. This will also lead to heightened academic performance among students, particularly concerned the enhancement of their communication abilities in this research (Purwati, 2016).

In a research the effect of RME on students' abilities to communicate mathematically, it was found that one of the difficulties was explained mathematical concept, situations and relations verbaly or in wrote with real objects, images, and graphs. Inability to convey mathematical concepts, situations, and relationships effectively used real objects, images, and graphs leads to mistakes in problem modeled. Nonetheless, researchers also uncovered that the issue extended beyond just the challenge of verbally or textually explained mathematical ideas with tangible objects, images, and graphs. This reveals a discrepancy between the conducted research and the practical realities observed. Consequently, researchers recognized the necessity to explore the impact of RME further concerned students' mathematical communication skills. The originality of this study compared to earlier ones lies in the demographic examined. Due to the different research setting, the population and sample surveyed are undoubtedly distinct. Additionally, while prior studies characterized RME as a learning model, this study treats RME as a learning approach.

Methods

The research method employed is quasi-experimental, in which this variable cannot be entirely regulated. There are two categories of participants: the experimental group, which undergoes instruction used the RME approach, and the control group, which receives traditional teaching. The researcher adopts a Pre-test Post-test Control Group Design for this study. This design's aim is to have two chosen groups; one group undergoes treatment (experimental class) while the other experiences conventional instruction (control class). Subsequently, both classes are presented with practice questions to assess if they possess the same level of ability.

Table 1. *Research Design*

Sample	Pre-test	Treatment	Post-test
Experiment	O_1	X	O_2
Control	O_1	-	O_2

Source : (Gani & Nasution, 2020)

Information :

O_1 : *Pre-test*
O_2 : *Post-test*
X :*Treatment*

The entirety of the research subject comprises the population. The population refers to the complete set that has the traits that will be analysed (Susanti, 2005). In this research, the population consists of the entire class X at SMA Negeri 1 Kuok for the academic year 2024/2025. The sample for the study includes class X-1 designated as the experimental group, while class X-2 serves as the control group.

The method of sampling utilized in this research will be the Simple Random Sampling technique, which is often referred to as Random Sampling. Simple random sampling involves selecting a sample in a way that gives each unit within the population an equal opportunity to be included in the sample (Pathak, 2016). In this investigation, random assignment was carried out through a lottery system. Methods for gathering data included direct observation and examinations. The tools used for the research comprised observation forms and test items. To determine the validity of the research tool prior to its application, a validity assessment will be conducted. This evaluation of the instrument's validity is performed through two methods, which include validity test and reliability tesnt. Validity test is intended to ascertain if a measurement tool is valid or not. In this case, the measurement tool refers to the questions included in the test. Reliability represents a metric that indicates how much trust can be placed in a measurement tool. Therefore, A reliability assessment can be used to determine how dependable the measurement instrument is, particularly in terms of whether it produces stable results upon repeated measurements. A measurement tool is considered reliable if it yields the same results even after multiple assessments are conducted (Janna & Herianto, 2021).

The analytical method employed for the data was the descriptive statistic and inferensial test. Descriptive statistical analysis involves examining data by offering details or insights regarding the information, circumstances, or occurrences. To put it differently, this type of analysis aims to evaluate conditions, indicators, or issues. During this evaluation, investigators outline the findings from the data processing performed in the inferential assessment (Nasution, 2017). Prior to conducting the hypothesis test, initial assessments are performed, which include the normality and homogeneity tests. A basic approach to assessing normality involves generating a frequency distribution chart of the scores in question. The evaluation of normality hinges on our capacity to examine the dataset. In cases where the dataset is relatively large and the distribution does not perfectly align with normality, the conclusions reached could potentially be flawed. The homogeneity test serves to ascertain whether the variances among different populations are equivalent. This examination is essential as a preliminary step in executing the independent sample t test and ANOVA. Conducting a variance homogeneity test is crucial before comparing two or more groups, ensuring that observed differences are not a result of variations in the underlying data (the inhomogeneity of the compared groups) (Usmadi, 2020). All inferential test procedures were carried out with the help of Statistical Product and Service Solutions (SPSS).

Results and Discussion

The results of the descriptive statistical analysis on the pre-test of the experiment class and control class as well as the post-test in the experiment class and control class are shown in Table 2 :

Table 2. *Summary of Pre-Test and Post-Test Scores in Control Class and Experimental Class*

Data	*Control Class*		*Experiment Class*	
	Pre-test	***Post-test***	***Pre-test***	***Post-test***
Lots of Data	23	23	23	23
Ideal Score	100	100	100	100
Lowest Score	0	60	0	65
Highest Score	60	85	60	90
Score Range	60	25	60	25
Mean Score	43,91	73,91	40,65	78,70
StD	13,311	6,901	16,188	6,944
Variance	177,174	47,628	262,055	48,221

According to table 2, among the 23 learners, the mean score for the pre-test on mathematical communication skills was 43.91, accompanied by a standard deviation of 13.311. The scores varied from a minimum of 0 to a maximum of 60, resulting in a score range of 60 and a variance of 177.174. In contrast, the post-test revealed an average score of 73.91, with a standard deviation of 6.901. The scores ranged from a low of 60 to a high of 85, providing a score range of 25 and a variance of 47.628. In experiment class, the pre-test average score for mathematical communication skills was 40.65,

accompanied by a standard deviation of 16.188. The scores ranged from a low of 0 to a high of 60, indicating a score span of 60 and a variance of 262.055. In contrast, the post-test displayed an average score of 78.70, with a standard deviation of 6.944, where low score noted was 65 and high score reached was 90, resulting in a range of 25 and a variance of 48.221. It can be concluded from table 2 that there is a distinction in the outcomes of the experiment class before and after the intervention. The result test outcomes of the experimental group showed that they met the established standards for completeness in mathematical communication skills. To gain greater assurance, we will proceed with an inferential analysis.

Prior to conducting the hypothesis test, initial assessments are performed, which include the normality and homogeneity tests. The normality test in this study used the Kolmogorov-Smirnov test with the help of SPSS 25, the results of the normality test are presented in table:

Table 3. *Normality Test*

Class	Pre-test			Post-test		
	Statistic	**Df**	**Sig**	**Statistic**	**Df**	**Sig**
Control Class (X.1)	.167	23	.096	.149	23	.200
Experiment Class (X.2)	.168	23	.090	.166	23	.101

According to table 3, the results derived from the Kolmogorov-Smirnov pre-test analysis reveal that the significance value for the control group is reported to be 0. 096, which exceeds the threshold of 0. 05. Similarly, the experimental group exhibits a significance value of 0. 090, also above the 0. 05 threshold. In contrast, the outcomes of the Kolmogorov-Smirnov post-test indicate that the control group has a significance value of 0.200, signifying it exceeds 0.05, and the group under experimentation reveals a significance value of 0.101, which stays over 0.05 as well. Therefore, it can be determined that the significance values for both the control and experimental groups, being greater than 0.05, indicate that the data is normally distributed.

And the homogeneity test in this study used the Levene's test with the help of SPSS 25, the results of the homogeneity test are presented in the following table:

Table 4. *Homogeneity Test*

Pre-test				***Post-test***			
Levene's Test	df1	df2	Sig	***Levene's Test***	df1	df2	Sig
.416	1	44	.522	.050	1	44	.824

According to table 4, the homogeneity assessment during the pre-test revealed a significant value of 0.522, indicating it is greater than 0.05, while the post-test indicated a significant value of 0.824, also

greater than 0.05. Therefore, it can be inferred that the variance in data between the two groups is homogeneous.

For the analysis, the research utilized SPSS Version 25. The results derived from the independent sample T-test are presented in the subsequent table.:

Table 5. *Results of the T-Test*

		F	Sig	t	df	*Sig.(2-tailed)*
Communication Mathematic Skill	*Equalvariances assumed*	.050	.824	2.343	44	.024
	Equalvariances not assumed			2.343	43.998	.024

According to the results presented in table 5, the t-test reveals that homogeneity test demonstrates consistent variances across the two data sets. Therefore the calculated t value stands at 2.343, accompanied by a two-tailed p-value of 0.024, which is under 0.05. Consequently, we reject the null hypothesis (H_0), thereby supporting the alternative hypothesis (H_a). This implies that there exists a notable gap in mathematical communication abilities among pupils in the group participated in the RME learning approach and the control group undergoing conventional education at SMA Negeri 1 Kuok, class X.

This research indicates that students utilizing the RME learning approach illustrates enhanced mathematical communication skills in comparison to individuals participated in traditional learning approach. A post-test administered in the experimental group, comprising 23 participants, revealed a mean score of 78.70. In contrast, the control group, also consisting of 23 participants, achieved a mean score of 40.65. Hypothesis testing conducted with SPSS 25 and employed the T-Test resulted in a significance (2-tailed) value of 0.024 inferior to 0.05, this resulted in the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_a). The findings indicate that the average post-test score of the test group surpassed that of the control group. Therefore, it can be inferred that the RME learning approach positively affects the mathematical communication abilities of students in class X at SMA Negeri 1 Kuok.

The examination of the data resulting from the students' mathematical communication skills test following the implementation of the RME instructional approach indicated that among the 23 students involved in the study, 19 students (82.00%) met the minimum completion criteria, while 4 students (18.00%) did not meet this requirement. The enhancement in mathematical communication skills due to this method has enabled students to meet the standards for completion. The achievement of these students stemmed from the utilization of the RME approach, which facilitates the learning experience by

incorporating everyday occurrences and students' own experiences, thereby fostering more significant learning opportunities.

The findings from this research align with Nofrianto (2017) titled "The Impact of RME Learning Application on Students' Mathematical Communication Skills According to Self Efficacy" which indicates that the average last test scores for students in the experimental group reached 92.34, whereas the control group scored 58.25. Statistical analysis conducted using a t-test revealed that the t value from the experimental group exceeded the critical t value from the control group, resulting in t calculated = 1.43 and t critical = 1.03, with a significance level set at 5%. This finding suggests that H1 is upheld while H0 is dismissed. Based on Nurjanah et al (2022), it was found that the application of the RME model supported by audio-visual media has an effect on students' mathematical communication skills at SD Negeri 2 Kebonpedes. This finding is supported by the results of the T Test reveals a significance value of Sig. (2-Tailed) at 0. 000, indicating that the implementation of the RME model, augmented by audio-visual media, has a positive impact on the mathematical communication abilities of young students in elementary education.

According to the research performed by Atikah et al (2020) he examination of the information showed a difference in results between the first test and the last test for both the experimental group and the control group.. This variance is further substantiated by the t-test significance value of 0.00, which is less than 0.05, indicating that the alternative hypothesis holds true and reveals a notable distinction between the two groups. The significance found in this t-test lends support to the hypothesis of this research, which posits that the Realistic Mathematics Education model grounded in the tabut ethnomathematics has influences to the mathematical communication abilities in SDN located in Bengkulu. Therefore, it can be inferred that the implementation of RME Learning significantly enhances Students' Mathematical Communication Skills in relation to their Learning Interests when compared to traditional teaching. RME can enhance the enjoyment of learning, ensuring that when learners engage in educational tasks, they remain interested due to the information being straightforward and applicable to their prior knowledge.

This, in turn, has a positive impact on students' capacity to discuss mathematical concepts. Drawing from both this research and various earlier studies, it can be determined that the RME has beneficial influence mathematical communication abilities of tenth-grade students at SMA Negeri 1 Kuok. Based on research that has been conducted, the RME approach can have an impact and improve communication skills in mathematics, so that learning goals can be achieved. Therefore, it is important to carry out various other efforts, one of which is by continuing to apply the RME approach to influence other aspects of

mathematical abilities. According to the theory formulated by researchers, it is clear that RME greatly influences the mathematical communication abilities of students, leading to enhancement.

Conclusion

According to the findings of this research, it was found of average score for the first assessment regarding the student abilities in the experiment group scored 40.65, whereas the control group had an average score of 50.21. Additionally, the average score for the Post-test related to mathematical communication abilities for the experimental group was 78.69, in contrast to the control group's score of 73.91. Hence, it can be concluded that the RME teaching approach has a beneficial impact on the mathematical communication abilities of class X.1 students at SMA Negeri 1 Kuok.

This study still has some limitations, one of which is the small subject pool, as it exclusively focuses on tenth-grade students at SMAN 1 Kuok. Consequently, the results only highlight the specific challenges and suitable measures to address the identified issues. It is hoped that future researchers will take these limitations into account. RME does not serve as the sole solution to this challenge; in reality, there exists a variety of educational models and strategies that can be utilized depending on the context and individual needs of each student.

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