



The influence of Indonesian realistic mathematics learning (PMRI) based ethnomathematics on the improvement of mathematical communication skills in terms of gender

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ABSTRACT

This study uses the Indonesian Realistic Mathematics Education (PMRI) approach to see the differences between PMRI learning and conventional learning models for increasing mathematical communication skills in terms of student gender. The type of experiment used in this research is Quasi Experiment Design using pretest and posttest. The population of this study were students of class VIII Al Sudais Indonesia Foundation. The sample used was 2 classes selected by cluster random sampling technique, namely 1 class as an experimental class with the PMRI approach and 1 class as a control class with conventional learning. The data collection technique used is a test. Analysis of the data used is the normalize gain test, two-way ANOVA test, t-test, and Kruskal-Wallis test. The findings of this study are: a) the mathematical communication ability of students between those who take mathematics learning with the PMRI approach is higher than students who take conventional learning, b) the mathematical communication ability of male and female students between those who take mathematics learning with the PMRI approach is not. there are differences with students who follow conventional learning, and c) there is no interaction between the learning approach and gender differences in increasing mathematical communication skills

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INTRODUCTION

In the 21st century, education is faced with an era of knowledge that requires various intellectual capital that students need to have. According to Sidi (2001) that the paradigm is a change from the paradigm of teaching (teaching) to learning (learning). According to Tilaar (2009) that in this century the learning process requires educated human qualities. Some of the competencies needed for success include the ability to (1) think critically, analyze, and solve complex real world

problems, (2) find, evaluate, and use appropriate learning resources, (3) work together in teams and small groups, (4) effective oral and written communication skills, and (5) use content knowledge and intellectual skills to become continuous learners (Dutch et al., 1998). The same thing was expressed by Trilling & Hood (1999) that some of the skills that must be possessed in the knowledge era include (1) critical thinking skills and hard work, (2) creativity, (3) collaboration, (4) communication, (5) computing, and (6) career and independence.

In learning activities, communication is an important part because the communication process can help build meaning and explain ideas. During learning communication between teachers and students can be done orally or in writing (Wijayanto et al., 2018). Communication can occur between individuals or groups. As social beings, communication is an important part of everyday life (Ahmad & Nasution, 2018). When there is communication between the teacher as a communicator and students as communicants, where students receive messages in the form of mathematical concepts. Mathematics is inseparable from problems presented with symbols, symbols, graphs, diagrams, pictures and variables (Lutfianannisak & Sholihah, 2018). With qualified communication skills can help students understand the mathematical problems presented so as to be able to provide ideas to solve problems orally or in writing (Hendriana & Kadarisma, 2019).

Mathematical communication is one of the process standards in Mathematics learning proposed by the National Council of Teachers of Mathematics (NCTM, 2000). Mathematical Communication Skills refers to students' abilities to (1) organize and relate mathematical thinking through communication; (2) communicating logic and mathematical thinking to friends, teachers, and others; (3) analyze and assess the mathematical thinking and strategies used by others; and (4) using mathematical language to express mathematical ideas correctly, (NCTM, 2000).

Learning mathematics aims to equip students to be able to think critically, logically and practically, as well as to have a positive attitude and have a creative spirit in solving a problem. The difficulties experienced by students in solving math problems are related to the students' own perceptions in learning mathematics (Fredlina et al., 2021; Hasbullah & Sajiman, 2021).

The results of the research conducted by Wijayanto showed the low ability of students' mathematical communication where students experienced difficulties and made mistakes when expressing problems in questions into mathematical notation and symbols (Wijayanto, 2018). Furthermore, the results of Lutfianannisak's research show that students who have low mathematical communication skills, these students have not been able to find mathematical ideas and describe problem situations in questions that have been given in oral or written form, pictures/diagrams, have not been able to provide a representation of work results. logically (Lutfianannisak & Sholihah, 2018). Also supported by the results of Yanti's research showing the low ability of students' mathematical understanding and communication based on students' answers to the questions given (Yanti et al., 2019).

This was also reinforced based on observations and interviews conducted by researchers at the As Sudais Indonesia Islamic Boarding School, Kab. Bogor, the results obtained were that students' mathematical communication skills were still low. In class VIII students, as many as 70% of students complained because they often had difficulty understanding questions in each material from the mathematics lesson being taught, whether it was Geometry, Statistics, or Algebra material. Based on information from one of the mathematics teachers, many of the difficulties experienced by students were found when given the form of word problems. These errors include: (a) errors in writing what is known and asked; (b) students have difficulty in describing the situation on the problems contained in the questions; (c) students have difficulty expressing solutions to problems in the form of mathematical notations and symbols; and (d) students have difficulty explaining the results of their work logically.

Realistic mathematics learning (PMRI) provides opportunities for students to construct subject matter and a balanced emphasis on mathematical concepts. Realistic learning starts from

something real or something that is close to students' daily lives. PMRI has the goal of increasing the intelligence of students so they are interested in learning mathematics (Saptana et al., 2022). The PMRI approach can help reduce students' fear of mathematics which can cause students to be active in learning mathematics so that meaningful mathematics learning can be created (Ndiung et al., 2019). An important tenet of PMRI is their involvement in mathematics which starts from a meaningful context.

In its development, over time, various studies began to emerge that linked mathematics and culture, or what is known as ethnomathematics. Ethnomathematics in history and pedagogy emphasizes a broad conceptualization of mathematics that makes it possible to identify some practices that are inherently mathematical (Ernest, 1991). The concept of ethno includes all that can be identified culturally by jargon, codes, symbols, myths, and even specific ways of reasoning and information. This stems from the concept of culture as the result of a hierarchy of behavior, from individual behavior through social behavior to cultural behavior. According to Shirley (1995) ethnomathematics is mathematics that arises and develops in society according to local culture. Ethnomathematics includes mathematical ideas,

The research plan that will be carried out is that the teacher gives contextual problems to students such as, assigning students (who have formed groups, where one group consists of 4 students) to go to the canteen to observe the price of traditional snacks sold in the canteen, then students are asked to buy 2 types different snacks. (this activity is carried out outside of mathematics learning hours or outside school hours), then students carry out assignments that have been given by the teacher at the previous meeting. That is, in the form of several types of market snacks that have been purchased by students, then from the snacks that have been purchased by these students, The teacher asks students to make questions using a mathematical model with the condition that students do not tell their friends who are in other groups the unit price of the snacks that have been purchased by their group. This is because the questions made by each group will be exchanged with other groups for discussion. After that, the group that has received questions from other groups, discusses with their group mates to solve the problems that have been given. Then the results of the discussion can be presented to the group giving the questions to correct the answers presented whether the findings of the group given the questions match the actual price of the snacks per unit that have been purchased by the group giving the questions. So that from the discussion activities between groups of students correcting each other's work results from the group that has been given questions by the group that gave the questions. Here the teacher's role is to correct the form of questions and answers that have been given and worked on by students whether they are in accordance with mathematical modeling or not, if not then the teacher will direct students to correct the inaccurate parts of the questions that have been made by students and the answers that have been answered. done by students. So that between students and students and students and teachers will build positive interactions. Here the teacher's role is to correct the form of questions and answers that have been given and worked on by students whether they are in accordance with mathematical modeling or not, if not then the teacher will direct students to correct the inaccurate parts of the questions that have been made by students and the answers that have been answered. done by students. So that between students and students and students and teachers will build positive interactions. Here the teacher's role is to correct the form of questions and answers that have been given and worked on by students whether they are in accordance with mathematical modeling or not, if not then the teacher will direct students to correct the inaccurate parts of the questions that have been made by students and the answers that have been answered. done by students. So that between students and students and students and teachers will build positive interactions.

In order to optimize learning that can affect students' mathematical communication abilities, teachers also need to pay attention to students' abilities based on gender. Based on research conducted by Rosi Dwi Pinanti (2014) there are differences in communication skills between male

and female students. As in male students, their written communication skills are more accurate than those of female students. In general, teachers give equal treatment to female and male students based on the principle of gender equality, but it turns out that the reasoning abilities of male and female students have different and varied speeds (Sudi Prayitno, et al: 2014).

Based on problems regarding students' communication skills, they are still relatively low compared to learning conditions in the New Normal Era. This can hinder students in developing their communication skills. Therefore the purpose of writing this article is to find out: a) differences in the mathematical communication abilities of students who take mathematics lessons using the Indonesian Realistic Mathematics Education (PMRI) approach and students who take conventional learning, b) differences in the mathematical communication abilities of male students and students women in both classes with Indonesian Realistic Mathematics Education (PMRI) and conventional learning, and c) there is an interaction between learning approaches and gender differences towards improving mathematical communication skills.

RESEARCH METHOD

The type of research used is quantitative research, while the method used is the experimental method. The experimental research method is a research method used to find the effect of certain treatments on others under controlled conditions (Sugiyono, 2017). The design used in this study was a quasi-experimental design with the nonequivalent pretest-posttest only control group design. This research was conducted at the As Sudais Indonesia Islamic Boarding School, Kab. Bogor, namely in class VIII students. As for the research sample, namely students in class VIII C as an experimental class totaling 25 students and VIII D as a control class totaling 24 students selected from 5 classes with cluster random sampling (random class technique). The sampling technique from the population is carried out randomly without regard to the strata in that population. The draw was carried out by giving serial numbers to each class and then taking them randomly. In taking the first serial number for the experimental class and taking the second serial number for the control class. The experimental class is a class that is taught using the PMRI approach, and the control approach is a class that is taught with the 3R approach, namely Reading, Writing, and Arithmetics. The nonequivalent pretest-posttest only control group design can be seen in the following figure. The draw was carried out by giving serial numbers to each class and then taking them randomly. In taking the first serial number for the experimental class and taking the second serial number for the control class. The experimental class is a class that is taught using the PMRI approach, and the control approach is a class that is taught with the 3R approach, namely Reading, Writing, and Arithmetics. The nonequivalent pretest-posttest only control group design can be seen in the following figure. The draw was carried out by giving serial numbers to each class and then taking them randomly. In taking the first serial number for the experimental class and taking the second serial number for the control class. The experimental class is a class that is taught using the PMRI approach, and the control approach is a class that is taught with the 3R approach, namely Reading, Writing, and Arithmetics. The nonequivalent pretest-posttest only control group design can be seen in the following figure. Writing (writing), and Arithmetic (country science). The nonequivalent pretest-posttest only control group design can be seen in the following figure. Writing (writing), and Arithmetic (country science). The nonequivalent pretest-posttest only control group design can be seen in the following figure.

Table 1.

Research design			
Group	Pretest	treatment	Posttest
Experiment	O1	X	O2
Control	O3	-	O4

Data collection techniques are in the form of: a) Mathematical communication ability tests are given to students in the form of essay tests as a measuring tool for mathematical communication abilities, therefore the tests are arranged based on indicators of mathematical communication abilities, b) documentation to find data regarding matters -things or variables in the form of notes, transcripts, books and so on, c) Interviews to obtain clear information for research needs, and d) Observations made by researchers, namely observations of researchers when learning mathematics and the state of the school to be studied.

The instrument used in this study was a test of mathematical communication skills which was compiled based on indicators of mathematical communication abilities. Data analysis techniques in the form of: a) normalize gain test, b) prerequisite test using the Liliefors normality test and homogeneity test using the Bartlett method, c) hypothesis testing using two-way ANOVA test and t-test, d) ANOVA follow-up test (double comparison) if the results of the analysis of variance show that the null hypothesis is rejected by the Scheffe method. e) Non-parametric statistics use the Kruskal-Wallis test when the assumptions of the Anova test are not met.

RESULTS AND DISCUSSION

1. Mathematical Communication Ability Data

To find out the initial state of students' mathematical communication skills, a pretest of mathematical communication abilities was carried out on algebraic operations material. After the initial data about students' mathematical communication abilities were obtained, then the highest score (X_{max}) and lowest score (X_{min}) could be found in the control class and the experimental class. Then look for the size of the central tendency which includes the mean (\bar{x}), median (Me), mode (Mo), and the size of group variation including range (R) and standard deviation (S) which can be summarized in the following table:

Table 2.
Description of Mathematical Communication Ability Data

Data	Class	Gender	X_{max} x	X_{min} n	Central Tendency			Group Variation		
					\bar{x}	Me	Mo	S	R	N
Pretest	Control	Man	54	13	28,4	25,5	23	12,13	41	14
		Woman	60	15	40,2	38	60	16,68	45	10
	Experiment	Man	48	15	37,4	26,5	36	9,50	33	14
		Woman	68	24	47,9	39	-	12,13	44	11
Posttest	Control	Man	60	23	46,7	31,2	46	23,12	27	14
		Woman	65	28	48,6	44,3	63	32,23	36	10
	Experiment	Man	88	53	79,8	58,9	72	25,13	29	14
		Woman	92	57	83,7	63,7	77	32,31	36	11

Based on Table 2, it is known that the average pretest of mathematical communication skills in terms of gender differences (males and females). In the pretest results, female students in the experimental class were higher than female students in the control class, and male students in the experimental class were higher than male students in the control class. Likewise, the posttest results of female students in the experimental class were higher than female students in the control class, and male students in the experimental class were higher than male students in the control class.

To determine the improvement and quality of students' mathematical communication skills after participating in mathematics learning using the Indonesian Realistic Mathematics Education (PMRI) approach and students participating in conventional learning, gain index data is used.

Below are presented descriptive statistics of the gain index data for the experimental class and the control class.

Table 3.

Description of Data Mathematical Communication Ability Improvement

Class	Gender	N	Xmax	Xmin	Central Tendency			N-Gain Criterion
					\bar{x}	Me	Mo	
Control	Man	10	0.74	0.02	0.28	0.25	0.34	Low
	Woman	14	0.50	0.05	0.25	0.24	0.23	Low
Experiment	Man	14	0.51	0.02	0.34	0.41	0.33	Currently
	Woman	11	0.60	0.11	0.41	0.33	0.23	Currently
Control		24	0.74	0.11	0.27	0.24	0.33	Low
Experiment		25	0.60	0.02	0.38	0.39	0.33	Currently

Based on the table above, it is known that the average male student in the Experiment class is 0.34 higher than the male student in the control class, namely 0.28 and the average female student in the Experiment class is 0.41 higher than female students in the control class, namely 0.25. overall the average score increase in the experimental class is 0.38 and the average in the control class is 0.27. This shows that the class that received the Indonesian Realistic Mathematics Education (PMRI) learning method had a higher average score compared to the class that received the conventional learning model.

2. Hypothesis testing

The results of the two-way ANOVA calculation of mathematical communication ability and gender differences are presented in the table below:

Table 4.

Summary of Two-Way Analysis of Variance

Source	JK	DK	RK	Fcount	Ftable
Learning Model (A)	11,691	1	11,691	5,169	4,057
Gender (B)	2152,551	1	2152,551	2,730	4,057
Interaction (AB)	31,862	1	31,862	0.188	4,057
Error	7609,022	45	169,089		
Total	9805,125	48			

a) The Mathematical Communication Ability of Students who Participate in Mathematics Learning with the Indonesian Realistic Mathematics Education Approach (PMRI) is higher than Students who Follow Conventional Learning.

Based on table 4 above, it can be seen that the learning model (A) has Fcount = 5.169 and Ftable = 4.057. Based on the calculation of data analysis in the table, it can be seen that Fcount > Ftable. Thus it can be concluded that H0 is rejected, meaning that there are differences in the mathematical communication abilities of students who take mathematics learning using the Indonesian Realistic Mathematics Education (PMRI) approach and students who take conventional learning or students' mathematical communication skills between those who take mathematics learning with a realistic mathematics education approach indonesia (PMRI) is higher than students who take conventional learning.>

After the researchers tested using the test, the average results of students' mathematical communication abilities in the experimental class were higher than those in the control class.

this means learning with the Indonesian Realistic Mathematics Education (PMRI) approach is better than the conventional learning model, this is because the Indonesian Realistic Mathematics learning model (PMRI) trains students to get used to thinking and expressing opinions so that students have the courage to explain their answers, in addition to learning with the Indonesian Realistic Mathematics Approach (PMRI) is also able to foster cooperation within the group so that the use of this method is effective for improving students' mathematical communication.

Based on this, Pugalee (2004) said that if students are given the opportunity to communicate about mathematics, then students will try to awaken their thinking processes in developing skills in writing and reading mathematics or mathematical literacy. By using contextual problems (things that are close to students), students organize these problems into models, and present their work so that students are able to express opinions, answer questions, and justify their answers. From the PMRI characteristics, it can be seen that there is a relationship with students' mathematical communication abilities, which means that the Indonesian Realistic Mathematics Education (PMRI) approach is suitable for improving students' mathematical communication skills.

b) There is no difference between the Mathematical Communication Skills of Male and Female Students who take Mathematics Learning with the Indonesian Realistic Mathematics Education Approach (PMRI) and Students who Take Conventional Learning.

Based on table 4 above, it can be seen that gender (B) has $F_{count} = 2.730$ and $F_{table} = 4.057$. Based on the calculation of data analysis in the table, it can be seen that $F_{count} < F_{table}$. Thus it can be concluded that H_0 is accepted, meaning that there is no difference in the mathematical communication skills of male and female students both in the class that will be taught by learning Indonesian Realistic Mathematics Education (PMRI) and conventional learning.

Based on the calculation, there is no difference in the mathematical communication abilities of male students and female students both in classes with Indonesian Realistic Mathematics Education learning and conventional learning. Based on the theory which states that the gender factor (the effect of differences between men and women) in mathematics is due to biological differences in the brains of boys and girls which is known through observation, that girls, in general, are superior in language and writing, while boys excel in mathematics because of their better spatial abilities.

According to the American Psychological Association cited by Ariska Yuliana (2014) posited that based on a recent analysis of international research, the ability of women around the world in mathematics is no worse than that of men, although men have more confidence than women in mathematics, and women from countries where gender equality has been recognized show significant ability. do better on math tests.

Various studies also state that there is no gender role, male or female, which outperforms each other in mathematics and in the end, women can excel in various fields related to mathematics. As a result, gender differences in mathematics are quite difficult to change. Based on the analysis of the research data described in this section, it shows that there is a diversity of results between male and female students. So it can be concluded that the role of gender in this study has a significant effect on learning mathematics.

The diversity of results between male and female students is due to factors that influence student learning outcomes, namely internal factors and external factors. Internal factors are factors from within the student that relate to how much the individual likes or dislikes the material being studied by students, while external factors are factors from outside the student's self including the family environment, harmonious relationships between family

members will help students carry out learning activities well so that the learning outcomes obtained will be good too.

c) There is no interaction between learning approaches and gender differences in improving mathematical communication skills.

Based on Table 4 above can be seen that in sex (B) it has $F_{count} = 0.188$ and $F_{table} = 4.057$. Based on the calculation of data analysis in the table, it can be seen that $F_{count} < F_{table}$. Thus it can be concluded that H_0 is accepted, meaning that there is no interaction between Indonesian Realistic Mathematics Education (PMRI) and gender differences in improving mathematical communication skills.

Based on table 7 above on the test for normality and homogeneity then the data enhancement The students' mathematical communication skills obtained by the researcher cannot fulfill the normality test and homogeneity test. In other words, hypothesis testing cannot be done with parametric statistics, but instead uses nonparametric statistics. So the researchers decided to test the data using the Kruskal-Wallis test, as an alternative to the Anova test if the Anova assumptions are not met. The statistical formula used is:

$$H = \frac{12}{n(n+1)} \sum_{j=1}^k \frac{R_j^2}{N_j} - 3(n+1)$$

The H_{count} value is then compared to the table Chi Square price with $dk = k - 1 = 4 - 1 = 3$. If the error level is 5% (0.05), then the Chi Square table price is 17.815. The value of H_{count} turns out to be smaller than the table (8.233 17.815) so that a decision can be taken that H_0 is accepted, in other words that there is no difference in improving mathematical communication skills using the Indonesian Realistic Mathematics Education (PMRI) learning approach in terms of student gender at the As Sudais Indonesia Islamic Boarding School, Kab. Bogor.

Then Based on statistical tests, it can be seen that there is no interaction between learning approaches and gender differences in improving mathematical communication skills. This means that there is no influence given to differences in learning with gender together on improving mathematical communication skills. So, learning mathematics with the Indonesian Realistic Mathematics Education (PMRI) approach is good for improving mathematical communication skills without separating men from women. Thus, from the results of the above interaction description, it was found that the learning approach that contributed the most to improving mathematical communication skills was the learning approach compared to gender.

It was concluded from the results of the analysis that there was no interaction, it was possibly caused by 2 factors namely: (1) student factors: students' unpreparedness with the material to be taught so that learning was hampered, especially that both male and female students had not been able to develop creative ideas and mathematical mindset, has not been able to investigate various strategies in solving problems. Besides that, in solving questions, students tend to exchange opinions so that the answers are not based on their own conscience, (2) the time factor: the targeted time is sometimes not in accordance with reality, partly due to: the condition of the class where the arrangement of class furniture is lacking support,

CONCLUSION

Based on the data analysis and hypothesis testing that has been done, it can be concluded that: (1) The mathematical communication skills of students participating in mathematics learning using the Indonesian realistic mathematics education approach (PMRI) are higher than students participating in conventional learning; (2) There is no difference in the mathematical communication abilities of male and female students between those participating in mathematics

learning using the Indonesian realistic mathematics education approach (PMRI) and students participating in conventional learning; and (3) there is no interaction between learning approaches and gender differences in improving mathematical communication skills.

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