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AIP Conference Proceedings 2733, 030023 (2023)

<https://doi.org/10.1063/5.0140241>



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# The Effectiveness of Guided Inquiry Learning on Students' Mathematical Communication Skills

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**Abstract.** The purpose of this study was to analyze the difference between guided inquiry learning and conventional learning on mathematical communication skills in fifth grade elementary school students. The research method used in this research is a quasi-experimental method with a quantitative approach. The experimental design used is a posttest only control group design. The subjects of this study were fifth grade elementary school students in Godong District, Grobogan Regency, Indonesia. Data collection techniques using observation techniques, tests and documentation. The data analysis used includes the prerequisite analysis test, namely the normality test and homogeneity test, the final analysis uses the T test. The results show that there are differences between the guided inquiry learning model and conventional learning to improve the students' mathematical communication skills. The results of data processing with the t test showed that the guided inquiry learning variable was Sig. (2-tailed) is 0.004 < 0.05 then  $H_0$  is rejected, and  $H_a$  is accepted. It means there is the difference in mathematical communication skills between students who are taught using guided inquiry learning and conventional learning, the average value of guided inquiry learning is 72.71 which is higher than the conventional class of 58.85.

## INTRODUCTION

The ability to communicate is an important component in the learning process, because it can help teachers understand students' abilities in interpreting and expressing understanding of the concepts and processes they learn [1] the importance of communication skills in mathematics learning is because mathematics contains an efficient, orderly language of symbols, and prioritizes quantitative analysis so that mathematical communication skills become a bridge to access material or mastery of mathematical material; [2] mathematical communication is capital in completion, the basis for mathematical exploration and investigation. Another benefit is that it is a forum for social activities with peers.

Based on observations at state elementary school 2 Harjowinangun Indonesia, it shows that the ongoing learning process is still teacher-centered. Students are less involved in expressing the results of the knowledge they gain while studying. This results in students not being accustomed to optimally applying mathematical communication skills. Only 30% of students have good communication skills, this data is obtained based on the analysis of students' answers in expressing mathematical symbols and conveying mathematical ideas both orally and in writing in accordance with mathematical statements. This indicates that mathematical communication is still not mastered by students.

The selection of the right learning model is one of the efforts to improve students' mathematical communication skills. This is because the learning model is a structured learning design that has a specific purpose so that it has an impact on the effectiveness and efficiency of a learning process [3]. The guided inquiry model is learning to develop systematic, logical and critical thinking skills or develop students' intellectual abilities [4]. The model is relevant to the research objective, namely optimizing mathematical abilities which are identical to intellectual abilities related to the outpouring of ideas and ideas of students [5]. Thus, through the guided inquiry model students' mathematical communication skills are able to develop optimally [6].

Inquiry is defined as the process of asking and finding answers to scientific questions posed. Scientific questions are questions that can lead to investigative activities on the object of the question [7]. Inquiry is a series of learning activities that emphasize critical and analytical thinking processes to seek and find answers to the problems in question [8]. Meanwhile, inquiry as a process in which a person seeks information or understanding, it is often called away of thought. Meanwhile, Kildsvatter et al explain inquiry as a teaching model where teachers involve students' critical thinking skills to analyze and solve problems [9].

Guided inquiry learning (Guided Inquiry) is an inquiry learning method in which the teacher provides fairly broad guidance or instructions to students. Part of the planning is made by the teacher; students do not formulate problems. In guided inquiry learning, the teacher does not let go of the activities carried out by students. Teachers must provide direction and guidance to students in carrying out activities so that students who think slowly or students who have low thinking skills are still able to follow the activities that are being carried out and students who have high intelligence do not monopolize activities. [10].

Mathematical communication skills are the ability to convey mathematical ideas/ideas, both orally and in writing as well as the ability to understand and accept other people's mathematical ideas/ideas carefully, analytically, critically and evaluatively to sharpen understanding [11]. Mathematical communication ability is defined as a dialogue event that occurs in the classroom environment, where there is a transfer of the message conveyed [12].

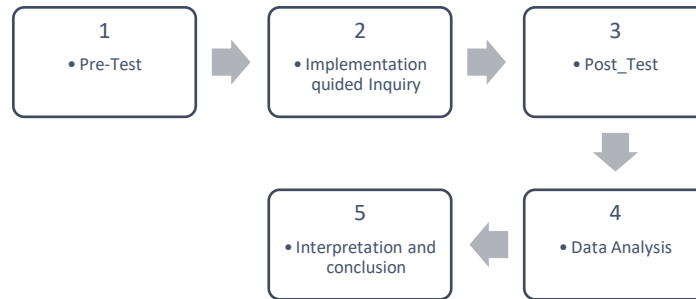
Mathematical communication is a way to express ideas that have been encountered, and able to connect the concept of an object, image, or diagram in a mathematical idea to be expressed orally or in writing. Written Communication Ability Indicators include; 1) Presenting mathematical problems in the form of objects (pictures, diagrams, tables); 2) debate and solving mathematical problems; 3) Expressing mathematical concepts from everyday problems into mathematical models [11,12].

The syntax of the inquiry method consists of (1) Orientation is a step to foster a conducive learning atmosphere. Orientation stages: explain the topic, goals, and learning outcomes to be achieved by students, explain the steps inquiry model activities for students to achieve goals, provide motivation by explaining the importance of the topic and learning activities, (2) formulating problems, the teacher gives students to a problems or problems that contain puzzles. The process of finding the answer is the most important thing in learning inquiry to gain experience through students' thinking processes, (3) formulating hypotheses, students are given various questions that can encourage participants students to provide hypotheses from problems discussed, (4) collect data is a very important mental process in the intellectual development of learning inquiry, due to required activities to test the proposed hypothesis, (5) testing hypotheses is developing rational thinking skills. It means, the truth of the answer is not only based on argument, but supported by data found and can accountable, (6) formulate Conclusion is the process of describing findings based on the results of hypothesis testing. In order to reach an accurate conclusion the teacher should be able to show students about which data relevant (9). The purpose of this study was to analyze the effectiveness of guided inquiry learning on the mathematical communication skills of fifth grade elementary school students. The indicators of guided inquiry learning are said to be effective if the average mathematical communication skills of students taught by guided inquiry learning are better than conventional learning.

## METHODOLOGY

This study was conducted to determine the difference in the mathematical communication skills of fifth grade elementary school students between guided inquiry learning and conventional models. The results of the data collected will be used as a basis for using the model to improve students' academic performance. The stages of this research started from giving pre-test. The activity was continued with the implementation of guided inquiry in the experimental class. After the series of learning activities are completed, students are given a post-test to measure mathematical

communication skills. The post test results were then analyzed using statistical hypothesis testing. the results of hypothesis testing are interpreted, and conclusions are drawn. The complete research stages are in Figure 1.



**FIGURE 1.** Research Flow

The research method used in this study is a quasi-experimental method with a quantitative approach. The form of this experimental design is posttest only control group design. In this design, there are two classes used in the study, namely the experimental class was treated with a guided inquiry learning model and the control class was given a conventional model. Before being given treatment, both classes were given a pre-test using the same test instrument. The pre-test was to determine the initial state between the experimental class and the control class.

**TABLE 1.** Research Design Model

Experiment	O1	X	O2	Y
Control	O3	-	O4	Y

Information:

- O1: Pretest of experimental class
- O2: Post-test results for the experimental class
- O3: Control class pretest
- O4: Results of the control class post-test
- Y: mathematical communication skills

The population in this study was 110 students class V elementary school (SD) in Godong District, Grobogan Regency, Indonesia. The research sample was selected using a purposive random sampling technique. Sample on research is a fifth-grade student of SD 2 Harjowinangun totaling 21 participants students, with 13 male students and 8 female students as the experimental class. And as the control class is SD 1 Harjowinangun, totaling 20 students with 11 male students and 9 female students.

The data collection technique uses test and documentation techniques. The test is used to measure mathematical ability given before and after learning with the application of guided inquiry learning. Documentation is used to show the activities carried out by students in each learning phase using guided inquiry learning. The variables in this study are guided inquiry learning models and mathematical communication skills. Data analysis in this study uses prerequisite tests which include normality test and homogeneity test, while research hypotheses are tested using T test.

## RESULT AND DISCUSSION

Before testing the hypothesis, the prerequisite test for the analysis test is carried out, namely the normality test and homogeneity test.

**TABLE 2.** Normality Test

Class	Kolmogorov-Smirnova		
	Statistic	df	Sig.
E	0.176	21	0.090
K	0.104	20	0.200

Based on Table 2, it shows that the results of the normality test using the Kolmogorov-Smirnov test are that both classes are normal. It is proven that the sig result in the experimental class is 0.090 and the control class is 0.200 > 0.05.

**TABLE 3.** Homogeneity Test

Results		Levene			Sig.
		Statistics	df1	df2	
Results	Based on Mean	1,591	1	39	,215
	Based on Median	1,596	1	39	,214
	Based on Median and with adjusted df	1,596	1	38,971	,214
	Based on trimmed mean	1,666	1	39	,204

Based on table 3, it shows that the results of the homogeneity test using the test Levene Statistics shows that both the experimental class and the control class in normal conditions, the sig result is 0.215 or greater than 0.05.

To find out the difference between the two studies, a pretest was carried out to determine the normal state data. Furthermore, the experimental class is given a guided inquiry learning model while the control class is conventional. At the end of the study, both classes were given a posttest, each test consisted of five questions referring to the indicators of students' mathematical communication skills.

**TABLE 4.** TestIndependent Sample T Test hypothesis 1

Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
TKKMEqual variances results assumed	1,591	.2153	0.7739	.004	13,864	4.505	4.752	22,977	
Equal variances not assumed		3.05936	0.003	0.004	13,864	4,532	4.672	23.056	

Based on Table 4 shows that the results of the analysis of the guided inquiry learning model with conventional learning on students' mathematical communication skills that the average score of the guided inquiry learning posttest is higher than conventional learning. The results of data processing with the t test showed that the guided inquiry learning variable was Sig. (2-tailed) is 0.004 < 0.05 then  $H_0$  is rejected, and  $H_a$  is accepted. It means there is the difference in mathematical communication skills between students who are taught using guided inquiry learning and conventional learning, the average value of guided inquiry learning is 72.71 which is higher than the conventional class of 58.85.

These results are inseparable from the application of the guided inquiry learning model that emphasizes two-way interaction between teachers and students. In the phase of making hypotheses and collecting data, in this phase there is a two-way interaction between students and teachers, students are invited to make temporary answers and the teacher guides students to collect as much data as possible, so that in this phase the indicators of students' communication skills in making arguments can develop well, while conventional learning students tend to be passive during the learning process. as Figure 2.



**FIGURE 2.** Phase Making Hypothesis



**FIGURE 3.** Phase Analyzing Data

The main basis of communication skills is that students need to practice reasoning and mastering concepts. On Figure 3 shows the data analysis phase, in this phase the guided inquiry learning model facilitates students to be able to reason and master concepts well which is guided in student worksheets. Students observe objects and are able to name objects that are similar to the shape, this has trained verbal communication skills. Thinking skills are developed in the next stage, namely students must be able to guess how many shapes are based on the knowledge they have. Next, students discuss based on the evidence collected to check the hypotheses that have been made. So that the guided inquiry learning model can train mathematical communication skills. While conventional learning, student worksheets are not designed to strengthen students' reasoning, resulting in mathematical communication skills not developing.

The success of the guided inquiry learning model of this study is relevant to the research conducted by [13]. In their research, that there were differences in the value of students' mathematical communication skills, between conventional learning and the guided inquiry learning model. In his research, the guided inquiry learning model can improve students' mathematical communication.

Based on the T test, it shows that the guided inquiry model can influence students' mathematical abilities. This is because each phase contained in the guided inquiry model can affect thinking skills and increase learning activities. The results of this study confirm previous research with the conclusion that learning mathematics with a guided inquiry

approach was significantly better in improving students' mathematical understanding and communication skills in terms of learning and categories of students' mathematical abilities [14].

This study strengthens the results of previous studies with the results showed that 86.6% had actually exceeded the minimum completeness criteria that had been set at 70. It could be concluded that guided inquiry was effective in improving students' mathematical abilities [15]. Thus, the guided inquiry learning model is very suitable for students to be able to improve their mathematical abilities.

## CONCLUSION

Improving the mathematical communication skills of fifth grade elementary school students. Because in the guided inquiry learning model, students can learn to solve their own problems and when studying in groups, their communication skills with their friends can be well trained. In connection with this research, the authors can put forward the following suggestions: (1) Teachers should use guided inquiry learning models to improve students' mathematical communication skills in elementary schools because guided inquiry learning is more effective (2) Teachers should be able to develop other learning models to improve students' mathematical communication skills. Students are expected to always be active in each lesson.

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