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IMPLEMENTATION OF THE *COLLABORATIVE PROBLEM-SOLVING* LEARNING MODEL USING GEOGEBRA ON THE MATHEMATICAL COMMUNICATION ABILITY AND CONFIDENCE OF MTS ISLAMIYAH CIOMAS STUDENTS

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Abstract

One of the low cognitive and affective abilities of students is mathematical communication skills and self-confidence. This study aims to determine the difference in mathematical communication skills and students' confidence between those who use *the Collaborative problem-solving model* with the Geogebra application and those who use the lecture method. The research design used in this study is *actual experimental design*. Sampling in this study was carried out randomly, namely classes VIIIA and VIIIB. The data collection technique uses a mathematical communication ability test and a student confidence questionnaire. Data analysis was carried out by prerequisite tests (normality and homogeneity tests), hypothesis tests, and t-tests. From the results of the t-test data *posttest of* students' mathematical communication skills, a score *of sig. (2-tailed)* 0.047 < 0.05, so it was concluded that there was a difference in the mathematical communication ability of students in the experimental and control classes. The average result of the confidence questionnaire of students in the experimental class was 75.75, while in the control class, it was 55.80, so it was concluded that the student's confidence in the experimental class was better than that of the control class.

Keywords: Mathematical Communication, Confidence, *Collaborative Problem Solving,* Geogebra

INTRODUCTION

Every individual in the 21st century needs to master at least four skills, namely critical thinking skills (*critical thinking*), creative thinking (*creative thinking*), communication skills (*communication)*, and collaboration skills (*collaboration*) (Adventure) *et al*., 2019; Priyatni & As'ari, 2019; Daughter *et al*., 2021). In the 21st century, the development of science and technology requires students to be able to follow it, including in mastery of mathematics. Mathematics learning is so essential that it is studied almost at all levels of education, from elementary school, junior high school, to high school. Mathematical skills and knowledge are critical in everyday life. Almost all human activities are inseparable from the application of mathematics.

According to Fay *et al*. (2022), the *National Council of Teachers of Mathematics* formulates the objectives of mathematics learning: Mathematical problem-solving, mathematical reasoning and proof, mathematical communication, mathematical connections, and mathematical representation are the five main objectives in mathematics learning. Among the five goals, mathematical communication skills are among the most important. According to Baroody, there are two main reasons why mathematical communication is the main focus of

mathematics learning. First, because mathematics is the language of mathematics itself, and second, because the process of learning and teaching mathematics is a social activity that involves at least two parties, namely teachers and students (Argarini *et al*., 2020; Baroody & Coslick, 1998; Hamidah & Kusuma, n.d.).

Given the importance of mathematical communication skills in mathematics learning, mathematical communication skills must be improved. Mathematical communication skills are the ability to convey information and ideas related to mathematics in mathematical language (Erath *et al*., 2021; Gardenia *et al.*, 2021). The indicators of mathematical communication skills are 1) The ability to express mathematical ideas or ideas both orally and in writing; 2) the Ability to interpret and assess mathematical ideas or ideas both orally and in writing; 3) Ability to use mathematical terms, symbols, and structures in modeling mathematical situations or problems (Chasanah & Usodo, 2020; Kusumah *et al*., 2020).

Based on observations in grade VIII of Mts Islamiyah Ciomas, it was found that students' mathematical communication skills in learning are still low. This can be seen when students do not meet the indicators of thematic communication skills, where students do not write down the information in the questions, such as what is known and what is asked. Students also do not disclose the strategy of solving problems with these strategies systematically and clearly. Students are also less able to write mathematical symbols when solving mathematical problems. When given communication problems, almost all students have difficulty describing problems using mathematical models, and many are confused when interpreting questions.

In addition to mathematical communication skills, students must also have affective abilities to help the learning process so that confidence develops. Confidence is a feeling of confidence in the abilities possessed, such as not being too timid about actions, being free to act as you wish, taking responsibility for actions, treating each other with respect, being performance-oriented, and being able to recognize their strengths and weaknesses (Akbari & Sahibzada, 2020; White *et al.*, 2020; H. Hamidah *et al.*, 2022; malaria *et al.*, 2021). Self-identity indicators are 1) Belief in one's abilities, 2) Acting independently in making decisions, and 3) positive self-concept. 4) Dare to express opinions. Confidence plays a vital role in helping students realize their potential, and when they are confident, they will be more motivated and happy when learning math. However, the critical role of confidence is not in line with the facts happening on the ground.

Based on observations at MTs Islamyah Ciomas, grade VIII students lack confidence. This can be seen when the teacher orders them to work on the problem in front of the class, but

when they have come forward, he still asks his friends to be helped to write the answer. Besides that, he prefers to be silent in front of the class, saying he cannot. Even when he has written the answer, he still asks his friends because he feels doubtful about the answer he wrote. Based on this, students have not met the confidence indicator. In addition, when they present, they lack confidence in conveying the content of their presentation. When working in groups with their friends, they are still embarrassed to express their opinions, and students are even embarrassed to ask the teacher if they do not fully understand what is being taught. Many are not confident in their abilities. Even when faced with a problem, they always feel they cannot do it independently, so they prefer to see their friend's answer, which is considered more intelligent.

According to Andini *et al.* (2019), One factor that needs to be considered to understand the cause of low communication skills and students' confidence is the learning process itself. Most schools in Indonesia still use traditional learning methods that focus on direct teaching (*teacher-centered*). As a result, students' mathematical communication skills and confidence tend to decrease. Given the importance of these two aspects in mathematics learning, alternative methods are needed that provide opportunities for students to develop these skills. Researchers try to apply a collaborative problem-solving learning model to improve students' mathematical communication skills and confidence. This model is considered appropriate to be applied in the learning process to help achieve educational goals in the 21st century (Sun *et al*., 2020; Szabo *et al.*, 2020; Xu *et al*., 2023).

According to Setiawan Jamaan (2019), the collaborative problem-solving learning model encourages students to cooperate and collaborate to solve mathematical problems. Learning *Collaborative Problem Solving* Starting with giving problems, students can design individual problem-solving first. Students are divided into groups of 4-5 people to solve problems given by the teacher and finally present the results of their group work. The assignment encourages students to present their ideas about a problem in such a way that it helps them find the solution.

In addition to the learning model, learning media and platforms are indispensable to supporting the learning process because they can provide benefits such as adding information, facilitating learning, and increasing students' interest in learning. One of the media that can be used to learn mathematics is geometry. Geogebra is a very complete and diverse software or application that can be used in various ways to help in learning mathematics (Kramarenko *et al.*, 2020; John & Chen, 2023). Geogebra was developed in 2001 by Markus Hohenwarter. Geogebra can solve math problems, create virtual learning media, and draw geometric shapes

and function graphs (J. W. K. Hamidah & Auliana, 2024). According to Nuritha Tsurayya (2021), Geogebra has three uses: a medium for learning mathematics, a tool for making mathematical materials and solving math problems.

METHOD

This study uses quantitative research. This research occurred at MTs Islamiyah Ciomas, located in Kp. Babakan Sukawangi, Sukadana Village, Ciomas District, Serang Regency. The time of this research was carried out in the even semester of the 2023/2024 school year.

This study uses *a proper experimental design*, which allows researchers to control all external variables that can affect the implementation of the experiment. In the design of the actual experiment, the groups were taken randomly, namely classes VIIIA and VIIIB. Significance testing uses parametric *t-test-related* statistics (for two paired sample groups) and variant analysis when the groups are more than two.

Table 1. *Posttest-Only Control Design*

R	X	O
R		O

Information:

R : Two groups, each randomly selected

X : The group that was given the Collaborative Problem Solving model using Geogebra

O : Mathematical communication ability test

RESULTS AND DISCUSSION

1. Results of Descriptive Analysis

From the research that has been carried out, data on the results of the student mathematical communication ability test (*posttest*) for the experimental class and the control class were obtained. This data was obtained through a description test instrument regarding students' mathematical communication skills on the Two-Variable Linear Equation (SPLDV) material. The following are the data of the results of the mathematical communication ability test (*posttest*) for the experimental and control classes:

Table 2. Results of Posttest Descriptive Analysis

Results of Descriptive Analysis	
Eksperimen	**Control**

77.00	69.25

The table above shows that the average score of the student's mathematical communication ability test (*posttest*) for the experimental class is greater than that of the control class, namely the experimental class of 77.00, while the control class is 69.25. Furthermore, this difference will be tested significantly with the following statistical test.

2. Prerequisite Test

a. Normality Test Results

The students' mathematical communication ability test (posttest) data were obtained from the experimental and control classes with *the Kolmogorov Smirnov* test using SPSS version 29. The data can be considered normal if *the Sig* > a, where the value of a = 0.05. The normality test of the data of the student's mathematical communication ability test (posttest) is as follows:

Table 3. Kolmogorov Normality Test Results

-Smirnov

Class	***Sig.***
Post-test experiments	0,200
Posttest Control	0,108

The table above shows that the significant score for the students' mathematical communication ability test (*posttest*) of the experimental class is 0.200, and the control class is 0.108, where *Sig*. > 0.05. This shows that the research data is normally distributed.

b. Variance Homogeneity Test Results

The homogeneity test used in this study is *the Levene test* with SPSS version 29. The data is said to be homogeneous if it meets the criteria *of Sig.* > 0.05. The results of the homogeneity test data of the student's mathematical communication ability test (*posttest*).

Table 4. Hasil Uji Homogenitas *Based on Trimmed Mean*

Class	***Sig.***

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Experiment and Control	0.650

Based on the table above, the significance value of *Sig is known. Based on the Mean, it* is 0.650 > 0.05. Because of the significant value, it can be concluded that the variance of the data of the student's mathematical communication ability test (*posttest*) in the experimental and control classes is homogeneous.

c. Uji Hipotesis

Hypothesis testing is used for t-tests using parametric statistics, namely independent sample *t-tests* (t-tests). The calculation process uses SPSS software version 29.

Table 5. Hasil uji sample *t-test* (2-tailed)

Class	Sig.
Experiment and Control Classes	0,047

Based on the table above, the value of *Sig. (*2-tailed) *was obtained of 0.047 < 0.05 so that H0 was rejected and H*1 was accepted. This means there is a difference in the student's mathematical communication ability test (posttest) results in the experimental and control classes. Furthermore, based on the average score of the two classes, it is known that the experimental class is better than the control class, so it can be concluded that the mathematical communication skills of students who are given learning with the *Collaborative problem-solving* learning model assisted by the Geogebra application are better than the mathematical communication skills provided by the lecture method.

3. Results of Descriptive Analysis of Questionnaire

The analysis of questionnaire data aims to determine students' confidence during the learning process using the *Collaborative Problem Solving model* based on the Geogebra application. The calculation of the questionnaire analysis test used Microsoft Excel and SPSS version 29 software. The data obtained as follows:

Table 6. Results of Descriptive Analysis of Student Confidence Questionnaire

Results of Descriptive Analysis	
Eksperimen	**Control**
75.75	55.80

The table above shows that the average score of the student confidence questionnaire for the experimental class is 75.75, while in the control class, it is 55.80. Thus, after being given different treatments between the experimental and control classes, the results can be seen that the experimental class that was treated using the *Collaborative problem-solving learning model* assisted by the Geogebra application of the two-variable linear equation system material obtained a better average score on the student's confidence questionnaire than the control class that used the lecture method.

Discussion

This study aims to determine the influence of learning using a learning model and c*ollaborative Problem Solving*, with the help of the Geogebra application, on students' mathematical communication skills and confidence, which was applied to grade VIII at MTs Islamiyah Ciomas. Based on the study's results, the mathematical communication skills and confidence of students who use the learning model *Collaborative Problem Solving* assisted by the Geogebra application are better than the mathematical communication skills and confidence of students who use the lecture method. The steps of the learning implementation process *Collaborative Problem Solving* which are as follows:

1. Learning begins with individual problem-solving.

Figure 1. Given the Problem

In this first stage, students are asked to solve problems independently and are guided by the teacher to find solutions to the problems presented by the teacher. At this stage, there is communication between students and teachers to find solutions and answers to problems.

2. In the second stage, students can independently identify and design solutions to these problems with the help of the Geogebra application. In this second stage, students express ideas from their thoughts in the form of pictures, graphs, and mathematical symbols.

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Figure 2. Doing Independent Assignments

3. Third stage. The division of groups consists of 4 to 6 people.
4. In the fourth stage, students work in small groups of 4 to 6 people to clarify their understanding, criticize the ideas of their friends in the group, choose solutions, and discuss with each other to solve the given problem with the help of the Geogebra application.

Figure 3. Group Work

Group learning is an excellent learning method because it has a positive impact (Michaelsen *et al*., 2023; SEO *et al*., 2021). By studying in groups, students can hone their communication skills with their peers, increase their confidence in exchanging ideas and opinions, and practice their ability to take on the responsibilities that all group members expect to complete their tasks.

5. Furthermore, the fifth stage is the presentation of group work results.

Figure 4. Presentation

At this stage, students are trained to express their opinions confidently in front of their peers. In addition, students will be trained to find the right solution to the problem. When presentations are involved in learning, students are encouraged to be proactive because of the automatic compulsion they feel when they feel humiliated by other students if they cannot present the material (Michaelsen *et al*., 2023; SEO *et al*., 2021). Otherwise, students will be forced to expand their knowledge and ability to answer other students' questions.

Learning in the control class focuses only on the teacher, and students learn passively. During learning, there is no group discussion, so students cannot exchange information, opinions, and experiences to understand more clearly how to complete the tasks given by the teacher. Furthermore, there is no presentation in the control class learning that uses the lecture method, so students cannot develop their communication skills and confidence.

It is crucial to design a learning environment that supports students in collaborating naturally and effectively to expand their knowledge through their experiences (Herrera-Pavo, 2021; Sanger, 2020). Based on this, applying the learning model of *Collaborative Problem Solving* with the help of the Geogebra application can provide an exciting and meaningful experience for students in dealing with various problems, including daily problem-solving. Thus, students can indirectly develop mathematical communication skills increase confidence in learning, and other skills.

Based on the research hypothesis, the Collaborative *problem-solving* learning model assisted by the Geogebra application is feasible for students' mathematical communication skills and confidence. In classroom learning using the *Collaborative Problem Solving* learning model assisted by the Geogebra application, students are more enthusiastic about learning mathematics, become more active and successfully solve complex problems, encourage students to develop and practice communication skills and improve student collaboration.

Students' mathematical communication skills and confidence are better after learning the *Collaborative Problem Solving* model assisted by Geogebra for the following reasons:

1. Interactivity and Visualization: Geogebra provides visual tools that help students understand mathematical concepts more clearly. This visualization makes mathematical communication more effective because students can see and discuss concepts concretely.
2. Active Collaboration: *The Collaborative Problem Solving* model encourages students to work together to solve problems. This collaboration strengthens their ability to explain and discuss mathematical ideas, improving their communication skills.

3. Increased Motivation and Engagement: Geogebra-assisted learning tends to be more engaging and interactive, which increases students' motivation to participate actively. Higher motivation can boost their confidence when practicing and communicating about math.
4. Meaningful Problem Solving: Using the *Collaborative Problem Solving* model, students engage in relevant and challenging problem-solving. This experience helps them feel more confident in tackling math problems and communicating effectively about their solutions.
5. *Feedback* and Reflection: The collaborative process allows students to get direct feedback from peers and teachers. This feedback helps them improve how they communicate and think and boost their confidence through continuous improvement.

CONCLUSION

There was a difference in students' mathematical communication skills and confidence between those who were given learning with the Geogebra-assisted *Collaborative Problem Solving* model and those who were given learning with the lecture method. Furthermore, based on the average results of *the posttest*, it is known that the experimental class is higher than the control class. So, it can be concluded that the mathematical communication skills and confidence of students learning with the *Collaborative Problem Solving* model assisted by Geogebra are better than those given by the lecture method.

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