IMPROVING STUDENTS' MATHEMATICAL COMMUNICATION SKILLS AND LEARNING OUTCOMES USING GEOGEBRA-ASSISTED THINK PAIR SHARE LEARNING MODEL

Nofyta Arlianti[1*], Efriana Jon[1]
[1]STKIP Muhammadiyah Sungai Penuh, Kerinci, Indonesia
nofytaaja@gmail.com

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Abstract
This study was motivated by the observation of students' low mathematical communication skills, which consequently led to poor mathematics learning outcomes. The primary aim of this research is to investigate the enhancement of students' mathematical communication skills and learning outcomes through the implementation of the Think Pair Share (TPS) learning model, supplemented with GeoGebra software, in the context of Grade VIII students at SMP Negeri 24 Kerinci. The research employed Classroom Action Research (CAR) methodology, structured into two cycles. In the first cycle, the findings indicated an average student score improvement to 68.35 with a learning completeness rate of 65%, while the students' average mathematical communication skills were rated at 73.65. In the second cycle, there was a further increase in the average score to 77.55, with a learning completeness rate of 85%, and the students' mathematical communication skills averaged 77.1. These results demonstrate that the application of the Think Pair Share learning model, enhanced by GeoGebra, significantly improves both mathematical communication skills and overall mathematics learning outcomes for Grade VIII students at SMPN 24 Kerinci. This study underscores the effectiveness of integrating collaborative learning strategies and technological tools in enhancing students' academic performance in mathematics.
Keywords: Math Communication Skills, *Think Pair Share, Geogebra.*

Abstrak
Penelitian ini dilatarbelakangi oleh rendahnya keterampilan komunikasi matematis siswa yang mengakibatkan hasil belajar matematika yang rendah. Tujuan utama dari penelitian ini adalah untuk mengetahui peningkatan keterampilan komunikasi matematis dan hasil belajar siswa melalui penerapan model pembelajaran Think Pair Share (TPS) yang dibantu dengan perangkat lunak GeoGebra, dalam konteks siswa kelas VIII di SMP Negeri 24 Kerinci. Metode penelitian yang digunakan adalah Penelitian Tindakan Kelas (PTK), yang terdiri dari dua siklus. Pada siklus pertama, hasil penelitian menunjukkan peningkatan nilai rata-rata siswa menjadi 68,35 dengan tingkat ketuntasan belajar sebesar 65%, sedangkan keterampilan komunikasi matematis rata-rata siswa dinilai sebesar 73,65. Pada siklus kedua, terdapat peningkatan lebih lanjut pada nilai rata-rata menjadi 77,55, dengan tingkat ketuntasan belajar sebesar 85%, dan keterampilan komunikasi matematis siswa rata-rata sebesar 77,1. Hasil-hasil ini menunjukkan bahwa penerapan model pembelajaran Think Pair Share yang dibantu oleh GeoGebra secara signifikan meningkatkan keterampilan komunikasi matematis dan hasil belajar matematika siswa kelas VIII di SMPN 24 Kerinci. Penelitian ini menegaskan efektivitas integrasi strategi pembelajaran kolaboratif dan alat teknologi dalam meningkatkan kinerja akademik siswa dalam mata pelajaran matematika.
Kata Kunci: Kemampuan Komunikasi Matematika, Think Pair Share, Geogebra.

INTRODUCTION

In learning mathematics, students are not only required to understand the material taught, but are also expected to have mathematical abilities that are useful for facing global challenges. Based on the type of mathematical ability, it can be clarified in five main competencies, namely: mathematical understanding; mathematical problem solving; mathematical communication; mathematical connection; mathematical reasoning (La'ia & Harefa, 2021). One of the important issues in mathematics learning today is the importance of developing students' mathematical communication skills. Communication development is also one of the objectives of learning mathematics and is one of the standards of graduate competence in mathematics. (Astuti, 2020). According to Musfiqon "Communication is a routine activity of every interaction between two or more people. In essence, every activity to transfer ideas or ideas from one party to another, be it between humans, between humans and the surrounding nature or vice versa, there will be a communication process" (Musfiqon, 2012). Communication here involves communicators who convey messages to communicants who immediately respond actively.

Based on the description above, student activity in mathematics communication skills is not optimal and the lack of maximum delivery of material from the teacher. The mathematics learning outcomes of most students in class VIII of SMPN 24 Kerinci are still low. Many efforts have been made to improve the quality of mathematics learning. One of the ways that can be done is by utilising technology as a medium for learning mathematics. One of the efforts to establish good communication and interaction between teachers and students requires a strategy that can make students active in the learning process. There are several learning models that can be applied by teachers in learning mathematics, one of which is the Think Pair Share learning model assisted by the Geogebra application. Geogebra is a mathematical software that is a combination of geometry, algebra and calculus. Geogebra is free software that can be obtained (downloaded) via the internet from the Geogebra website, namely www.geogebra.org. There are at least 3 uses of Geogebra, namely as: maths learning media, tools to help create mathematics teaching materials, and solving maths problems (Rusmining & Yuwaningsih, 2019).

Based on the description above, student activity in mathematical communication skills is not optimal and less than the maximum way of delivering material from the teacher. The math learning outcomes of most students in class VIII SMPN 24 Kerinci are still low. To overcome the above problems, the teacher as one of the main components in the learning process, through learning mathematics, students are expected to be able to communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. One of the efforts to establish good communication and interaction between teachers and students requires a strategy that can make students active in the learning process. There are several learning models that can be applied by teachers in learning mathematics, one of which is the Think Pair Share learning model.

Cooperative Learning Model Type Think Pair Share (TPS)

In the Think Pair Share learning model the question is posed to the whole class, then each student thinks about the answer, then students are divided into pairs and discuss, these pairs report the results of their discussion and share their thoughts with the whole class, (Alma, et al, 2008). This is a simple technique that has the advantage of optimizing student participation to express opinions and increase knowledge, and students share ideas, thoughts or information they know

about the problems given by the teacher and together find solutions. Broadly speaking, the steps of the Think Pair Share model are:

1) Thinking: This lesson begins with the teacher posing a question or issue related to the lesson for learners to think about. The teacher gives students the opportunity to think about the answer.
2) Pairing: at this stage the teacher asks students to pair up, giving the pairs the opportunity to discuss for about 4-5 minutes. It is hoped that this discussion can deepen the meaning of the answers they have thought of through intersubjective with each partner.
3) Sharing: in this activity, it is expected that there will be questions and answers that encourage the construction of knowledge in an integrative manner so that students can find the knowledge structure (Trianto, 2007)

Based on the explanation above, the author concludes that the steps of the Think Pair Share learning model that the author will apply are as follows:

1) Thinking: the teacher asks questions or issues related to the lesson or issues related to the lesson for learners to think about, independently.
2) Pairing: at this stage the teacher asks learners to pair up to discuss for about 4- 5 minutes what they have thought about in the first stage.
3) Sharing: The teacher asks the pairs to share ideas, information, knowledge or understanding with the whole class about what they have discussed.

In an effort to improve students' mathematical communication skills and learning outcomes, teachers must be able to strive for a pleasant learning atmosphere, so that it will increase self-confidence and develop students' creativity and innovation. Based on the above problems, the formulation of the problem in this study is whether the Think Pair Share model assisted by geogebra can improve the ability of mathematical communication and learning outcomes of students of SMP Negeri 24 Kerinci. The questions asked in this study relate to indicators of mathematical communication skills described by (Kuslinar et al., 2019) mentioning indicators of mathematical communication skills, namely as follows: 1.) The ability to understand and read written mathematical representations, 2.) The ability to model situations or problems using verbal, written, graphical and algebraic methods, 3.) The ability to understand everyday life using mathematical language and symbols, 4.) Ability to refine mathematical ideas into pictures, diagrams, and objects, 5.) The ability to make conclusions, build arguments, and generalize.

RESEARCH METHODS

The research method that the author uses is Classroom Action Research. Classroom action research is action research conducted in the classroom with the aim of improving/improving the quality of learning practices, Suhardjono in (Asrori, 2009). The stages of classroom action research are one or two cycles consisting of planning, implementing actions, observing/ observing, reflecting. To see the learning outcomes of students in the learning process, observation sheets were used during the learning process, to see the achievement of student learning, question sheets (written tests) were used. The data obtained during the research process were analyzed qualitatively. The data generated qualitatively will be processed by quantitative methods. Quantitative data analysis can be in the form of numbers, letters, or percentages. The assessment formula used learning outcomes:

$$\bar{x} = \frac{\sum x_i}{n}$$

Description:
$\bar{x}$ = Average value
n = Number of students
$\sum x$ = Number of values
(Arikunto, 2010)

Meanwhile, to determine the success of this research can be seen from the improvement of student learning outcomes in mathematics subjects. The increase in student learning outcomes is considered complete if it has reached 75%, it can be shown by increasing student learning completeness.

$$KB = \frac{NS}{N} x\ 100\%$$

Description:
KB = Percentage of Individual Learning Completeness
NS = Number of students who completed
N = Total number of students

Learning outcomes are categorized as successful if students get an average score exceeding the minimum completeness criteria (KKM) set by the school, which is 65.

DISCUSSION

The research subjects consisted of 20 students from class VIII of SMPN 24 Kerinci. The study's findings are significant in several respects. Initially, the baseline data indicated that students had low mathematical communication skills and poor overall performance in mathematics. This was a cause for concern, as effective mathematical communication is crucial for understanding and solving mathematical problems. Where the results of this study are as follows:

Table 1. Pre-cycle Learning Outcomes

No.	Test Results	The value is
1	Highest Score	80
2	Lowest Score	55
3	Average Value	65,15
4	Classical Absorption	50%

Cycle I

The subject matter that is the focus of cycle I is the discussion of the operation of algebraic forms. This topic is foundational in mathematics, as it forms the basis for understanding more complex algebraic concepts and operations. The learning activities were structured around the Think Pair Share (TPS) learning model, which was implemented in the classroom setting. The choice of this model was driven by the need to create a more interactive and engaging learning environment where students could actively participate and collaborate.

The Think Pair Share learning model is a structured collaborative learning strategy that involves three key steps. First, a question or problem is posed to the entire class. This allows all students to focus on the same task and provides a common ground for subsequent discussions. Each student then individually thinks about the answer to the question, reflecting on their own understanding and forming their initial responses. This phase is crucial as it encourages independent thinking and helps students develop their own ideas before being influenced by their peers.

After individual thinking, students are paired up to discuss their thoughts and answers. This pairing is an essential part of the TPS model as it promotes peer-to-peer interaction and allows students to articulate their ideas in a more informal setting. Through discussion, students can clarify their thoughts, ask questions, and receive immediate feedback from their partners. This collaborative dialogue helps deepen their understanding of the algebraic operations being studied and exposes them to different perspectives and approaches to problem-solving.

The final step involves pairs reporting their discussion results to the whole class. This sharing phase provides an opportunity for students to present their ideas publicly, enhancing their communication skills and building their confidence. It also allows the teacher to assess the students' understanding and provide additional guidance or clarification as needed. The TPS model's simplicity and structured nature make it highly effective in optimizing student participation. It encourages all students to contribute their opinions, thereby increasing their engagement and knowledge. By sharing ideas, thoughts, and information, students collaboratively find solutions to the problems presented by the teacher, fostering a deeper and more comprehensive understanding of algebraic operations. The steps of the Think Pair Share learning model that researchers will apply are as follows:

1) Thinking: the teacher asks questions or issues related to the lesson or issues related to the lesson for students to think about, independently.
2) Pairing: at this stage the teacher asks learners to pair up to discuss for about 4-5 minutes what they have thought about in the first stage.
3) Sharing: The teacher asks the pairs to share ideas, information, knowledge or understanding with the whole class about what they have discussed.

After completing the cycle I action, a test was held as a sign of the completion of the learning process in cycle I. From the observation of the implementation of cycle I, the following results were obtained:

Table 2. Observation results of the implementation of cycle I

No.	Test Results	The value is
1	Highest Score	85

2	Lowest Score	60
3	Average Value	68,35
4	Classical Absorption	65

Classically, the performance of the students in the first cycle showed promising results. Out of the total number of students, 13 managed to score 65 and above. This indicates a level of learning completeness at 65%, suggesting that a majority of the class was able to grasp the fundamental concepts of the algebraic operations being taught. This level of achievement, while not perfect, marks a significant step towards the overall learning goals set for the cycle. The distribution of these learning outcomes is visually represented in Fig. 1 below. This graph provides a clear illustration of how the students' scores are spread across the class, highlighting the proportion of students who achieved the minimum score of 65. Such a graphical representation is useful for both educators and students, as it allows for a quick and intuitive understanding of the class's performance as a whole. It also helps in identifying patterns or trends in the learning process, which can be crucial for making informed decisions about future instructional strategies. Analyzing the graph, it becomes evident that while a good number of students have reached the desired level of comprehension, there is still a significant portion of the class that falls below the threshold. This discrepancy points to the need for additional support and targeted interventions for those students who did not meet the learning completeness criteria. It underscores the importance of differentiated instruction and the need to address diverse learning needs within the classroom.

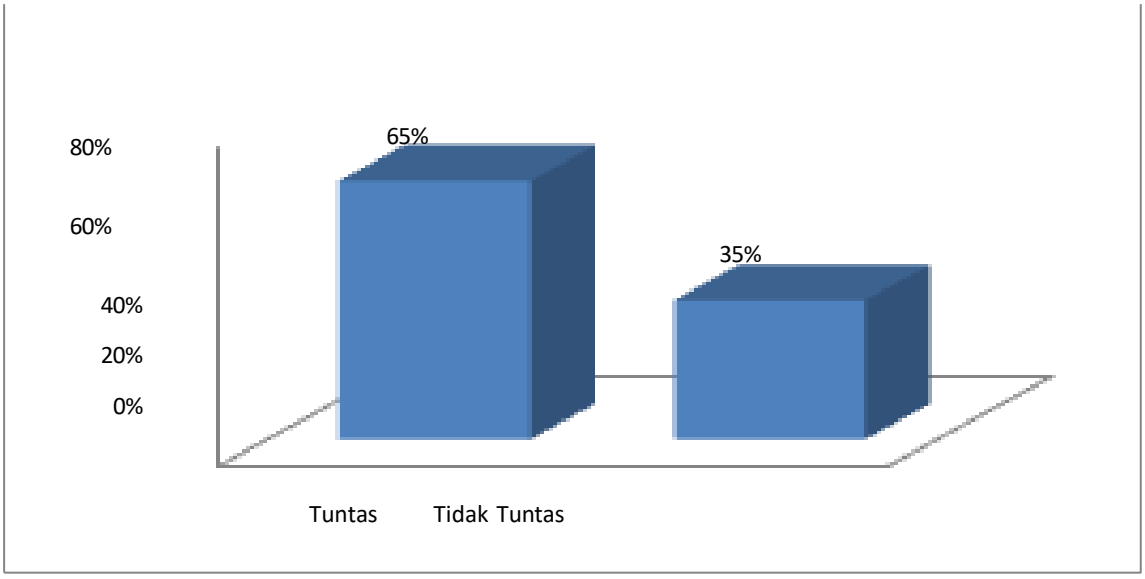

Figure 1: Learning Completeness of Cycle I

The results of descriptive analysis of students' mathematical communication skills using SPSS application, obtained data on the results of students' mathematical communication skills can be seen in table 3 below:

Table 3. Description of Mathematical Communication Ability cycle I

Descriptive Statistics	Value
Average	66,6
N	20
Standard Deviation	11,04
Variance	121,937
Max Value	82
Min Value	50
Skewness	-0,133

From table 3 above, it can be seen that the average student's mathematical communication ability is 73.65 with the number of students who have improved 13 out of 20 students.

Recapitulation of Final Test Results

Cycle I

By examining the graph, it is evident that out of 20 students, 13 successfully completed their learning tasks individually, while 7 did not achieve the desired level of understanding. This results in a classical learning completeness rate of only 65%, falling short of the required 75% threshold for classical learning completeness. To meet this standard, at least 75% of the students need to score 65 or above. The current rate indicates that the instructional strategies used in the first cycle did not fully meet the learning objectives for all students.

Additionally, the average score for students' mathematical communication ability was 73.65, showing that while the majority of students were performing adequately, there were still 7 students who exhibited low proficiency in mathematical communication. This gap underscores the need for targeted interventions to help these students improve their skills. Mathematical communication is essential for understanding and solving problems, and these students require additional support to reach the necessary level of competence.

Based on the reflection from cycle I, it is clear that further steps need to be taken to enhance student engagement and performance. One crucial area for improvement is increasing student motivation. The teacher needs to provide more encouragement and support to ensure that students remain focused and serious during lessons. This can involve using various motivational strategies such as setting clear goals, providing positive reinforcement, and creating a more stimulating learning environment.

In preparation for cycle II, the teacher should implement these motivational strategies and perhaps introduce more interactive and engaging activities to capture the students' interest. By doing so, it is anticipated that the results in cycle II will show a marked improvement over cycle I. The goal is to increase the number of students achieving the required scores and enhance overall mathematical communication skills, thereby meeting the classical learning completeness criteria and ensuring a higher quality of learning outcomes for all students.

Cycle II

Cycle II focused on the topics of addition, subtraction, and multiplication, building on the foundation laid in Cycle I. This cycle served as a refinement of the previous one, incorporating lessons learned from the initial implementation and further developing the stages of preparation and execution of learning activities. The adjustments made in Cycle II aimed to

address the challenges faced in Cycle I and to enhance the overall effectiveness of the teaching strategies employed. In Cycle II, the results showed a significant improvement compared to Cycle I. The modifications in instructional methods, including increased student motivation and engagement, contributed to better learning outcomes. The Think Pair Share model, coupled with the use of GeoGebra, continued to play a crucial role in facilitating a deeper understanding of mathematical concepts and enhancing students' mathematical communication skills.

Upon completing the learning activities in Cycle II, a final test was administered to evaluate the students' mastery of the material. The results of this test marked the completion of the learning process for Cycle II and provided a comprehensive assessment of the students' progress. The recapitulation of Cycle II final test results indicated that the students had made notable strides in their understanding and application of addition, subtraction, and multiplication. The test outcomes demonstrated that a higher number of students achieved the minimum score of 65, reflecting an increase in learning completeness. This improvement suggests that the refined strategies implemented in Cycle II were effective in addressing the gaps identified in Cycle I. The data from the final test provided valuable insights into the students' learning trajectories and highlighted the success of the iterative process of action research in enhancing educational outcomes.

Overall, the experiences and results from Cycle II underscore the importance of continuous reflection and adjustment in teaching practices. By iteratively refining instructional approaches and incorporating student feedback, educators can create more effective and responsive learning environments. The positive results from Cycle II not only validate the effectiveness of the Think Pair Share model and GeoGebra but also pave the way for further innovations and improvements in future teaching cycle.

Table 4. Observation results of cycle II implementation

No.	Test Results	The value is
1	Highest Score	90
2	Lowest Score	60
3	Average Value	77,55
4	Classical Absorption	85

In the second cycle, the results indicated a significant improvement in student performance. Seventeen students achieved a score of 65 and above, which corresponds to an impressive 85% learning completeness. This marked increase from the first cycle demonstrates the positive impact of the instructional strategies employed, particularly the Think Pair Share learning model augmented by GeoGebra. The substantial rise in the number of students meeting the learning completeness criteria suggests that the teaching methods were effective in enhancing students' understanding and skills in algebraic operations. The distribution of learning outcomes is depicted in the accompanying graph, shown in the following figure. This visual representation provides a clear and detailed view of how the students' scores

are distributed across the class. It highlights the significant improvement in the overall performance, with a larger cluster of students achieving the benchmark score of 65. The graph not only shows the increased number of students who have reached the desired level of understanding but also helps in identifying any remaining gaps in learning.

This graphical analysis is a crucial tool for educators. It offers a snapshot of the class's progress and allows for a quick assessment of the effectiveness of the learning interventions. By examining the distribution of scores, the teacher can identify patterns that may indicate which aspects of the algebraic operations were most challenging for students and which teaching strategies were most successful. This insight is invaluable for planning future lessons and ensuring that all students continue to progress. The marked improvement in learning completeness from 65% to 85% reflects a significant advancement in the students' abilities and confidence. It underscores the importance of iterative cycles of teaching and assessment, where feedback from one cycle informs the strategies and focus of the next. The positive outcomes from this cycle provide a strong foundation for continued improvement and suggest that the Think Pair Share model, supported by GeoGebra, is an effective approach to teaching complex mathematical concepts. This progress not only benefits the students academically but also boosts their confidence and engagement in learning mathematics.

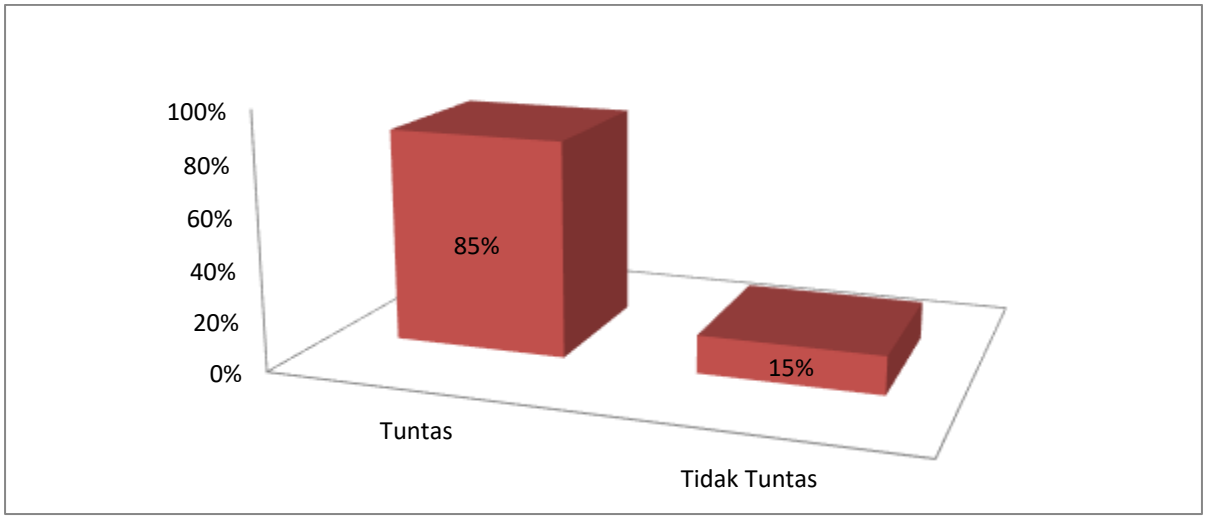

Figure 2. Cycle II Learning Completeness

By paying attention to the graph, it can be seen that out of 20 students, 17 students completed their learning individually and 3 students did not complete their learning. Classical learning completeness is only 85%, meaning that it has met the requirements for classical learning completeness, because classical learning completeness is achieved at least 75% of the number of students who get a score of 65 or more. The improvement of the learning process above was also followed by the improvement of students' learning outcomes with an average score of 77.55. While the results of descriptive analysis of students' mathematical communication ability scores in cycle II using SPSS application, obtained data on the results of students' mathematical communication ability can be seen in table 5 below:

Table 5. Description of Mathematical Communication Ability

Descriptive Statistics	Value
Average	77,1
N	20
Standard Deviation	12,24
Variance	149,779
Max Value	95
Min Value	60
Skewness	-0,119

Table 5 in cycle II shows that students' mathematical communication skills have increased to an average of 77.1 with the number of students who have improved, namely 18 out of 20 students.

From the description above, it can be said that in general teachers carry out the learning steps using the Think Pair Share learning model well. The more this Think Pair Share learning model is applied, the results are the more optimized the learning process, the more enthusiastic the students will be. However, if it is implemented carelessly, then the opportunity to increase the role of students in learning is getting smaller. Therefore, teachers should be more careful and serious in implementing learning with the Think Pair Share learning model.

CONCLUSION

Student learning outcomes and student learning completeness increased from one cycle to another. Cycle I student average increased to 68.35 and learning completeness of 65% and students' mathematical communication skills averaged 73, 65 where there were still 7 students who still had low mathematical communication skills. Cycle II the average value increased further, namely to 77.55 with 85% completeness and 77.1 mathematical communication skills. From the results of the above research, it can be seen that the Think Pair Share learning model is very suitable for use in mathematics subjects. This can be seen from the results of the assessment carried out in each cycle of learning activities showing an increase from each cycle. Based on these findings, it is revealed that the Think Pair Share learning model can improve mathematics communication skills and mathematics learning outcomes of 8th grade students of SMPN 24 Kerinci.

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