The Effect of Students' Learning Activeness in the Two Stay Two Stray Learning Model Assisted by Student Worksheets on Mathematical Communication Ability

1*Nurkholifah Windy Astuti, 2Dian Nataria Oktaviani, 3Ibnu Sina

1,2,3 Universitas Pancaskati Tegal (INDONESIA)

Corresponding author: windynurkholifah@gmail.com1*, dian85nataria@gmail.com2
ibnusinaupstegal@gmail.com3

Abstract

Low learning activity and poor mathematical communication skills among students remain problems in mathematics education. Initial observations and interviews revealed that most students were less active during lessons and struggled to express mathematical ideas in written form. This study aims to determine the effect of students' learning activity in the Two Stay Two Stray (TSTS) learning model assisted by Student Worksheets (LKPD) on their mathematical communication skills. The research employed a quantitative approach with a pre-experimental method and a one-group pre-test-post-test design. The sample consisted of 36 tenth-grade students selected using purposive sampling. Data were collected through tests, observation, and documentation, and analyzed using simple linear regression. The results showed a positive and significant effect between the two variables, with a t-value of 4.836. The regression equation obtained was $\hat{Y} = 7.338 + 0.986X$, with a coefficient of determination (R^2) of 0.408. This means that 40.8% of students' mathematical communication skills are influenced by their learning activity in the TSTS model assisted by LKPD. These findings indicate that the TSTS model supported by LKPD is effective in enhancing students' learning activity and mathematical communication skills.

Keywords: Learning activity, mathematical communication skills, TSTS model, LKPD

A. Introduction

Education plays an important role in developing high-quality human resources, one of which is through mathematics learning. Mathematics learning does not only require computational skills but also the ability to interpret and communicate ideas through mathematical language, which is symbolic and abstract [1]. Therefore, mathematical communication ability is an essential competency that needs to be developed in the learning process.

Mathematical communication ability refers to students' capacity to express mathematical ideas or problems through various representations such as concrete objects, drawings, graphs, tables, and mathematical symbols [2]. This ability is crucial for understanding concepts, solving problems, and presenting mathematical arguments systematically.

However, students' mathematical communication ability in Indonesia is still relatively low. Based on the 2022 Programme for International Student Assessment (PISA) results, Indonesian students obtained an average mathematics score of 366 points [3]. This score placed Indonesia 70th out of 81 participating countries and remained below the OECD average mathematics score of 472 points. This low score indicates obstacles in understanding and applying mathematics, including difficulties in expressing mathematical ideas in written form.

Observations and interviews with mathematics teachers at SMA Negeri 3 Brebes showed that most students were less active in learning and were not accustomed to expressing mathematical ideas in writing. Learning activeness refers to various activities that occur during learning and reflect students' curiosity in gaining understanding [4]. Classroom conditions indicate that learning is still dominated by teachers through the Direct Instruction model. This model is designed to facilitate step-by-step learning processes, particularly in mastering declarative and procedural knowledge, with the teacher playing a dominant role in managing instruction [5]. While effective for delivering information, this model tends to limit interaction and active student participation.

Classroom observations also showed that students tend to take notes without fully understanding the material, copy answers without critical thinking, and during summative assessments often fail to state known information from problems, writing only final answers without solution steps. Difficulties also arise in converting information into mathematical representations, particularly in statistics topics.

To address these problems, a learning model that promotes student activeness and involvement while enhancing mathematical communication ability is needed. One relevant model is the Two Stay Two Stray (TSTS) learning model. This model encourages collaboration in small groups, where two students remain in their group to explain discussion results while two others visit different groups to exchange information [6]. This pattern requires students to actively express ideas and understand others' perspectives, potentially improving mathematical communication ability in a more systematic manner.

To support the effective implementation of the TSTS model, instructional media such as Student Worksheets (LKPD) are required. LKPD consists of sheets containing tasks that students must complete during learning, including instructions or steps aligned with learning indicators and core competencies [7]. Through LKPD, students receive guidance to participate actively, organize ideas, and write problem-solving steps systematically.

Previous research by Ningsih [8], showed that the TSTS learning model effectively increases student engagement through group discussions. Meanwhile, Siregar and Hasratuddin [9] found that the use of LKPD can enhance mathematical communication ability and encourage active participation. However, these studies have not specifically examined the influence of student learning activeness in the TSTS learning model assisted by LKPD on mathematical communication ability. This study is expected to contribute theoretically to the development of innovative learning models and serve as a reference for teachers in managing more effective, student-centered mathematics learning.

B. Research Method

This study employed a quantitative approach using a pre-experimental method with a one-group pretest–posttest design. Students were given a pretest as an initial assessment, followed by treatment using the TSTS learning model assisted by LKPD, and then a posttest as the final assessment after treatment. The research design follows Sugiyono [10]:

Table 1. Research Design

Group	Pre-test	Treatment	Post-tes
Eksperiment	O_1	X	O_2

The study was conducted at SMA Negeri 3 Brebes during the second semester of the 2024/2025 academic year, with class X E6 as the research sample consisting of 36 students. The sample was selected using purposive sampling based on observation results and documentation of final summative assessment scores. These preliminary data indicated that learning activeness and mathematical communication ability in class X E6 were relatively lower compared to other classes.

Data were collected through observation and essay tests. In this article, analysis focuses on observation scores of student learning activeness and posttest scores of mathematical communication ability. Observations were conducted using observation sheets completed by three observers, based on Sudjana's indicators [11]: (1) participation in completing tasks, (2) involvement in problem solving, (3) asking questions, (4) seeking information sources, (5) participating in group discussions, (6) self-evaluating learning outcomes, (7) practicing similar problems, and (8) applying understanding to solve problems.

The test instrument consisted of a posttest with six essay questions to measure students' mathematical communication ability. The test was developed based on indicators from Wildaniati et al. [12]: (1) written text, (2) drawing, and (3) mathematical expression. The collected data were analyzed using simple linear regression to determine the effect of learning activeness on mathematical communication ability.

C. Result and Discussion

Based on the research results, observations of student learning activeness across four meetings are summarized as follows:

Table 2. Observation Results of Student Learning Activeness

n	Minimum Score	Maksimum Score	Range	Mean	Standard Deviation	Variance
36	63	90	27	75,504	6,918	47,858

Table 2 shows that from 36 students, the minimum score was 63, the maximum score was 90, the range was 27, the mean was 75.504, the standard deviation was 6.918, and the variance was 47.858. The average score of 75.504 indicates that student learning activeness in the TSTS model assisted by LKPD falls into the "good" category.

The next data are the posttest results of mathematical communication ability:

Tabel 3. Posttest Result

n	Minimum Score	Maksimum Score	Range	Mean	Standard Deviation	Variance
36	56	100	44	81,833	10,697	114,429

Table 3 shows that the minimum score was 56, the maximum score was 100, the range was 44, the mean was 81.833, the standard deviation was 10.697, and the variance was 114.429. These results indicate an improvement in mathematical communication ability from a mean pretest score of 43.833 to a posttest mean of 81.833.

The data were analyzed using simple linear regression. Prior to regression analysis, classical assumption tests were conducted, including residual normality, linearity, and heteroscedasticity tests to ensure the regression model met feasibility requirements.

Tabel 4. Residual Normality Test Results

Data	$L_{calculated}$	L_{table}	Decision
Nilai Residual	0,098	0,148	Normal

Using the Liliefors test at a 5% significance level, $L_{calculated} = 0{,}098$ and $L_{table} = 0{,}148$, indicating normally distributed residuals.

Tabel 5. Linearity Test Results

Variance	dk	JK	RK	$F_{calculated}$	F_{table}
Total	36	245086	245086		
Coefficient (a)	1	241081	241081		
Regresi (b|a)	1	1632,159	1632,108	0,895	4,130
Residual	34	2372,841	69,791		
Tuna Cocok	16	1051,011	65,689		
Error	18	1321,830	73,435		
Conclusion			Linear		

ISSN: 3026-023X

At a 5% significance level, $F_{calculated} = 0{,}895$ and $F_{tabel} = 4{,}130$, indicating a linear relationship between student learning activeness in the TSTS model and mathematical communication ability.

Tabel 6. Heteroscedasticity Test Results

n	$t_{calculated}$	$P - value$	Conclusion
36	-1,488	0,146	H_0 diterima

Based on the results of the heteroscedasticity test using the Glejser test at a 5% significance level (α), a p-value of 0.146 > 0.05 was obtained. Therefore, H_0 is accepted, indicating that no heteroscedasticity occurs.

Based on the results of the classical assumption tests that have been conducted, it was found that the residual data are normally distributed, there is a linear relationship between variables X and Y, and no heteroscedasticity symptoms are present. Thus, the data meet the requirements for simple linear regression analysis.

The results of the simple linear regression analysis show that the regression equation obtained is $\hat{Y} = 7{,}338 + 0{,}986X$. This equation implies that:

a. The constant (a) of 7.338 indicates that if there is no learning activeness (X = 0), the students' mathematical communication ability score is 7.338.
b. The positive regression coefficient (b) indicates a positive relationship between learning activeness and mathematical communication ability. This means that each one-unit increase in learning activeness is followed by an increase of 0.986 in mathematical communication ability.

Tabel 7. Regression Analysis Results

n	Correlation Coefficient (r	Determination Coefficient	$t_{calculated}$	$t_{table} = t_{\left(\frac{\alpha}{2};n-2\right)}$	Conclusion
36	0,638	0,408	4,836	2,032	H_0 ditolak

Based on the calculation results at a 5% significance level (α), the obtained values were $t_{calculated} = 4{,}836$ dan $t_{table} = 2{,}032$: since $t_{calculated} > t_{table}$, H_0 is rejected. This indicates that there is an effect of students' learning activeness in the TSTS learning model assisted by LKPD on students' mathematical communication ability.

Based on Table 7, the correlation coefficient (r) is 0.638, indicating a strong relationship between the two variables [13]. Meanwhile, the coefficient of determination is 0.408. It can therefore be concluded that the magnitude of the effect of learning activeness in the TSTS learning model assisted by LKPD (X) on mathematical communication ability (Y) is 40.8%, while the remaining variance is influenced by other variables not examined in this study.

The role of the TSTS learning model is very important in providing opportunities for students to actively interact, exchange information, and engage in discussions. Through the "stay" and "stray" roles, students are trained to explain the results of their discussions to other groups and gather additional information. This process encourages students to develop skills in expressing opinions and mathematical ideas both orally and in written form.

In addition, LKPD serves as a supporting tool in the learning process. In this study, LKPD was developed based on indicators of mathematical communication ability, helping students solve problems gradually and systematically according to the stages of mathematical communication ability. In line with this, Melenia [14], states that LKPD functions as a guideline that facilitates students' active involvement in communicating mathematical ideas. Through LKPD, students are directed not only to write final answers but also to present complete solution procedures. Thus,

 ISSN: 3026-023X

LKPD trains students to solve problems systematically, which ultimately contributes to improving their mathematical communication ability.

The results of this study are supported by Susanti [15], who found that students' learning activeness influences mathematical communication ability. In that study, the regression coefficient was positive and indicated an effect of 17.4%. This is further supported by the findings of Firdawati and Hidayat [16], who reported a positive relationship between students' learning activeness and mathematical communication ability. If students' learning activeness is categorized as good, their mathematical communication ability will also tend to be good.

D. Conclusions

Based on the research findings, it was found that students' learning activeness in the TSTS learning model assisted by LKPD has a positive effect on mathematical communication ability, with a contribution of 40.8%, and the linear regression equation obtained is $\widehat{Y} = 7{,}338 + 0{,}986X$.

Through the implementation of learning models that encourage active participation and the use of appropriate instructional media, students' potential to express mathematical ideas systematically can develop more optimally. Therefore, educators are expected to begin implementing more participatory learning approaches, one of which is the application of the TSTS learning model combined with LKPD that aligns with students' characteristics and needs. This study can serve as a foundation for further research development in mathematics education. Future studies are recommended to consider additional variables in order to provide a more comprehensive understanding of the factors influencing students' mathematical communication ability.

E. References

[1] Lutfianannisak dan U. Sholihah, "Kemampuan Komunikasi Matematis Siswa dalam Menyelesaikan Soal Materi Komposisi Fungsi Ditinjau dari Kemampuan Matematika," J. Tadris Mat., vol. 1, no. 1, hal. 1–8, 2018, doi: 10.21274/jtm.2018.1.1.1-8.

[2] A. Astuti dan Leonard, "Peran Kemampuan Komunikasi Mmatematika Terhadap Prestasi Belajar Matematika Siswa," Formatif, vol. 2, no. 2, hal. 102–110, 2015, doi: 10.1016/0749-6036(91)90087-8.

[3] OECD, PISA 2022 Results, vol. 1. 2023. doi: 10.22201/iisue.24486167e.2024.183.61714.

[4] N. Rokhanah, A. Widowati, dan E. H. Sutanto, "Peningkatan Keaktifan Belajar Siswa dengan Menerapkan Model Pembelajaran Kooperatif Tipe Student Team Achievement Divisions (STAD)," Edukatif J. Ilmu Pendidik., vol. 3, no. 5, hal. 3173–3180, 2021, doi: 10.31004/edukatif.v3i5.860.

[5] I. K. E. Dwipayana dan I. N. Natajaya, "Penerapan Model Pembelajaran Kooperatif Tipe Two Stay Two Stray Untuk Meningkatkan Motivasi Dan Hasil Belajar Siswa Kelas X …," J. Pendidik. …, vol. 1, no. February, hal. 84–91, 2022, [Daring]. Tersedia pada: https://ejournal.undiksha.ac.id/index.php/JJPP/article/view/20839%0Ahttps://ejournal.undiksha.ac.id/index.php/JJPP/article/view/20839/12910

[6] D. F. Une, S. W. D. Pomalato, dan T. Machmud, "Pengaruh Model Pembelajaran Two Stay Two Stray Terhadap Kemampuan Komunikasi Matematis Siswa," Jambura J. Math. Educ., vol. 4, no. 1, hal. 11–23, 2023, doi: 10.34312/jmathedu.v4i1.18206.

[7] N. E. Martika, Isnani, dan I. Sina, "Pengembangan Lembar Kerja Peserta Didik Berbasis Problem Solving Polya di Kelas VII Sekolah Menengah Pertama," Integr. (Jurnal Penelit. Pendidik. Mat., vol. 5, no. 2, hal. 147–153, 2023, doi: 10.24905/jppm.v5i2.107.

[8] R. dkk Ningsih, "Pengaruh Model Pembelajaran Two Stay-Two Stray Berbantuan Media Mathcircle Terhadap Kemampuan Komunikasi Matematis Siswa," vol. 14, no. 2, hal. 178–185, 2023, doi: http://dx.doi.org/10.36709/jpm.v14i2.72.

[9] N. Siregar dan Hasratuddin, "Kemampuan Komunikasi Matematis Siswa Berbantuan

Lembar Kerja Siswa," J. SILOGISME Kaji. Ilmu Mat. dan Pembelajarannya, vol. 6, no. 1, hal. 23–32, 2021, doi: 10.24269/silogisme.v6i1.3087.

[10] Sugiyono, Metode Penelitian Kuantitatif Kualitatif dan R&D. 2023.

[11] N. Sudjana, Penilaian Hasil Proses Belajar Mengajar. Bandung: PT. Remaja Rosdakarya, 2016.

[12] Y. Wildaniati, P. Merliza, S. Loviana, dan J. Mustika, Kemampuan Matematis Untuk Guru Dan Calon Guru Matematika. 2021.

[13] Sugiyono, Statistika Untuk Penelitian. In Alfabeta, 2015.

[14] A. Melenia, "Konsep Dasar Pengembangan Bahan Ajar," Al-Ahnaf J. Islam. Educ. Learn. Relig. Stud., vol. 1, no. 1, hal. 33–43, 2024, doi: 10.61166/ahnaf.v1i1.2.

[15] T. . Susanti, "Pengaruh Motivasi Belajar dan Keaktifan Belajar Terhadap Kemampuan Komunikasi Matematis Siswa Kelas VIII SMPN 7 Purwokerto," Universita Islam Negeri PROF. K.H. SAIFUDDIN ZUHRI PURWOKERTO, 2022. [Daring]. Tersedia pada: https://repository.uinsaizu.ac.id/id/eprint/16382

[16] I. Firdawati dan W. Hidayat, "Hubungan Antara Keaktifan Belajar Siswa Terhadap Kemampuan Komunikasi Matematis Siswa SMK," vol. 9, no. 1, hal. 1151–1158, 2018.