

The Effect of Wordwall-Assisted STAD Cooperative Learning Model to Improve Students' Problem-Solving Ability in Two-Variable Linear Equation Systems for Grade VIII Students at SMP St. Yoseph Medan

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ABSTRACT

This study aims to determine the effect of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall on the mathematical problem-solving abilities of eighth-grade students of St. Yoseph Catholic Private Junior High School Medan in the 2025/2026 Academic Year and the improvement of students' mathematical problem-solving abilities after the model is implemented. This study uses a quantitative approach with the Pre-Experimental Design method using the One Group Pretest-Posttest Design. The research sample consisted of 36 students. Data analysis used normality tests, Paired Sample t-Test, and N-Gain. The results showed that the average pretest score of 50.806 increased to 80.167 in the posttest. The results of the hypothesis test obtained $t_{hitung} = 53.303$ and $t_{tabel} = 2.030$, so that H_0 was rejected and H_a was accepted. The N-Gain test results obtained an average of 0.611, categorized as moderate. Thus, it can be concluded that the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall has a significant effect and is able to improve students' mathematical problem-solving abilities.

ABSTRACT

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran kooperatif tipe Student Teams Achievement Division (STAD) berbantuan Wordwall terhadap kemampuan pemecahan masalah matematis siswa kelas VIII SMP Swasta Katolik St. Yoseph Medan Tahun Ajaran 2025/2026 serta peningkatan kemampuan pemecahan masalah matematis siswa setelah diterapkan model tersebut. Penelitian ini menggunakan pendekatan kuantitatif dengan metode Pre-Experimental Design menggunakan desain One Group Pretest-Posttest Design. Sampel penelitian berjumlah 36 siswa. Analisis data menggunakan uji normalitas, Paired Sample t-Test, dan N-Gain. Hasil penelitian menunjukkan bahwa rata-rata nilai pretest sebesar 50,806 meningkat menjadi 80,167 pada posttest. Hasil uji hipotesis diperoleh $t_{hitung} = 53,303$ dan $t_{tabel} = 2,030$, sehingga H_0 ditolak dan H_a diterima. Hasil uji N-Gain diperoleh rata-rata sebesar 0,611 dengan kategori sedang. Dengan demikian, dapat disimpulkan bahwa model pembelajaran kooperatif tipe Student Teams Achievement Division (STAD) berbantuan Wordwall berpengaruh secara signifikan dan mampu meningkatkan kemampuan pemecahan masalah matematis siswa

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1. Introduction

Education is a crucial factor in improving the quality of human resources. Through education, individuals can develop their potential, including knowledge, skills, and attitudes, necessary for social life. According to Law Number 20 of 2003 concerning the National Education System, education is a conscious and planned effort to create a learning atmosphere and process that allows students to actively develop their potential, fostering spiritual and religious strength, self-control, intelligence, noble character, and the skills necessary for themselves, society, the nation, and the state.(Afriantoni, Dhea, Sari, & Nuria, 2025)This shows that education has an important role in forming quality human beings who are able to contribute to national development.(Dotutinggi, Zees, & Rahmat, 2023).

In addition, the importance of education was also expressed by the Indonesian education figure, Ki Hajar Dewantara, who stated that education is an effort to advance the morals, minds and bodies of students so that they can achieve a life in harmony with their social environment.(Afrilia & Oktaviarini, 2025). Thus, education focuses not only on mastering knowledge, but also on developing students' character and thinking skills. Therefore, the educational process must be implemented optimally to produce quality human resources capable of facing developments in science and technology.(Abrori & Sumadi, 2023).

WrongOne subject that plays a vital role in education is mathematics. Mathematics is the study of numbers, patterns, relationships, and structures arranged logically and systematically. Learning mathematics is crucial because it can train students' logical, critical, systematic, and creative thinking skills. According to(Amelia, Sinaga, & Asriati, 2024)states that mathematics is a deductive science with abstract objects and plays a role in developing logical, systematic, critical, and rational thought patterns in students. Furthermore, mathematics also serves as a means to train thinking skills in systematically proving and discovering the truth of a concept. Therefore, mathematics learning plays a crucial role in shaping students' thinking skills.(Asmiati, Kasman, & Amaliah, 2024).

According to the National Council of Teachers of Mathematics (UNESCO), the objectives of mathematics learning include developing problem-solving skills, reasoning and proof, mathematical communication, mathematical connections, and mathematical representation. Through mathematics learning, students are expected to be able not only to perform calculations but also to understand concepts, explain mathematical ideas, and use mathematics effectively to solve various problems encountered in real life.

The goal of mathematics learning emphasizes not only the ability to perform calculations but also the development of mathematical problem-solving skills. According to the National Council of Teachers of Mathematics(Bugis, Ratau, Salatalohy, Sarifa, & Wagola, 2023) Mathematics learning aims to develop several important abilities, such as mathematical problem solving, mathematical reasoning, mathematical proof, mathematical communication, mathematical connections, and mathematical representation.(Damopolii & Rahman, 2019)Among these abilities, problem solving is one of the main abilities that students must have, because through problem solving students are trained to understand a problem, plan a solution strategy, and determine the right solution systematically.(DEWI, IRHAM, & WIBOWO, 2021). Thus,

mathematics learning does not only focus on mastering formulas, but also on students' ability to use mathematical concepts to solve various problems related to everyday life.(Cahyani & Setyawati, 2016).

However, students' mathematical problem-solving abilities can be seen through the results of the Programme for International Student Assessment (PISA) international study, which shows that Indonesia's PISA score in 2022 was lower than in 2021, as seen in the following table.

Table 1. PISA 2022 Results

PISA Year	Indonesian Mathematics Score	OECD average
2012	375	494
2015	386	490
2018	379	489
2022	366	472

Based on the results of the 2022 Programme for International Student Assessment (PISA) published by the Organisation for Economic Co-operation and Development (OECD), Indonesia's mathematics score has decreased compared to the previous year. In 2018, Indonesia's mathematics score was 379, then decreased to 366 in 2022. These results indicate that Indonesian students' mathematical abilities are still relatively low compared to the OECD average of 472. The low PISA score indicates that many students still have difficulty understanding problem-solving questions, especially questions related to everyday life situations, reasoning, and the application of mathematical concepts.(Fitriani, Mursidik, & Teguh, 2024). Furthermore, students are still less accustomed to solving problems that require critical, analytical, and systematic thinking skills. Therefore, a more innovative and active learning process is needed to improve students' mathematical problem-solving skills. Furthermore, research conducted by (Majekroatina et al., 2024) also shows that most students still have difficulty solving problems that require higher-order thinking skills, especially in determining the correct steps to solve mathematical problems. This indicates that students' mathematical problem-solving skills still need to be improved through the implementation of more effective and innovative learning models so that students can be more active in understanding concepts and solving various mathematical problems.(Fahrudin, Ansari, & Ichsan, 2021).

Referring to the 2025 National Coordination Meeting held by the Ministry of Education, Culture, Research, and Technology, improving students' literacy and numeracy skills is one of the main focuses of the national education policy.(Hasanah & Firmansyah, 2022)This is because the results of various educational assessments indicate that students' ability to understand and solve problems related to mathematics is still low. Numeracy skills are not only related to calculation skills but also include the ability to understand, analyze, and solve various problems related to everyday life situations. Therefore, strengthening literacy and numeracy in learning is also closely related to improving students' mathematical problem-solving abilities.(Haryadi, 2022). Based on the results of the author's interview with the eighth-grade mathematics teacher at St. Yoseph Middle School, Medan, on February 19, 2026, it was found that students' mathematical problem-solving abilities were still relatively low. This was evident from the results of daily tests, practice questions, and student assignments on mathematics material, where only about 30% of students were able to solve problem-solving problems according to the correct solution

steps. Most students still had difficulty understanding the information known and asked in the problem, determining mathematical models, and solving problems systematically. In addition, students also rarely checked their work, so the answers obtained were often inaccurate. The teacher also stated that the learning process still tended to use conventional methods, so students were less active in the learning process and preferred to memorize formulas rather than understand mathematical concepts in depth.(Johnson & Johnson, 2009). Therefore, a learning model that can actively involve students is needed so that their mathematical problem-solving abilities can improve. In addition to the interview results above, the low problem-solving abilities of eighth-grade students at St. Yoseph Middle School, Medan, are also evident in the students' process of completing the mini-test questions administered by the author. Students' problem-solving abilities in solving the given problems are still very low, as seen from the students' answers to the following mini-test questions.(Hasratuddin, 2008).

Question 1: Two rectangular gardens have the same perimeter. Garden A has a length of $(3x+2)$ cm and a width of 6 cm, while garden B has a length of $(x+8)$ cm and a width of 10 cm. x value, then determine which garden has a larger area. Explain your solution steps.

Dik : Persegi panjang A
 $p = (3x+2)$ cm
 $l = 6$ cm
Persegi panjang B
 $p = (x+8)$ cm
 $l = 10$ cm
Dit : nilai x ... ?
tentukan bangunan yang lebih luas
Jawab $2(p+l) = K$
 $2((3x+2)+6) = 2((x+8)+10)$
 $2(6x+8) = 2(x+18)$
 $12x+16 = 2x+36$
 $12x-2x = 36-16$
 $10x = 20$
 $x = 2$
 $l = (3x+2) \times 6$
 $l = (3(2)+2) \times 6$
 $l = 30$
Luas Persegi panjang A
 $l = (x+8) \times 10$
 $l = (2+8) \times 10$
 $l = 100$
Luas persegi panjang B
lebih luas persegi panjang B.

Figure 1. Results of Student Completion of Question 1

Based on Figure 1, it can be seen that students have attempted to solve the problem based on the information provided in the problem. Students have written down the known and questioned elements quite well. Furthermore, students have also attempted to use the formula for the perimeter of a rectangle to determine the value of x .(Luwiti, Mahmud, & Panigoro, 2023). However, students still make mistakes in simplifying algebraic expressions. Students change the form $(3x+2) + 6$ to $(6x+8)$, even though it should be simplified to $(3x+8)$. This error causes the next calculation step to be inaccurate. In addition, students are also less careful in multiplying the number 2 into the algebraic form so that the resulting equation is incorrect. As a result of this error, the value of x obtained by students does not match the correct answer. This shows that students still have difficulty in performing algebraic operations and solving mathematical problems systematically.(La'ia & Harefa, 2021).

This question measures all indicators. For the understanding problem indicator, 29 out of 36 students were able to identify known and requested information, or approximately 80.56%. For the planning solution indicator, 21 out of 36 students, or approximately 58.33%, began to try to determine a solution strategy. Furthermore, for the implementing the plan

indicator, only 13 out of 36 students, or approximately 36.11%, were able to complete the problem-solving process. Meanwhile, for the re-checking answer indicator, only 10 out of 36 students, or approximately 27.78%, checked their results. However, from the entire problem-solving process, only 8 out of 36 students, or approximately 22.22%, answered correctly. These results indicate that although some students were able to understand the problem, many still experienced difficulties in the planning strategy, implementing the solution, and re-checking the answers. This indicates that the mathematical problem-solving abilities of eighth-grade students are still relatively low and need to be improved through the implementation of more effective learning models.(Maharani & Nawangsih, 2023).

Furthermore, students' low problem-solving abilities are also influenced by the lack of implementation of varied learning models and the use of interactive learning media in the classroom. Based on interviews with teachers at St. Yoseph Middle School in Medan, learning often uses conventional methods, resulting in students being less active in discussions and expressing opinions. This condition results in students being less trained in critical and systematic thinking in solving mathematical problems. Therefore, efforts are needed to implement learning models that can actively engage students so that students' mathematical problem-solving abilities can improve.

One learning model that can be used is the Student Teams Achievement Division (STAD) cooperative learning model. This learning model emphasizes collaboration among students in groups to understand material and solve problems together. Through discussion and group work activities, students can exchange ideas, understand concepts more deeply, and practice thinking skills in solving mathematical problems. Thus, the application of the STAD cooperative learning model is expected to improve students' mathematical problem-solving abilities.(Majekroatina, Darsono, & Yohanie, 2024).

According to (Wardana et al., 2024), the STAD cooperative learning model provides opportunities for students to be actively involved in learning so that students gain direct experience in discovering concepts from the material being studied. In addition, the implementation of this model will provide opportunities for students to work together or collaborate in completing tasks given by the teacher. Students are also given the opportunity to present their work in front of the class so that students will better remember and understand the concepts of the material being studied.

Based on the results of the writing (Dewi et al., 2021) The Effect of STAD Type Cooperative Learning on Students' Mathematical Problem-Solving Abilities. The results of the writing show that the mathematical problem-solving abilities of students who participate in STAD type cooperative learning have a higher increase compared to the mathematical problem-solving abilities of students who learn with a scientific approach. In line with the results of the writing by (Wulandari & Neolaka, 2013) that the STAD type cooperative learning model is more effective than the conventional model in increasing student involvement and understanding in the learning process.

In implementing the Student Teams Achievement Division (STAD) cooperative learning model, the use of interactive learning media is essential to create an engaging and conducive learning environment. Appropriate learning media can increase student engagement in group learning activities and

encourage students to think actively in solving problems. One form of media that can be utilized is educational games, which not only make learning more enjoyable but also help improve students' problem-solving skills.(Mantiri, 2019). Currently, there are various interactive applications that can be used in classroom learning effectively and innovatively, such as applications that provide games and quizzes that can be tailored to the learning material. These media enable students to learn collaboratively through discussion and cooperation in groups. One interactive learning medium that can be used to support the STAD cooperative learning model is Wordwall.

Wordwall is a web-based application that provides various interactive learning features, such as quizzes and puzzles. Through a game-based learning approach, students can practice and repeat numeracy material in a more applicable way, thereby helping to strengthen understanding of mathematical concepts.(Narpila, Pitaloka, Ramadhan, & Muttaqin, 2025)a.

Based on the research results from (Dotutinggi et al., 2023), it can be concluded that the use of Wordwall educational game media has a positive influence on student interest and learning outcomes, and is able to increase student activity and motivation in the learning process. In line with the results of the opinion (Alizah et al., 2023), it was stated that Wordwall creates an interesting and enjoyable learning experience. In addition, Wordwall features such as interactive games and quizzes provide variety in learning, increase student engagement, and provide effective direct feedback in the learning process.(Mathematics, 2025).

Based on the description of the background, the author wants to conduct research on "The Effect of the STAD Cooperative Learning Model Assisted by Wordwalls to Improve Problem Solving Skills in SPLDV Material for Class VIII Junior High School Students"

2. METHOD

The approach used in this study is a quantitative one-group pretest-posttest design. This design includes a pretest before the treatment is administered. This allows for more accurate results, as it allows for comparison between the pretest and the posttest.(Pasaribu, Agradadya, Shabrina, & Krisnaldy, 2020).

This writing was conducted at St. Yoseph Junior High School Medan located at Jl. Flamboyan Raya No. 139, Tanjung Selamat, Medan Tuntungan District, Medan City, North Sumatra in class VIII of the 2025/2026 Academic Year. The research design used was a one-group pretest-posttest design and simple random sampling as a sample selection technique. The research design scheme in Table 3.2 below shows that this study began with the provision of 4 essay-shaped pre-test questions (O1) which aimed to identify students' initial mathematical problem-solving abilities before treatment was given, the next step was to provide treatment by applying the STAD type Cooperative learning model in learning activities carried out offline on the Two-Variable Linear Equation System material (VIII). Furthermore, students were given 4 essay-shaped post-test questions (O2) whose criteria were the same as the pre-test questions in order to identify students' abilities after receiving treatment.(Nurhikmayati, 2019).

The population in this study was all eighth-grade students, consisting of 149 students divided into four classes. The data sampling technique used was simple random sampling. Simple random sampling is a sampling technique that provides

an equal opportunity for all classes in the population to be selected as members of the research sample. (Prayoga, Sasmita, & Mahendra, 2025).. After conducting simple random sampling of the four existing classes, the sample obtained was class VIII-C.(Permana M. & et al., 2015).

The type of data used is quantitative data, namely data in the form of numbers obtained from the results of mathematical problem-solving ability tests given to students and analyzed using mathematical calculations. The data source in this study is the results of problem-solving ability tests answered by 36 class VIII-C students consisting of 22 male students and 14 female students. (Rahmadhani & Sutriyani, 2025). As for supporting data sources from other parties, such as reports and documentation(Rahmah, 2018).

A test is defined as a series of questions given to be answered or responded to by an individual, in this case, a grade VIII-C student. The test technique chosen in this study was intended to obtain specific and accurate student cognitive data. In this study, the test was an assessment based on indicators of problem-solving ability.

3. RESULTS AND DISCUSSION

3.1 DescriptionData

The data described in this study are the results of a mathematical problem-solving ability test of eighth-grade students at St. Yoseph Middle School, Medan, in the 2025/2026 academic year. This study was conducted in one class that was given treatment in the form of the implementation of the Student Teams Achievement Division (STAD) cooperative learning model assisted by a Wordwall. Data on students' mathematical problem-solving abilities were obtained through pre-tests and post-tests. The test results were used to determine students' initial abilities, abilities after being given treatment, and improvements in students' mathematical problem-solving abilities. The pre-test and post-test data are presented as follows.(Editorial, 2015).

Table 2. Description of Pretest and Posttest Data on Problem Solving Ability

Mark	Pretest	Posttest
N	36	36
Lowest	38	68
Highest	65	95
Mean	50,805	80,166
Standard deviation	8,307	7.99

Based on the calculation, it can be seen that the number of students who became the research sample was 36 students. In the pretest results, the lowest score obtained by students was 38, while the highest score was 65. The average pretest score of students was 50.805 with a standard deviation of 8.307. After being given treatment using the STAD type cooperative learning model assisted by Wordwall, the posttest results were obtained with the lowest score of 68 and the highest score of 95. The average posttest score of students was 80.166 with a standard deviation of 7.99.

Based on the results of the pretest and posttest, it can be seen that there was an increase in students' mathematical problem-solving abilities after participating in learning using the STAD type cooperative learning model assisted by Wordwalls.(Rita, 2017).

This is indicated by the increase in students' average score from 50.805 in the pretest to 80.166 in the posttest. Furthermore, students' lowest and highest scores also increased after the treatment. The smaller standard deviation in the posttest compared to the pretest indicates that the distribution of students' scores after the learning process became more even. Descriptively, these results indicate that learning using the STAD cooperative learning model with the help of Wordwall can improve students' mathematical problem-solving abilities.

The description of the pretest and posttest data on students' mathematical problem-solving abilities in the experimental class after the application of the STAD type cooperative learning model assisted by Wordwall can be seen in the following figure.

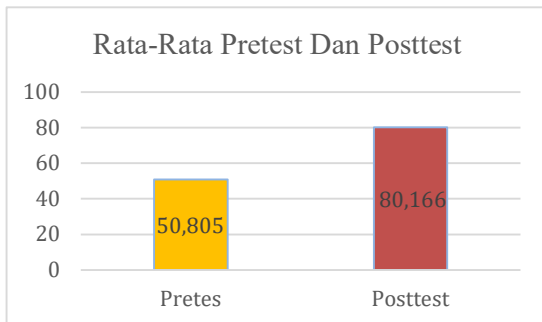


Figure 2. Bar Chart Comparing Pretest and Posttest Averages

Based on Figure 4.1, it can be seen that the average posttest score is higher than the average pretest score. The average pretest score was 50.805, while the average posttest score was 80.166. This indicates that after participating in learning using the STAD cooperative learning model assisted by Wordwall, students' mathematical problem-solving abilities increased. Thus, descriptively, it can be said that the application of the STAD cooperative learning model assisted by Wordwall provided better results for students' mathematical problem-solving abilities.(Riyanto & Amidi, 2024).

3.2 Test Prerequisite Data analysis

Data analysis was conducted to determine whether the STAD cooperative learning model with the help of a word wall had an effect on students' mathematical problem-solving abilities. Prior to hypothesis testing, a prerequisite test was conducted, namely a normality test. After the data were declared normally distributed, the hypothesis was tested using a paired sample t-test. Furthermore, to determine the extent of improvement in students' mathematical problem-solving abilities, an analysis was conducted using the N-Gain test.(Sagita, Ermawati, & Riswari, 2023).

3.3 Normality Test

A normality test was conducted to determine whether the pretest and posttest data on students' mathematical problem-solving abilities were normally distributed. The test was conducted using the Liliefors test manually and the Shapiro-Wilk test with the help of SPSS version 25, as the research sample size was 36 students.(Sari & Hadi, 2024).

The decision-making criteria in the Liliefors test are as follows:

If, then the data is normally distributed. $L_{hitung} \leq L_{tabel}$

If $>$, then the data is not normally distributed. $L_{hitung} > L_{tabel}$

The decision-making criteria in the Shapiro-Wilk test are as follows:

If the significance value (Sig.) > 0.05 , then the data is normally distributed.

If the significance value (Sig.) ≤ 0.05 , then the data is not normally distributed.

The decision-making criteria for the normality test are as follows.

If the significance value (Sig.) > 0.05 , then the data is normally distributed.

If the significance value (Sig.) ≤ 0.05 , then the data is not normally distributed.

The results of the Liliefors test show that the value for the pretest is 0.091 and the value for the posttest is 0.1162, while the value at the 0.05 significance level with a sample size of 36 students is 0.1477. These values are smaller than the value $L_{hitung} < L_{tabel}$, so it can be concluded that the pretest and posttest data are normally distributed (H_0 is accepted). Furthermore, the results of the normality test are also proven using SPSS version 26 with the Shapiro-Wilk test.

The test criteria are if the significance value (Sig.) obtained is greater than 0.05 then H_0 is accepted so that the data is normally distributed, whereas if the significance value (Sig.) is less than 0.05 then H_0 is rejected so that the data is not normally distributed. shows the results of the normality test using SPSS version 26 with the Shapiro-Wilk test. The test results show that the pretest data obtained a significance value (Sig.) of 0.221, while the posttest data obtained a significance value (Sig.) of 0.354. Based on the test criteria, if the significance value (Sig.) is greater than 0.05, then H_0 is accepted so that the data is normally distributed. Therefore, because the significance value of the pretest ($0.221 > 0.05$) and posttest ($0.354 > 0.05$), it can be concluded that the pretest and posttest data are normally distributed.(Sinaga, Pratiwi, Kartika, Rahmah, & Pertiwi, 2024) Thus, the research data has met the normality assumption so that it can be continued to the hypothesis testing stage using parametric statistical tests, namely the paired sample t-test.(Hidayah, Purwoko, & Ngazizah, 2023).

3.4 Hypothesis Testing

Hypothesis testing is used to determine whether the hypothesis proposed in this study is accepted or rejected. To see whether there is an effect of the STAD cooperative learning model with the help of Wordwall on students' mathematical problem-solving abilities, the following hypothesis is formulated.

Hypothesis I

H_0 : There is no influence of the STAD type cooperative learning model assisted by Wordwall on students' mathematical problem solving abilities.

H_a : There is an influence of the STAD type cooperative learning model assisted by Wordwall on students' mathematical problem solving abilities.

Hypothesis II

H_0 :There was no increase in students' mathematical problem-solving abilities after the application of the STAD cooperative learning model assisted by Wordwall.

H_a :There was an increase in students' mathematical problem-solving abilities after the application of the STAD type cooperative learning model assisted by Wordwall.

The purpose of this test is to determine whether there is an effect of the STAD type cooperative learning model assisted by Wordwall on students' mathematical problem-solving abilities using the Paired Sample t-Test. Furthermore, to determine the extent of the increase in students' mathematical problem-solving abilities after being given treatment, an analysis was carried out using the N-Gain test.

3.5 Paired Sample t-Test

Hypothesis testing is used to test the hypothesis proposed in this study, namely whether there is an influence of the STAD type cooperative learning model assisted by Wordwall on the mathematical problem-solving abilities of eighth-grade students of St. Yoseph Catholic Private Middle School Medan. Hypothesis testing is carried out using the Paired Sample t-Test with a significance level of 0.05. The testing criteria are as follows.

H_0 rejected and accepted if $>H_a t_{hitung} t_{tabel}$

H_0 accepted and rejected if $H_a t_{hitung} \leq t_{tabel}$

H_0 : There is no influence of the STAD type cooperative learning model assisted by Wordwall on students' mathematical problem solving abilities.

H_a : There is an influence of the STAD type cooperative learning model assisted by Wordwall on students' mathematical problem solving abilities.

Table 3. Results of the Paired Sample T-test

Information	Pretest	Posttest	Difference (D) / Result
Mean	50,806	80.16	29,361
Standard Deviation	8,308	7,995	3,305
Variance	68.02	63.91	10,923
Number of Samples (n)	36	36	36
df			35
t count			53,303
t table ($\alpha=0.05$)			2.03
Decision	H0 is rejected and Ha is accepted		

Based on the test, the Sig. (2-tailed) value was obtained at 0.000. This value is smaller than the significance level of 0.05 ($0.000 < 0.05$), so H_0 is rejected and H_a is accepted. Thus, it can be concluded that there is a significant influence of the application of the Problem Based Learning (PBL) model assisted by Wordwall on students' numeracy literacy skills.

In addition, the test results showed a mean difference of 29.361. This positive value emerged because the difference in the SPSS output was calculated from Posttest - Pretest, so the average posttest score was higher than the average pretest score. This indicates that after participating in learning using the Problem Based Learning (PBL) model assisted by Wordwall, students' numeracy literacy skills increased by an average

difference of 29.361 points compared to before the treatment.(Soraya, Rahayu, & Ambarwati, 2018).

3.6 N-Gain Test

Data on students' problem-solving abilities obtained from the pretest and posttest can be used to determine improvements in assessment by observing and comparing the N-gain values. The N-gain values from the pretest and posttest results are presented in Table 4.

Table 4. N-Gain Test Results

Mean Pretest	Mean Posttest	N-Gain
50,805	80,166	0.6111

Based on the results of the N-Gain calculation in Table 4, the average N-Gain value was 0.61. This value is in the range of $0.30 \leq g < 0.70$, so it is included in the moderate category. This indicates that students' mathematical problem-solving abilities have increased after the application of the STAD cooperative learning model assisted by Wordwall. Thus, the hypothesis that the STAD cooperative learning model assisted by Wordwall can improve students' mathematical problem-solving abilities can be accepted.

3.7 Discussion

3.7.1 The Effect of the Student Teams Achievement Division (STAD) Cooperative Learning Model Assisted by Wordwalls on Students' Mathematical Problem-Solving Ability

This discussion aims to answer the first problem formulation, namely whether there is an influence of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall on students' mathematical problem-solving abilities. Based on the results of the hypothesis test using the Paired Sample t-Test, the value obtained was 53.303, while 2.030 was 2.030 at a significance level of 5%. Because , then H_0 is rejected and H_a is accepted. These results indicate that the STAD cooperative learning model assisted by Wordwall has a significant effect on the mathematical problem-solving abilities of eighth-grade students of St. Yoseph Middle School Medan. $t_{hitung} > t_{tabel}$ (Turnip & Simanjuntak, 2024).

This influence occurs because the STAD cooperative learning model provides students with the opportunity to learn actively through collaboration in heterogeneous groups. During the learning process, students discuss with each other, exchange opinions, help friends who are experiencing difficulties, and are responsible for the success of the group. These activities align with Wulandari's (2015) theory, which states that the STAD cooperative learning model encourages students to work together in small groups so they can help each other understand the material and improve their learning achievement. Furthermore, according to Johnson and Johnson (2017), the implementation of STAD is based on the principles of positive interdependence, individual responsibility, face-to-face interaction, social skills, and group evaluation. Through these principles, students not only gain knowledge but also train themselves to think critically, discuss, and solve problems collaboratively.(Supriadi, 2021).

The use of Wordwall media also supports the successful implementation of the STAD model. This media makes the learning process more engaging, interactive, and enjoyable through various quizzes and educational games. This situation

increases students' motivation, making them more active participants in the learning process and better understanding the material on Systems of Linear Equations in Two Variables (SPLDV). With increased student engagement during learning, their ability to solve mathematical problems also improves.

The results of this study are in line with the research of Rahmadhani et al. (2025) which stated that the application of the STAD learning model assisted by Wordwall media has a positive impact on students' mathematics learning outcomes. Although that study used learning outcome variables, while this study uses mathematical problem-solving abilities, both show that the combination of the STAD model and Wordwall media can create more active, interactive, and effective learning. Thus, the results of this study further strengthen that the application of the STAD cooperative learning model assisted by Wordwall is an effective learning strategy in improving students' mathematical abilities, especially problem-solving abilities.

3.7.2. Improving Students' Mathematical Problem-Solving Skills After Implementing the Student Teams Achievement Division (STAD) Cooperative Learning Model with the Assistance of Wordwalls

This discussion aims to answer the second problem formulation, namely whether there is an increase in students' mathematical problem-solving abilities after the application of the STAD type cooperative learning model assisted by Wordwall. Based on the results of the study, the average pretest score of 50.806 increased to 80.167 in the posttest. In addition, the results of the N-Gain analysis showed an average score of 0.611, which is included in the moderate category. These results indicate that the application of the STAD type cooperative learning model assisted by Wordwall is able to improve students' mathematical problem-solving abilities.

This improvement occurred because during the learning process, students were trained to understand problems, develop problem-solving strategies, solve problems, and review their answers. This process aligns with Polya's problem-solving ability indicators: understanding the problem, developing a solution plan, implementing the solution plan, and reviewing the results. Through group discussions in the STAD model, each student had the opportunity to exchange ideas, express opinions, and correct mistakes with group members, thereby improving their understanding of the material. Furthermore, the use of Wordwall provided more engaging practice questions, thus motivating students to practice solving various types of mathematical problems. (Upe & Usman, 2022).

The results of this study are in line with the research of Rahmawati et al. (2025) who concluded that the application of the STAD type cooperative learning model was able to improve students' mathematical problem-solving abilities with an N-Gain value of 0.67 which is in the moderate category. These results are not much different from this study which obtained an N-Gain value of 0.611 in the moderate category. The similarity of these results indicates that the STAD type cooperative learning model is consistently able to improve students' mathematical problem-solving abilities through discussion activities, group collaboration, individual responsibility, and active participation in learning. (Wardana, Fauziyah, & Niswati, 2024).

Thus, the increase in students' mathematical problem-solving abilities in this study shows that the application of the STAD cooperative learning model assisted by Wordwall not

only has a significant influence, but is also able to improve students' abilities in understanding concepts, developing solution strategies, solving problems, and re-evaluating the results of the solution according to the indicators of mathematical problem-solving abilities.

3.8 Research Findings

Based on the results of data analysis that has been carried out through the administration of pretests, the application of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall, the administration of posttests, and hypothesis testing, several research findings were obtained as follows.

3.8.1 Students' mathematical problem-solving abilities before the implementation of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall were still relatively low.

Based on the results of the pretest given to 36 eighth-grade students of St. Yoseph Middle School Medan, the average score was 50.806. These results indicate that students' initial ability to solve mathematical problem-solving problems is still not optimal. Most students still have difficulty understanding the information contained in the problem, determining the right solution strategy, implementing the solution steps systematically, and re-checking the results obtained. These findings indicate that before being given treatment, students' mathematical problem-solving abilities still need to be improved.

3.8.2 Students' mathematical problem-solving abilities increased after the implementation of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall.

After the learning process using the STAD cooperative learning model assisted by Wordwall was completed, a posttest was given to all students. The analysis results showed that the average posttest score increased to 80.167. When compared to the average pretest score of 50.806, there was an increase of 29.361 points. This increase indicates that after receiving learning using the STAD model assisted by Wordwall, students were able to understand the concept of the System of Linear Equations in Two Variables (SPLDV) better and were better able to solve mathematical problem-solving problems. (E. Wulandari & Neolaka, 2013).

3.8.5 The Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall has a significant influence on students' mathematical problem-solving abilities.

Based on the results of the hypothesis test using Paired Sample t-Test, the t-count value was 53.303, while the t-table value was 2.030 at a significance level of 5% with degrees of freedom (df) = 35. In addition, a significance value (Sig. 2-tailed) of 0.000 was obtained, which is smaller than 0.05. Thus, H_0 was rejected and H_a was accepted. These results indicate that the application of the STAD type cooperative learning model assisted by Wordwall has a significant influence on the mathematical problem-solving abilities of eighth-grade students of St. Yoseph Medan Middle School.

3.8.3 The increase in students' mathematical problem solving abilities is in the moderate category based on the results of the N-Gain analysis.

To determine the extent of improvement in students' mathematical problem-solving abilities after being given treatment, an analysis was conducted using the N-Gain test. The results of the analysis showed that the average N-Gain value was 0.611, which is included in the moderate category. These results indicate that the application of the STAD cooperative learning model assisted by Wordwall was able to improve students' mathematical problem-solving abilities with a fairly good level of effectiveness. This means that the applied learning model succeeded in improving students' abilities, although there is still an opportunity to obtain higher improvements through learning development in further research.

3.8.4 The application of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall encourages students to be more active, collaborative, and enthusiastic during the learning process.

During the learning process, students showed positive changes in their participation in learning activities. They appeared more active in discussions with group members, exchanging ideas, helping friends who were having difficulties, and were more confident when presenting their discussion results. The use of wordwalls also increased student enthusiasm because the learning was presented in an engaging and interactive way. This created a more enjoyable learning environment, making it easier for students to understand the material and more motivated to solve mathematical problems. (I. Wulandari, 2022).

3.9 Research Limitations

This research was conducted to the maximum extent possible to obtain results that can be used as a basis for drawing conclusions regarding the effects of the treatment given during the learning process. However, this study still has several unavoidable limitations. These limitations are expected to serve as considerations and input for future researchers in developing similar research. The limitations of this study are as follows:

- a. The available facilities and infrastructure still don't fully support the learning process. Classroom facilities, such as the suboptimal use of infocus, mean that the delivery of learning materials cannot take place optimally, resulting in the achievement of desired learning objectives.
- b. During group discussions, most students initially lacked focus in participating in the learning process. Therefore, teachers need to provide more intensive motivation and guidance to encourage students to participate more actively in the learning process, thereby effectively achieving the stated learning objectives.

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

Based on the results of research and discussion regarding the effect of the cooperative learning model of the Student Teams Achievement Division (STAD) type assisted by Wordwall on the mathematical problem-solving abilities of eighth-grade students of St. Yoseph Catholic Private Middle School Medan in the 2025/2026 Academic Year, it can be

concluded that the application of the cooperative learning model of the Student Teams Achievement Division (STAD) type assisted by Wordwall has a significant effect on students' mathematical problem-solving abilities. This is evidenced by the results of the Paired Sample t-Test which shows a t_{count} value of 53.303 greater than the t_{table} of 2.030 at a significance level of 5%, so that H_0 is rejected and H_a is accepted.

In addition, the results of the N-Gain calculation showed an average value of 0.611 which is included in the moderate category. These results indicate that students' mathematical problem-solving abilities increased after the implementation of the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall. Thus, the Student Teams Achievement Division (STAD) cooperative learning model assisted by Wordwall can be used as an effective learning alternative in improving students' mathematical problem-solving abilities.

4.2 Suggestions

Based on the results of the research that has been conducted, the researcher provides several suggestions as follows.

a. For Teachers

1. Mathematics teachers are advised to implement the Student Teams Achievement Division (STAD) cooperative learning model with the aid of a word wall as an alternative learning method. This learning model can increase student engagement, encourage group collaboration, and help improve students' mathematical problem-solving skills.

b. For Students

Students are expected to be more active in the learning process, confidently express their opinions, collaborate with group members, and optimally utilize the learning media provided by the teacher. This will help students' mathematical problem-solving skills continue to improve.

c. For Further Researchers

Future researchers are expected to expand this research by applying the Student Teams Achievement Division (STAD) cooperative learning model with the help of Wordwalls to different mathematics materials, different educational levels, or with a larger sample size. Furthermore, future researchers can also examine the effect of this learning model on other mathematical abilities, such as critical thinking, mathematical communication, or student creativity, to obtain broader and more in-depth research results.

REFERENCES

- Abrori, AN, & Sumadi, CD (2023). The Effect of the STAD Type Cooperative Learning Model on the Learning Activity of Grade 2 Students at SDN Morkoneng 1. Lencana: Journal of Educational Science Innovation, 1(4), 296–315. <https://doi.org/10.55606/lencana.v1i4.2385>
- Afrelia, M., & Oktaviani, N. (2025). Mathematical Problem Solving Ability in Mathematics Learning of Grade 2 Students of SDI Raudlatul Musthofa. JUPEIS: Journal of Education and Social Sciences, 4(3), 105–110. <https://doi.org/10.57218/jupeis.vol4.iss3.1666>
- Afriantoni, Dhea, A.-ZV, Sari, W., & Nuria. (2025). Online

- Journal System 01. MANJERIAL: Journal of Management Innovation and Educational Supervision, 5(1), 10–17.
- Amelia, Nina, Sinaga, Rachel Br., Asriati, WW (2024). Journal of MATHEMATIC PAEDAGOGIC. 9(1), 75–84.
- Asmiati, Kasman, MR, & Amaliah, F. (2024). Application of WordWall Media to Improve Student Learning Outcomes. Basic Education and Teacher Training, 9(2), 28–33.
- Bugis, H., Ratau, A., Salatalohy, A., Sarifa, S., & Wagola, N. (2023). The Effectiveness of Implementing the Times Games Tournament (TGT) Learning Model with a Realistic Approach on Students' Cognitive Mathematics Learning Outcomes in Class VII of SMP Cendekia Ambon. Sigma Mathematics and Learning Journal (Jpms), 9(1), 28–36. <https://doi.org/10.36987/jpms.v9i1.3838>
- Cahyani, H., & Setyawati, RW (2016). The importance of improving problem-solving ability through PBL to prepare a superior generation for AEC. Proceedings of the National Mathematics Seminar (PRISMA), 151–160.
- Damopolii & Rahman. (2019). Volume XI, Number 1, June 2025: Pages 36-41 Utile Journal of Implementation of the Stad Learning Model to Improve. Xi, 36–41.
- DEWI, NA, IRHAM, M., & WIBOWO, SE (2021). The Effect of Implementing Stad Type Cooperative Learning on Mathematical Problem Solving Ability. Ganec Swara, 15(1), 874. <https://doi.org/10.35327/gara.v15i1.186>
- Dotutinggi, M., Zees, A., & Rahmat, A. (2023). The Effect of Using Wordwall Educational Games on Student Learning Outcomes in Schools. Journal of Community Service: DIKMAS, 03(June), 363–368. <https://ejournal.pps.ung.ac.id/index.php/dikmas/article/view/1955%0A>
- Fahrudin, F., Ansari, A., & Ichsan, AS (2021). Conventional and Critical Creative Learning in the Perspective of Islamic Education. Hikmah, 18(1), 64–80.
- Fitriani, YI, Mursidik, EM, & Teguh. (2024). Improving Mathematics Learning Outcomes Through the TGT Type Cooperative Model Assisted by Question Cards for Class V of Sd Negeri 1 Tinatar. JPG: Journal of Teacher Education, 5(1), 1–13. <https://ejournal.uikabogor.ac.id/index.php/jpg/article/download/14803/4856>
- Haryadi, AT (2022). Indonesian Research Journal on Education. Indonesian Research Journal on Education Web., 4, 550–558.
- Hasanah, FJ, & Firmansyah, D. (2022). Analysis of Kemam Problem Solving in Terms of Student Learning Motivation. Jurnal Educatio FKIP UNMA, 8(1), 247–255. <https://doi.org/10.31949/educatio.v8i1.1959>
- Hasratuddin. (2008). Problems in Learning Mathematics... (Hasratuddin). Pythagoras, 4(1), 67–73.
- Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. Educational Researcher, 38(5), 365–379. <https://doi.org/10.3102/0013189X09339057>
- La'ia, HT, & Harefa, D. (2021). The Relationship between Mathematical Problem-Solving Ability and Students' Mathematical Communication Ability. Aksara: Journal of Nonformal Education, 7(2), 463. <https://doi.org/10.37905/aksara.7.2.463-474.2021>
- Luwiti, SR, Mahmud, M., & Panigoro, F. (2023). Analysis of Stad and Jigsaw Cooperative Learning: A Recommendation for Classroom Practices. Journal of Language, Literature, and ..., 13(3), 105–141. <https://ejournal.ung.ac.id/index.php/JBSP/article/view/24615>
- Maharani, I., & Nawangsih, K. (2023). Application of the Stad Type Cooperative Learning Model to Improve Students' Problem-Solving Skills on Number Pattern Material. OMEGA: Journal of Mathematics Education, 2(2), 59–65. <https://doi.org/10.47662/jkpm.v2i2.483>
- Majekroatina, D., Darsono, & Yohanie, DD (2024). Students' Mathematical Problem-Solving Ability on Two-Variable Linear Equation Systems. Citra Bakti Scientific Journal of Education, 11(1), 218–232. <https://doi.org/10.38048/jipcb.v11i1.2177>
- Mantiri, J. (2019). The Role of Education in Creating Quality Human Resources in North Sulawesi Province. Journal of Civic Education: Media for Pancasila and Citizenship Studies, 3(1), 20. <https://doi.org/10.36412/ce.v3i1.904>
- Mathematics, JP (2025). Development of Android-Based Learning Media Kodular and. 4(2), 230–237.
- Narpila, SD, Pitaloka, DD, Ramadhan, R., & Muttaqin, A. (2025). Comparison of Conventional Learning Activities and Technology-Based Learning on Student Learning Outcomes (Case Study in Class VIII A of SMP Cerdas Bangsa, Namorambe District, Deli Serdang Regency). Nakula Journal: Center for Education, Language and Social Sciences, 3(1), 210–220. <https://doi.org/10.61132/nakula.v3i1.1501>
- Nurhikmayati, I. (2019). Implementation of STEAM in Mathematics Learning. Didactical Mathematics, 1(2), 41–50. <https://doi.org/10.31949/dmj.v1i2.1508>
- Pasaribu, VLD, Agrasadya, Nina Shabrina, & Krisnaldy. (2020). Serving as servants. Journal of Community Service, 1(1), 177–180.
- Permana, Jeni, M., & et al. (2015). Journal of Mathematics Education Journal of Mathematics Education, 2(3), 41–60.
- Prayoga, MD, Sasmita, W., & Mahendra, A. (2025). Deep Learning: Emphasis on the Learning Process. Journal of Global Humanistic Studies, 3(3), 548–554.
- Rahmadhani, E., Sutriyani, W., Pendidikan, S., Sekolah, G., Islam, U., & Ulama, N. (2025). The Influence of the STAD Model Assisted by Wordwall Media. 15(2), 115–124.
- Rahmah, N. (2018). The Nature of Mathematics Education. Al-Khwarizmi: Journal of Mathematics and Natural Sciences Education, 1(2), 1–10. <https://doi.org/10.24256/jpmipa.v1i2.88>
- Editorial, . (2015). Journal of Educational Technology. Journal of Educational Technology (JTP), 8(2), 60–70. <https://doi.org/10.24114/jtp.v8i2.3329>
- Rita, TS &. (2017). Journal of Language Education. Indonesian Language and Literature Education, 2(1), 67–73.
- Riyanto NA and Amidi. (2024). Literature Study: Mathematical Problem Solving Ability in the Connecting, Organizing, Reflecting, Extending (CORE) Learning Model. PRISMA, Proceedings of the National Mathematics Seminar, 7(1), 261–267.

- Sagita, DK, Ermawati, D., & Riswari, LA (2023). Mathematical Problem Solving Ability of Elementary School Students. *Jurnal Educatio FKIP UNMA*, 9(2), 431–439. <https://doi.org/10.31949/educatio.v9i2.4609>
- Sari, RA, & Hadi, MS (2024). Analysis of Students' Mathematical Problem-Solving Ability on Arithmetic Sequences and Series. *INOVATIF: Journal of Research in Education, Religion, and Culture*, 10(2), 269–281. <https://doi.org/10.55148/inovatif.v10i2.984>
- Shafira Hidayah, Riawan Yudi Purwoko, & Nur Ngazizah. (2023). Analysis of Problem Solving Ability Based on Polya's Theory of Fraction Material in Elementary Schools. *Journal of Education and Social Sciences (Jupendis)*, 1(1), 155–161. <https://doi.org/10.54066/jupendis-itb.v1i1.116>
- Sinaga, S., Pratiwi, A., Kartika, D., Rahmah, S., & Pertiwi, P. (2024). The Influence of Wordwall Learning Media on Mathematics Learning Outcomes of Students of MTS Nurul Ikhlas I in the Material of Spatial Structures. Introduction Education is a complex activity that includes various parts that are closely related to each other. By k. 16(2), 93–97.
- Soraya, A., Rahayu, W., & Ambarwati, L. (2018). Improving mathematical problem-solving skills with the make-a-match method in inquiry viewed from gender differences. *Pythagoras: Journal of Mathematics Education*, 13(1), 33–42. <https://doi.org/10.21831/pg.v13i1.15341>
- Supriadi, F. (2021). The Influence of Work Ethic on the Organizational Commitment of State Civil Apparatus at the Investment and One-Stop Integrated Service Office of Kubu Raya Regency. *Productivity Journal*, 8(1), 8–14. <https://doi.org/10.29406/jpr.v8i1.2075>
- Turnip, F., Simanjuntak, SD, et al. (2024). The Effect of the Student Teams Achievement Division (STAD) Learning Model on the Critical Thinking Skills of Fourth Grade Students of SD Negeri 067093 Medan Helvetia in the 2023/2024 Academic Year. *Pendas: Scientific Journal of Elementary Education*, 9(4). <https://doi.org/10.23969/jp.v9i4.19063>
- Upe, Jusni Ambo; Usman, A. (2022). The Influence of Green Marketing on Customer Loyalty Through Customer Decisions at Starbucks Makassar. *Journal of Applied Business and Economic (JABE)*, 9(1), 1–14. <http://dx.doi.org/10.30998/jabe.v9i1.14165>
- Wardana, AW, Fauziyah, N., & Niswati, N. (2024). Implementation of Stad Type Cooperative Learning to Improve Student Learning Outcomes. *Proceedings of the International Conference on Lesson Study*, 1(1), 514. <https://doi.org/10.30587/icls.v1i1.7424>
- Wulandari, E., & Neolaka, A. (2013). Differences in Learning Outcomes Between the Team Assisted Individualization Cooperative Learning Model and the Conventional Plus Learning Model in Statics Subjects. *Journal of the Department of Civil Engineering, Faculty of Engineering, UNJ*, II(1).
- Wulandari, I. (2022). STAD (Student Teams Achievement Division) Type Cooperative Learning Model in MI Learning. *Papedas Journal: Journal of Elementary Education Publication*, 4(1), 17–
23. <https://doi.org/10.36232/jurnalpendidikandasar.v4i1.1754>

