Implementation of Cooperative Learning Model Using Wordwall Application to Improve Problem Solving Ability

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Article Info

Abstract

Problem-solving ability is an essential skill in mathematics learning. However, many students experience difficulties in understanding and solving mathematical problems, especially with conventional learning methods. This study aims to analyze the effectiveness of a cooperative learning model supported by the Wordwall application in improving the problem-solving abilities of 10th grade students. The method used in this study is quantitative with a pre-post group design, where students learning outcomes before and after the implementation of the learning model are analyzed using statistical tests. The population of this study was 17 students of class X. Data analysis was carried out using a paired sample t-test to measure differences in learning outcomes before and after the application of the learning model. Based on the results of the Paired Sample Test, the sig. (2-tailed) value was obtained = 0.000 < 0.05, so H0 was rejected and Ha was accepted. Thus, there was an average difference between the pretest and post-test learning outcomes, which indicated that the Wordwall-assisted cooperative learning model had a significant influence in improving students' problem-solving abilities

INTRODUCTION

In the world of modern education, problem-solving skills are an important aspect that every student must have. This ability not only plays a role in solving academic problems, but also in everyday life, where students are required to think critically and creatively in facing various challenges [1] . Teaching problem-solving from an early age is important to improve mathematical understanding as well as critical and creative thinking skills [2] . Problem-solving is a basic cognitive skill needed in resolving conflicts and facing challenges [3] [4] . In mathematics learning, problem-solving is one of the main aspects that determine students' success in understanding abstract concepts and applying them in real contexts [5] . Solving problems creatively means finding new, valuable ideas [6] [7] . Thus, problem-solving skills in education, especially mathematics, are important to help students understand abstract concepts, think critically, and apply them in real life creatively.

Despite its importance, many students experience difficulties in solving mathematical problems due to a lack of conceptual understanding and minimal active involvement in the learning process. Conventional learning methods that are still widely used, such as lectures and routine practice problems, are often unable to develop critical thinking skills and effective problem solving [8] . Therefore, innovation is needed in learning models that can increase student engagement and improve student learning outcomes. Cooperative learning models have been proven effective in improving students' social and academic skills [9] . Cooperative learning is widely recognized as an innovative and effective pedagogical approach in the world of modern education [10] . This

approach encourages interaction, planning, participation, leadership, and shared motivation, while strengthening student socialization and learning processes [11] . According to [12] , cooperative learning is a teaching method that promotes effective collaboration. This model strengthens academic achievement, social interaction, and enthusiasm for learning while supporting the process of adaptation in the social environment. Through intensive cooperative learning, students can feel the benefits of the positive impact of peers as a whole [13] . This method has become the focus of attention of educators and educational researchers in recent decades. This learning technique is effective for small groups with diverse abilities, helping students understand the material, take responsibility for their own learning and that of their peers, and improve cooperation, responsibility, and social skills [14] . Cooperative learning also helps develop general skills, such as teamwork, which are important and valued in the workplace [15] . Therefore, the cooperative learning model has been proven to be more effective than conventional methods [16] . This approach improves academic, social, and cooperation skills, and encourages active student involvement in learning.

One cooperative learning strategy that can be applied in the classroom is by using interactive digital media, such as the Wordwall application, which is designed to increase student participation in learning through various game-based activities. Wordwall is a very practical application for assessing students' critical thinking skills [17] , Wordwall is a web application that presents interactive educational quizzes and can be an interesting learning medium and assessment tool for students [18] . Wordwall helps teachers create interactive learning through quizzes, puzzles, and educational games. In a learning, this application makes it easier to understand complex concepts in a fun way, and its gamification encourages students to be active, resilient, and enthusiastic about learning [19] . Thus, the Wordwall application is very suitable for use in cooperative learning models to help students solve problems interactively and fun.

Several studies have shown that the application of Wordwall in mathematics learning can improve students' conceptual understanding and learning motivation [20] . A study conducted by [21] found that the use of Wordwall in a cooperative learning model significantly improves students' learning outcomes in mathematics, the results of the study [22] stated that Wordwall learning media can increase the learning interest of class X students. According to [23] in addition to improving conceptual understanding, the Wordwall-assisted cooperative learning model can also develop students' social skills. In this model, students work in small groups to solve problems together, so they learn to communicate, share ideas, and help each other in understanding the material. Research from [24] explains that combining gamification elements in cooperative learning significantly improves students' social interactions and creates an environment that encourages the emergence of prosocial behavior, such as cooperation. This cooperation-based learning can also increase students' confidence in completing academic tasks [25] . These results indicate that technology-based learning media can be an effective solution in improving the quality of learning.

However, although the cooperative learning model and the use of the Wordwall application have many advantages, its implementation still faces several challenges. Some teachers may have difficulty in adapting their teaching methods to new technologies, while some students may be less familiar with digital-based learning [26] . An effective teaching approach can be designed by integrating the latest teaching trends and utilizing the advantages of digital learning technology to increase effectiveness in the learning process [27] . [28] Stated that recent research emphasizes the

benefits of digital tools in enhancing the learning experience through interactivity and active student participation. Digital technology brings various benefits that contribute to improving the quality of education [29] . Therefore, there is a need for training for teachers and clear guidelines in the use of this application so that it can be optimally implemented in the classroom. To overcome this challenge, this study aims to evaluate the effectiveness of the Wordwall-assisted cooperative learning model in improving the problem-solving abilities of grade X students at MA Ma'arif Roudlotut Tholibin. This study will measure the extent to which this method can improve students' problem-solving abilities in mathematics learning.

The results of this study are expected to provide empirical contributions to the development of more innovative and effective learning methods, particularly in mathematics education. Through quantitative data analysis, this study examines the relationship between the integration of digital media in learning and improving the quality of learning. By understanding how cooperative learning models and Wordwall applications can be implemented effectively, it is hoped that teachers can more easily adopt technology in their teaching [30] . Thus, by combining cooperative learning models with interactive technology, it is hoped that students can be more active in the learning process and be able to develop better problem-solving skills.

From the various studies above, it can be concluded that the cooperative learning model assisted by the Wordwall application has great potential in improving the quality of mathematics learning. Therefore, this study will focus on the application of cooperative methods assisted by digital media in improving the problem-solving abilities of 10th-grade students.

METHOD

This study uses a quantitative approach with a pre-test and post-test group design to evaluate the effectiveness of the cooperative learning model assisted by the Wordwall application in improving the problem-solving abilities of class X students. The quantitative method was chosen because it is able to provide objective numerical data in measuring changes in student skills before and after treatment [31] . According to [32], quantitative research that is thorough, clear, and retestable is very important to develop theory, help practice in the field, and support appropriate policy decisions. In this study, students were given a pre-test before implementing the learning model, then given learning using the Wordwall-based cooperative model and ended with a post-test to assess improvements in student learning outcomes.

Research Sample

This research was conducted at MA Ma'arif Roudlotut Tholibin on 10th-grade students in the 2024/2025 academic year. The research location was selected based on the school's need to improve more innovative and interactive mathematics teaching methods. Subjects were selected using a purposive sampling technique, where one class was selected based on the criteria of active student engagement in learning and the school's readiness to implement digital learning technology.

Instruments and Data Analysis

The research instrument used included a problem-solving ability test. The pre-test and post-test consisted of questions that measured students' understanding of the concept of exponents and problem-solving skills based on Polya's (1973) indicators, which include problem understanding, problem-solving planning, strategy implementation, and answer evaluation [33] . The validity and reliability of the instrument in this study were tested using content validity techniques by experts and a reliability test using the Cronbach's Alpha method. The reliability test was conducted using

Cronbach's Alpha, with a minimum required value of 0.70. The test questions consisted of 10 multiple-choice items and 5 essay items. The results of the validity test showed that the instrument was declared valid based on the expert's assessment. Meanwhile, the item reliability obtained a score of 0.831, which indicates that this instrument has an almost perfect level of reliability. Thus, this research instrument is declared valid and reliable, so it can be used to measure students' problem-solving abilities accurately and consistently.

The data analysis techniques used in this study include normality tests to ensure that the data is normally distributed [34] , homogeneity tests to see the similarity of variance between groups, and paired sample t-tests to determine significant differences between students' pre-test and post-test scores. This can be done using the following formula:

$$t = \frac{\overline{D}}{\frac{S_D}{\sqrt{n}}}$$

With the following information:

$\overline{D}$ =the average difference between pre-test and post-test scores.

S_n =standard deviation of the difference between pre-test and post-test scores.

n =number of samples (number of students).

Research Hypothesis

This study proposes a hypothesis (H $_1$) that there is a significant difference in students' problem-solving abilities before and after the application of the cooperative learning model assisted by the Wordwall application.

RESULTS AND DISCUSSION

Research result

Before implementing the cooperative learning model with the Wordwall application, students were given a pre-test consisting of several problem-solving questions on the exponent material. The pre-test results showed that most students had difficulty understanding the questions and choosing the appropriate solution strategy. After being given treatment using the cooperative learning model assisted by the Wordwall application, students were given a post-test to measure their understanding.

To test the hypothesis proposed in this study, the variables studied, namely the independent variable in the form of the implementation of the cooperative model using the wordwall application and the dependent variable in the form of students' problem-solving abilities, were analyzed using a paired two-sample t-test. Before conducting the analysis, the research data was first examined using the requirements test, namely the normality test.

Table 1. Results of the Normality Test for Pretest and Posttest Data

Tests of Normality

	Shapiro-Wilk		
	Statistics	Df	**Sig.**
Pre-test	.958	17	**.595**
Post-test	.936	17	**.273**

The normality test aims to ensure that the data obtained are normally distributed, which is one of the prerequisites in parametric statistical analysis. In this study, the normality test was conducted using the Shapiro-Wilk test, which each provides significant results (p-value) for the pretest and posttest data. The test was carried out with the help of the IBM SPSS statistics 21 program. Based on the output table "test of normality" in the Shapiro-Wilk section, the Sig value for the pretest value is 0.595 and the posttest value is 0.273. Because these values are greater than 0.05, it can be concluded that the pretest and posttest data are normally distributed. Thus, the requirements or assumptions of normality in using the paired sample t test have been met.

Table 2. Results of the Pretest and Posttest Data Homogeneity Test

Test of Homogeneity of Variances

Levene Statistics	**df1**	**df2**	**Sig.**
.118	1	32	**.733**

Levene's test is used to test the equality of variance (homogeneity of variance) between groups in a dataset. If the significance value (Sig. or p-value) is less than 0.05 (assuming a significance level of $\alpha = 0.05$), Based on the results of the Homogeneity of Variance test (Levene's Test), the Levene Statistic is obtained at 0.118 with a significance value (Sig.) of 0.733. Because the significance value is greater than 0.05, it can be concluded that the variance between groups is uniform or does not show a significant difference.

The hypothesis in this study is a temporary assumption that needs to be tested for accuracy through data analysis. Hypothesis testing is conducted to determine whether there is a significant relationship or difference between the variables studied. By using appropriate statistical methods, the results of this hypothesis testing are expected to provide empirical evidence that supports or rejects the previously formulated hypothesis. To test the hypothesis that has been put forward, the following are the results of the paired sample t-test analysis, which includes paired sample statistics, paired sample correlation, and paired sample test (sig-2 tailed), as shown in the table below:

Table 3. Paired Samples Statistics

	Mean	**N**	**Standard Deviation**	**Std. Error Mean**
Pair-1 Posttest	79.4118	17	8.99346	**2.18123**
Pretest	70,0000	17	9.51972	**2.30887**

The t-test results above show that the average pretest score was 70.0000, while the average posttest score reached 79.4118. Thus, the average score after implementing the cooperative model using the wordwall application was higher than before its implementation. This indicates an increase in student problem-solving after implementing the cooperative model assisted by the wordwall application.

Table 4. Paired Samples Test

Pair-1 Pretst-Postes	**Paired Differences**			t	df	**Sig.(2-tailed)**
	Mean	Std. Deviation	Std.Error Mean			
	9.41176	7.04502	1.70867	5,508	16	**.000**

After being given treatment using the cooperative learning model assisted by the Wordwall application, students were given a post-test to measure their understanding improvement, and based on the results of the "paired sample test" output table above, it is known that the sig. (2-tailed) value is 0.000 which is smaller than 0.05, so H0 is rejected and Ha is accepted. So it can be concluded that there is an average difference between the pretest and post-test learning outcomes, which means there is an influence of the cooperative learning model using the wordwall application in improving the problem-solving abilities of class X students.

Discussion

Based on the research results, the use of a cooperative learning model supported by the Wordwall application has proven effective in improving students' problem-solving abilities. This approach allows students to be more actively involved in the learning process through group discussions, dynamic interactions, and the use of engaging and interactive learning media. These findings align with research, which states that cooperative learning models can improve learning outcomes because students are more active in sharing ideas, exchanging understanding, and collaborating in completing assigned tasks.

In addition, research conducted by [35] also supports these results, by showing that Wordwall-based learning can increase student motivation and participation in class. The interactive features available in the application help students focus more, understand the material better, and reduce boredom in the learning process. Therefore, the application of a cooperative learning model combined with interactive digital technology such as Wordwall can be an effective strategy to create a more interesting and meaningful learning environment, and can develop problem-solving skills in students.

The improvement in students' scores in the post-test indicates that the use of Wordwall contributes to changing the way students understand mathematical concepts more effectively. This application offers various interactive quizzes that allow students to learn in a more fun and interesting way, so that abstract mathematical concepts become easier to understand. Through educational game features such as matching games, quizzes, and flashcards, Wordwall not only helps students remember the material but also develops problem-solving skills. In addition, the application of Wordwall in mathematics learning creates a more interactive and dynamic learning atmosphere, which encourages students to be more motivated and active in the learning process. This finding is in line with research [36] , which states that the use of digital learning media can increase student engagement and strengthen their memory of the material learned. Therefore, the use of digital technology such as Wordwall not only helps improve student learning outcomes but also creates a more effective, interesting learning experience that is in line with the demands of today's digital era.

Figure 1. Presentation of material using the wordwall application

Figure 2. Implementation of the cooperative model with the wordwall application

From the image above, cooperative learning allows students to help each other understand the material, creating an interactive and collaborative learning environment. After being implemented in the classroom, this approach shows significant results in making it easier for students to solve problems. Collaborative-based learning allows students to be more active in discussing, exchanging ideas, and developing strategies in solving the problems or challenges given. Wordwall, as an interactive media, plays an important role in creating a more interesting and enjoyable learning atmosphere. According to [37] , cooperation in learning can improve understanding through social interaction, where students who understand better help their friends. In addition, the use of interactive media such as Wordwall also increases student motivation, because it makes learning more interesting, dynamic, and competitive. Research [38] supports these findings, showing that gamification elements in Wordwall encourage active participation and focus on learning. Therefore, the combination of cooperative learning and interactive technology can be an effective strategy to improve students' understanding and problem-solving skills.

However, this study also identified several challenges in implementing technology-based learning. One major obstacle is the difficulty experienced by some students in accessing digital devices, both due to limited resources such as a lack of adequate devices and internet networks, as well as limited technological skills. This obstacle reduces the effectiveness of learning for some students, especially in the use of interactive media such as Wordwall. In addition, the level of student readiness to adapt to technology varies, so further assistance is needed so that its use can

support the learning process optimally. This finding is in line with research [39] , which revealed that the adoption of technology in learning still faces various obstacles, especially in aspects of accessibility and teacher and student readiness. In addition to individual limitations, other factors such as lack of facilities in schools also act as obstacles, so that not all students can experience the full benefits of the technology implemented. Therefore, strategic steps are needed to overcome this challenge, such as equal access to devices, training in the use of technology for students and teachers, and the implementation of more flexible learning methods to remain inclusive for all students.

To address these challenges, schools can take strategic steps by providing computers or tablets in classrooms to ensure equal access to learning technology for all students. Furthermore, training programs for teachers and students should be organized to enhance their understanding and skills in optimally utilizing digital learning applications. This training can cover the use of various interactive platforms, strategies for implementing technology in learning, and how to overcome potential technical challenges. With infrastructure support and improved technological skills, the use of digital media in learning can be more effective and less of a barrier for certain students. Based on research and analysis, the cooperative learning model using the Wordwall application has been shown to have a positive impact on students, particularly in improving problem-solving skills. The engaging features in Wordwall encourage student engagement in the learning process, deepening their understanding of the material. Therefore, this method can be an innovative solution to improve the quality of mathematics learning in secondary schools, while also helping students develop critical thinking and collaborative skills, which are crucial for academic success.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the research that has been conducted, it can be concluded that the application of the cooperative learning model assisted by Wordwall media significantly improves students' problem-solving abilities. The results of the Paired Sample t-test show a significant difference between the test results before and after the application of this learning model. With a Sig. (2-tailed) value <0.05, it can be concluded that there is a significant increase in students' problem-solving abilities after participating in Wordwall-based learning. In addition, this learning method has proven effective in helping students be more active, increasing involvement in discussions, and strengthening conceptual understanding through more enjoyable and interesting interactions. Thus, the use of the cooperative learning model assisted by Wordwall can be one of the recommended strategies to improve students' problem-solving abilities in the learning process.

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