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EFFECTIVENESS OF STAD LEARNING MODEL WITH PULMAN MEDIA ON STUDENTS' UNDERSTANDING OF MATHEMATICAL CONCEPTS

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ABSTRACT

Latar belakang dari penelitian ini yaitu rendahnya kemampuan pemahaman konsep matematika siswa kelas IV SDN 1 Damarjati yang dibuktikan dengan pemberian soal tentang pemahaman konsep matematika. Penelitian ini bertujuan untuk mengetahui keefektivitas kemampuan pemahaman konsep matematika siswa melalui penerapan model pembelajaran STAD berbantuan media PULMAN. Penelitian ini menggunakan metode eksperimen kuantitatif dengan desain pre-experimental. Jenis penelitian yang digunakan adalah one group pretest-posttest design. Populasi penelitian adalah siswa kelas IV SDN 1 Damarjati yang berjumlah 36 siswa. pengambilan sampel menggunakan teknik sampling jenuh. Teknik pengumpulan data meliputi wawancara, observasi, tes, dan dokumentasi, sedangkan analisis data dilakukan menggunakan uji normalitas dan uji N-Gain. Hasil analisis uji N-Gain menunjukkan peningkatan dengan nilai rata-rata sebesar 0,59 dengan kategori sedang. Sementara itu, hasil N-Gain persen memperoleh rata-rata 59,9071 yang ditafsirkan dalam kategori cukup efektif . Berdasarkan hasil tersebut, maka dapat disimpulkan bahwa penerapan model pembelajaran STAD berbantuan media PULMAN efektif dalam meningkatkan Pemahaman konsep matematika siswa.

The background of this study is the low ability to understand mathematical concepts of fourth grade students of SDN 1 Damarjati which is evidenced by the provision of questions about understanding mathematical concepts. This study aims to determine the effectiveness of students' ability to understand mathematical concepts through the application of the STAD learning model assisted by PULMAN media. This study uses a quantitative experimental method with a pre-experimental design. The type of research used is one group pretest-posttest design. The population of the study was 36 fourth grade students of SDN 1 Damarjati. Sampling using saturated sampling techniques. Data collection techniques include interviews, observations, tests, and documentation, while data analysis is carried out using normality tests and N-Gain tests. The results of the N-Gain test analysis showed an increase with an average value of 0.59 with a moderate category. Meanwhile, the results of the N-Gain percent obtained an average of 59.9071 which was interpreted in the fairly effective category. Based on these results, it can be concluded that the application of the STAD learning model assisted by PULMAN media is effective in improving students' understanding of mathematical concepts.

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1. INTRODUCTION

Education is a learning process that is not only limited to the provision of scientific knowledge, but also includes cultural aspects that shape the character and skills of individuals (Rohmah, et al., 2024). In the context of modern life full of demands, education is the main instrument to improve the quality of human resources who are independent, responsible, creative, and noble in character (Ilfa, et al., 2023). One of the indicators of educational success is the effectiveness of learning which can be measured from students' ability to understand concepts in each subject, including mathematics (Faradhila, et al., 2024).

Mathematics at the elementary school level plays an important role as the foundation of students' numeracy and logical reasoning skills. Mathematics learning not only aims to teach abstract concepts, but also emphasizes its application in daily life (Candrasari, et al., 2023). Meanwhile, according to Nurhayanti et al. (2021) A good understanding of mathematical concepts is a prerequisite for solving problems, both in academic and real-life contexts. However, based on the results of observations in grade IV of SDN 1 Damarjati, it was found that the majority of students still experienced obstacles in understanding mathematical concepts, which was reflected in the low average learning outcomes (52.25) and only 11 out of 36 students met the Completeness Criteria for Learning Objectives. This problem is exacerbated by the application of learning models that have not varied and the lack of optimal use of learning media, thereby reducing students' motivation and participation in learning mathematics.

Based on these conditions, innovation in learning strategies is needed, one of which is through the application of a cooperative learning model of the Student Teams Achievement Division (STAD) type. The STAD model emphasizes student collaboration in heterogeneous groups, allows for peer-to-peer learning, and encourages the active participation of all group members (Suprihandayani, 2022). However, the effectiveness of the STAD model is highly dependent on the support of learning media that is able to facilitate direct and concrete interactions, especially in abstract mathematics learning (Rahmawati, et al., 2023). The use of learning media based on local wisdom, such as the Mantingan Mosque puzzle (PULMAN), is expected to increase student involvement and facilitate the understanding of mathematical concepts through a contextual approach.

Although many studies mention the importance of cooperative learning models, especially STAD (Student Teams Achievement Division) to improve understanding of concepts, there is still little research that integrates the STAD model with local wisdom-based media, especially in the form of puzzles such as PULMAN (Puzzle of Local Content of the Mantingan Mosque). In fact, the use of contextual media can increase students' interest, activeness, and memory.

Previous research by (Lailatul Priatini, 2024) shows that the application of the STAD model assisted by word card media can increase the activeness and understanding of mathematical concepts. Meanwhile, Sinaga et al. (2023) proving that the STAD model is more effective than the conventional model. However, research that utilizes puzzle media based on local wisdom such as PULMAN in mathematics learning has not been widely conducted, so it is a gap in this research.

2. METHOD

This research was carried out at SDN 1 Damarjati using a quantitative experimental research method with a pre-experimental design involving experimental classes that were given initial tests and final tests without using a control class. This type of research uses a one group pretest-posttest design. This study uses two variables, namely the independent variable (x) of the STAD learning model and the bound variable (y) of understanding of

mathematical concepts. The analysis of this research instrument uses the validity test of content (Expert Judgment).

Table 1. The One Group Pretest Posttest Research Design Scheme

Class	*Pretest*	*Treatment*	*Posttest*
Experiment	O1	X	O2

Source: (Umam & Jiddiyyah, 2021)

Information:

O1= Pretest

X = Treatment

O2= Final test (*Posttest*)

2.1. Research Subject

The population in this study is grade IV students of SDN 1 Damarjati, Kalinyamatan District, Jepara Regency with a total of 36 students. The class was chosen because there are Most students have a relatively low ability to understand mathematical concepts. The sample in this study used saturated sampling, the sampling technique taken from all members of the population was used as a sample. Thus, the sample of this study is grade IV students of SDN 1 Damarjati which totals 36 students consisting of 24 male students and 12 female students.

2.2. Data Collection

Data collection in this study is using data collection techniques in the form of observation, interviews, tests, and documentation. At this stage, the researcher conducted interviews with parties related to the problem being researched, namely teachers and fourth grade students of SDN 1 Damarjati. The interviews in this study aim to collect relevant and accurate data from the sources, understand their perspectives, and dig deeper into the research subject. Observation in this study was carried out through direct observation in grade IV of SDN 1 Damarjati during the preliminary study. Furthermore, the test is given to determine the level of ability to understand mathematical concepts of grade IV students in mathematics subjects by giving essay questions to students. The documentation in this study includes taking pictures of class IV activities during the learning process and asking for a list of names of grade IV students of SDN 1 Damarjati to the homeroom teacher of grade IV.

2.3. Data Analysis

The tests used to analyze the data include three types, namely: quantitative descriptive analysis, normality test, and hypothesis test. First, quantitative descriptive analysis According to Wulandari., (2023) is research that aims to describe, research, and explain something that is learned based on real things by drawing conclusions from the phenomenon being researched using numbers. In this study, quantitative descriptive statistical analysis includes the analysis of the results of the value of students' ability to understand mathematical concepts in mathematics learning subjects using the STAD learning model assisted by PULMAN media on students' ability to understand mathematical concepts by calculating average grades and standard deviations.

The normality test, aims to show that the sample data from the obtained population is normally distributed or not (Usmadi, 2020) If the data is centered on the mean and median, then the data will be distributed normally. The data used in this normality test is

the data of pretest and posttest results from the experimental class. In the analysis of normality test data in this study, the Shapiro Wilk test was used because the research sample was less than 50 subjects.

Hypothesis test aims to find out the hypothesis that has been formulated by the researcher. In this study, the hypothesis test used was using the Paired Sample T-Test and the N-Gain Test. Paired Test Sample T-Test is a hypothesis testing method that uses paired data, aiming to compare scores before and after the experiment and evaluate the changes that occur (Syafriani et al., 2023). This study uses the Paired Test of T-Test Samples to test the difference in the results of the pretest and posttest scores from the data obtained. While the N-Gain Test is a test that provides a general overview of the improvement in scores from learning before being treated and after being treated (Volunteer et al., 2024). N-Gain in this study was used to seek the understanding of mathematical concepts of grade IV students after applying the STAD learning model assisted by PULMAN media. The N-Gain calculation is used to determine the increase in student scores on pretest-posttest results.

3. RESULTS AND DISCUSSION

3.1. Result

This research was carried out in grade IV of SDN 1 Damarjati totaling 36 students on February 17-21, 2025. This study was conducted to determine the effectiveness of the ability to understand mathematical concepts through the application of the STAD learning model assisted by PULMAN media. Based on the results obtained, data regarding the results of the pretest and posttest with the following results.

Table 2. Pretest and Posttest Calculation

	Lowest Score	Highest Score	Average
Pretest	30	73	48.47
Posttest	63	100	78.92

Based on the table above, the data results obtained from grade IV of SDN 1 Damarjati on students' ability to understand mathematical concepts from the results of the pretest with the lowest score of 30 and the highest score of 73 with an average of 48.47. Meanwhile, the results of the posttest of students' mathematical concept comprehension ability showed an increase with the lowest score of 63 and the highest score of 100 with an average of 78.92.

Table 3. Normality Test Results

Significance of the Shapiro-Wilk Test	
Pretest	0,149
Posttest	0,349

Based on the results of the table above, the results of the normality test in the pretest data showed a significance level of 0.149. The value indicates that the pretest data is normally distributed, because the significance level is 0.149 > 0.05. Thus, the results of the normality unit in the posttest data showed a significance level of 0.349 which indicates that the posttest data is normally distributed. Therefore, it can be concluded that the pretest and posttest data are distributed normally. So that it can be used as a basis in hypothesis tests. The next stage is to conduct a hypothesis test using

the N-Gain test. The following are the results of the N-Gain test presented in the following table.

Table 4. N-Gain Test Results

	Lowest Score	Highest Score	Average
N-Gain Score	30	73	0,5991
N-Gain Percent	63	100	59.9071

Based on the results of the N-Gain test calculation above, it shows that the calculation of the N-Gain Score reaches 0.5991 which is included in the medium category. Meanwhile, the results of the N-Gain Percent test obtained an average of 59.9071 which was interpreted as quite effective. Therefore, it can be seen from these results that the treatment of the STAD learning model assisted by PULMAN media provided is quite effective in improving the ability to understand mathematical concepts of grade IV students of SDN 1 Damarjati.

Table 5. N-Gain Test Results Indicators of Understanding Mathematical Concepts

Indicators of Understanding Mathematical Concepts	Pretest	Posttest	N-Gain Score	Category
The ability to restate concepts that have been learned.	47,22	80,09	0,62	Keep
The ability to provide examples and not examples of concepts that have been learned.	58,33	81,94	0,57	Keep
The ability to apply concepts algorithmically.	41,20	76,38	0,60	Keep
The ability to classify objects based on whether or not the requirements that make up the concept are met.	51,39	81,48	0,62	Keep
The ability to present concepts in various forms of mathematical representation.	44,44	74,53	0,54	Keep

Based on the table above, it shows that the results of the calculation of the N-Gain test indicator of understanding of mathematical concepts increased after being given treatment. Therefore, it can be concluded that using the STAD learning model assisted by PULMAN media can improve the ability to understand mathematical concepts of fourth grade students of SDN 1 Damarjati.

3.2. Discussion

This research was carried out in grade IV of SD Negeri 1 Damarjati, Jepara Regency with a subject of 36 students, which showed a common problem in the form of low ability to understand mathematical concepts. The results of the data analysis showed that the average pretest score of 48.47 increased to 78.92 in the posttest, with an N-Gain score of 0.59 which was in the medium category. This improvement shows the positive influence of the application of the STAD-type cooperative learning model supported by PULMAN media on students' understanding of mathematical concepts.

These findings are in line with research (Suwondo, 2023) who found that the STAD model was more effective than conventional lecture methods in improving conceptual understanding. In addition, this result is also reinforced by the opinion

(Oktavianus, Hilyana, & Ardianti, 2025) that STAD-type cooperative learning is able to create an active and fun learning atmosphere, so that it has a positive impact on student learning outcomes. This research is also consistent with the results of the research (Sari et al., 2025) which emphasizes the importance of using interesting learning media to increase students' motivation and concept understanding.

The results of this study can be explained through Vygotsky's view of the zone of proximal development (ZPD), where group interaction in the STAD model acts as scaffolding that helps students understand concepts that were originally difficult. This approach allows for the construction of knowledge through social interaction. In addition, Piaget's theory emphasizes that elementary school students are at a concrete operational stage; The use of concrete media such as PULMAN is very appropriate because it helps them understand concepts through real activities. According to Bruner, PULMAN media supports the stage of iconic representation (understanding through images and symbols), which is a bridge to abstract understanding.

Indicators restate concepts, provide examples instead of examples, apply concepts, classify objects, and present concepts in various forms of representation, all of which have increased N-Gain scores ranging from 0.54 to 0.62. This improvement shows that the STAD model combined with the PULMAN media effectively strengthens students' overall understanding of concepts, not only limited to memorization but also applicative and analytical skills.

However, the results of this study also have limitations. First, the study used a pre-experimental design with a single group so that there was no comparison (control) group. These limitations make conclusions about the effectiveness of the model cannot be generalized thoroughly. Second, the measurement of concept understanding is only through a written test; In fact, the understanding of mathematical concepts can also be assessed through in-depth interviews or observation of learning activities to capture students' thinking processes qualitatively. Third, the increase in the medium category (N-Gain 0.59) indicates the need for further efforts to achieve an increase in the high category, for example through more intensive mentoring or strengthening of students' reflection activities.

As an alternative explanation, this improvement in learning outcomes may not only be due to the model and media applied, but also external factors such as students' new enthusiasm because this research is learning innovation or positive teacher and school environment support during the research implementation.

The antithesis to these findings is also worth noting: although the average score increases, it is possible that some students still have certain difficulties, especially on questions that demand a high level of reasoning. The fact that N-Gain is only classified as moderate signals that the understanding of concepts can still be improved, for example by strengthening the abstraction stage according to Bruner's theory, or expanding group discussion activities according to constructivist theory.

As a practical implication, the results of this study show that the application of the STAD model supported by concrete media such as PULMAN can improve the understanding of mathematics concepts of elementary school students. However, teachers need to pay attention to the variety of student characteristics and integrate constructivist approaches and theories of cognitive development to maximize learning outcomes.

Thus, this study contributes that the application of the STAD cooperative learning model enriched by PULMAN media can be an innovative alternative in improving students' understanding of mathematical concepts, in line with learning theories and

previous research results, although there is still room for improvement and further research.

4. CONCLUSION

Based on the results of data analysis and discussion that has been presented, this study can prove that the application of the STAD learning model assisted by PULMAN media is effective in improving the ability to understand mathematical concepts of grade IV students of SDN 1 Damarjati. This is evidenced by the average pretest score of 48.47 and the average posttest score of 78.92 with an average difference between the pretest and posttest scores of 30.45. The results of the analysis of the N-Gain test showed a decrease of 0.59 which is included in the category of moderate increase. Therefore, from the results above, it can be concluded that the application of the STAD learning model assisted by PULMAN media is effective in improving students' understanding of mathematical concepts and can be used as a learning method for teachers to improve students' understanding of mathematics concepts in the future.

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