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Effectiveness of Bar Chart Learning via Demonstration Method in TSTS Model for Elementary Students

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ABSTRACT

Education in Indonesia faces challenges in improving student learning outcomes, especially in mathematics. Observations at UPT SDN 2 Pakunden show that even though the learning facilities are adequate, the lecture method applied still does not actively involve students. The purpose of this study is to evaluate whether there is a significant impact of the use of the Two Stay Two Stray (TSTS) learning model combined with the demonstration method on student learning achievement in mathematics subjects. The method used is a quantitative approach with a Quasi Experiment design, Post-test Only Control Group Design. The sample consisted of 84 students in class V, who were divided into experimental and control groups. The results showed that the TSTS model with the demonstration method increased student involvement, confidence in presentation, and understanding of bar chart concepts. This finding is based on the results of a hypothesis test with a sig (2-tailed) value of 0.004 < 0.05 which is the basis for proving the effectiveness of the application of the model in mathematics learning. This study recommends the application of the TSTS model with a demonstration method as a more interactive and engaging learning alternative that guarantees improved mathematics learning outcomes for students.

Informasi Artikel

Kata Kunci:
Sekolah Dasar;
Pembelajaran Diagram Batang;
Pembelajaran Demonstrasi;
Model Pembelajaran TSTS

ABSTRAK

Pendidikan di Indonesia menghadapi tantangan dalam meningkatkan hasil belajar siswa, khususnya dalam matematika. Observasi di UPT SDN 2 Pakunden menunjukkan bahwa meskipun fasilitas pembelajaran memadai, metode ceramah yang diterapkan masih kurang melibatkan siswa secara aktif. Tujuan dari penelitian ini adalah untuk mengevaluasi apakah terdapat dampak yang signifikan dari penggunaan model pembelajaran *Two Stay Two Stray* (TSTS) yang digabungkan dengan metode demonstrasi terhadap pencapaian belajar siswa pada mata pelajaran matematika. Metode yang digunakan adalah pendekatan kuantitatif dengan rancangan *Quasi* Eksperimen *Post-test Only Control Group Design*. Sampel terdiri dari 84 siswa kelas V, yang dibagi menjadi kelompok eksperimen dan kontrol. Hasil penelitian menunjukkan bahwa model TSTS dengan metode demonstrasi meningkatkan keterlibatan siswa, kepercayaan diri dalam presentasi, dan pemahaman konsep diagram batang. Temuan ini didasari hasil uji hipotesis dengan nilai sig (2-*tailed*) sebesar 0,004 < 0,05 yang menjadi dasar pembuktian efektifnya penerapan model tersebut dalam pembelajaran

matematika. Studi ini merekomendasikan penerapan model TSTS dengan metode demonstrasi sebagai alternatif pembelajaran yang lebih interaktif dan menarik yang menjamin meningkatnya hasil belajar matematika siswa.

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INTRODUCTION

Education in Indonesia is currently facing various challenges, one of which is in an effort to improve student achievement in elementary school is low academic achievement, especially in Mathematics lessons. Based on previous research as researched by Schoenherr et al. (2024), The majority of students experience obstacles in understanding the fundamental concept of mathematical visualization from the bar diagram material. Likewise in Zahro et al. (2024) findings, difficulty understanding the basic concepts of bar charts, especially in remembering technical terms such as X and Y axes and the steps of creating visualization of the diagram. This signifies the need for more systematic and interactive teaching methods to help students understand the concept of data presentation (Rittle-Johnson, 2024).

Low academic achievement in math lessons, especially on bar chart topics or data visualization material which is a complex and multifactorial problem (Ali et al., 2025). The aspects that play a role in low achievement in mathematics learning can be grouped into internal and external factors. Internally, students' negative attitudes towards mathematics are the main obstacles, due to their low interest and motivation in understanding the material. In addition, limited cognitive abilities, especially in the sensing of abstract concepts, are also an obstacle in learning (Lange, 2024; Zhu et al., 2025). Difficulty in remembering technical terms such as X-axis, Y-axis, and frequency further complicates students' understanding of bar chart concepts and other materials (Zahro et al., 2024).

Meanwhile, external factors such as teaching quality also play a role in low learning outcomes. Learning methods that tend to be traditional and teacher-centered make students only act as passive listeners, so their involvement in the learning process is minimal. In addition, the learning environment, both at home and at school, has a significant impact. Lack of family support and limited learning facilities, such as the absence of tools or interactive media, make it difficult for students to understand

mathematical concepts in more depth. The low interest of students in mathematics, which is considered a difficult and frightening subject, further aggravates the situation by decreasing their activeness in taking lessons (Sydänmaanlakka et al., 2024; Wengang et al., 2024).

The results of observations at UPT SDN 2 Pakunden show that the school is equipped with adequate facilities to support learning activities, such as LCDs and projectors in the classroom. However, the teaching methods applied by teachers still tend to be less varied, namely using a teacher-focused lecture and question and answer approach. This makes students lack concentration and sometimes do not pay attention when the material is delivered. In addition, students rarely ask questions when facing difficulties in understanding the material. The teaching method used has not fully activated student participation to processed in learning.

Many times, Mathematics is considered a complex and difficult discipline to master, despite its vital role in daily activities. As stated by Hasibuan et al., (2024), The active participation of students in the learning process is very important. Principles such as attention, motivation, and individual differences can improve learning effectiveness. In line with the implementation of the Merdeka Curriculum, learning methods based on problem solving, group discussions, and the use of concrete media such as teaching aids or digital technology can increase student engagement and strengthen their analytical power. In addition, by considering individual differences, teachers can apply differentiated learning strategies so that each student gets a learning experience that suits their abilities and learning styles. To increase the effectiveness of learning, a model is needed that is able to attract students' attention so that they are more concentrated and actively participate in the learning process. Thus, learning mathematics not only becomes more interesting, but also more effective in instilling concepts that can be applied in daily life.

One of the approaches that can be applied is the Two Stay Two Stray (TSTS) type of cooperative learning model. According to Hanafia et al. (2023), The TSTS model has a number of advantages, including: (1) it can be applied at various levels of education; (2) encourage students to play a more active role during learning; (3) help train students' courage in expressing opinions; (4) strengthening student confidence; (5) developing students' speaking skills; and (6) help improve academic achievement. Research by Ismawati (2025) also shows that the TSTS model has been shown to be more successful in improving student learning achievement compared to traditional teaching methods. In its application, this model allows students to share information with each other in a more free way and strengthen their understanding through social interaction. By taking turns asking questions, discussing, and conveying ideas, students can develop critical thinking skills and improve their communication skills (Shen & Yang, 2025; Zapata et al., 2024).

In addition, there are other learning methods such as the demonstration method that can clarify the learning concept by showing or demonstrating a process or object directly to students. This method allows students to absorb the subject matter in a more memorable way, so that their understanding becomes more in-depth and clear (Rina et

al., 2020). The demonstration method also has a number of advantages, such as being able to attract students' attention better, avoiding errors in concept understanding due to less interactive lectures, and creating a deep impression on students (Suryati et al., 2024). According to research conducted by (Kusno, 2022), the application of the demonstration method significantly contributes to the improvement of student learning outcomes, with an N-Gain value of 0.800 which is included in the high classification.

The innovation presented in this study lies in the combination of the TSTS type cooperative learning model with the demonstration method to improve student learning outcomes in bar chart material in class V. Previous research has proven the effectiveness of the TSTS model in encouraging improvement in learning outcomes in general, but its application specifically in bar chart learning, especially on the topic of bar charts is still rarely explored.

The TSTS model was applied in this research to encourage active interaction and collaboration between students, while the demonstration method was used to provide concrete understanding through hands-on visualization. This approach is expected to be able to overcome the main obstacles in learning bar diagrams, such as students' difficulties in understanding technical terms such as X-axis, Y-axis, and frequency. Thus, combining these two methods not only increases student participation in learning, but also clarifies the understanding of the concepts being taught, so that students' learning achievement can be significantly increased. The combination of these two approaches is expected to be able to provide a more immersive learning experience. In addition, this research can also be a reference for educators to explore new learning strategies that are more innovative and relevant to the needs of students at various levels of education

The purpose of this study is to analyze the significant influence of the application of the TSTS learning model combined with the demonstration method on student learning outcomes in mathematics subjects. This research is expected to make a new contribution to more effective teaching methods in helping students understand mathematics material, especially in terms of presenting data through bar charts. In addition, this research also aims to provide guidance for teachers in designing a more attractive and interactive learning process. This research also to open up new insights for educators regarding the importance of combining various teaching methods to create more effective and enjoyable learning.

METHOD

This study utilizes a quantitative approach by applying a Quasi Experimental design. The design applied is a post-test only control group design, where the two groups are compared based on the final results without conducting an initial test.

Table 1. Post-test Only Control Group Design Schemen

List of Research Classes	Treatment	Post-Test
C1	X	O1
C2	-	O2

Informations:
C1 : Experimental groups
C2 : Control group
X : Learning with a cooperative model of the TSTS type is combined with demonstration method
O1 : Final assessment of the experimental class
O2 : Final assessment on the control class

Students underwent treatment in the experimental class in the form of the use of the TSTS learning model combined with the demonstration method applied to the experimental group, while the control group underwent traditional learning without any specific treatment. The post-test results of these two groups were then compared to evaluate the impact of the learning model on student learning outcomes. This research was carried out at UPT SP SD Negeri 2 Pakunden, Blitar, in the second semester of the 2023/2024 school year. Data collection was carried out from April to May 2024. The subject that is the focus is mathematics, with the material 'Data Analysis' and the sub-material 'Bar Diagram', which is taught to grade 5 students in even semesters.

The population of this study includes all grade V students at UPT SD Negeri 2 Pakunden which totals 84 students. The sample used in the study consisted of two classes, namely the VA class with 25 students as the control group and the VB class with an equivalent number as the experimental group. The sample selection was carried out randomly, ensuring that the distribution of students into classes was not based on skill level, so that each class included students with varying levels of ability, ranging from high to low.

This study uses observation sheets and tests as instruments. The observation sheet was used to assess the extent to which the TSTS method combined with the demonstration was applied in learning activities. The test serves to evaluate student learning outcomes based on the material that has been taught. This study aims to evaluate whether the application of this method has a significant effect on students' understanding and learning outcomes in mathematics subjects. The data collected through tests and observations will be analyzed using the validity and reliability test of the instrument, as well as the assumption test that includes normality and uniformity. To test the hypothesis, the t-test technique for two independent samples (Independent Sample T-Test) was used to determine whether there was a significant difference in learning outcomes between the treatment group and the control group.

RESULT AND DISCUSSIONS

A. Result

Learning activities at UPT SDN 2 Pakunden in the VB class as an experimental group were carried out in three sessions focused on the application of the TSTS model combined with demonstration methods. The TSTS model with Demonstration in learning consists of several stages designed to improve students' interaction and understanding of the material. The first step is for the teacher to explain the learning objectives and provide a brief summary of the material to be studied. Next, the teacher conducts an apperception by relating the material to the students' experience and asking provocative questions to foster their curiosity. Furthermore, the teacher delivers the learning material by lecture and demonstration methods, where the teacher shows directly the concepts or phenomena learned so that students can observe and understand concretely. Afterwards, the students were divided into small groups to exchange views and work on the assigned group assignments.

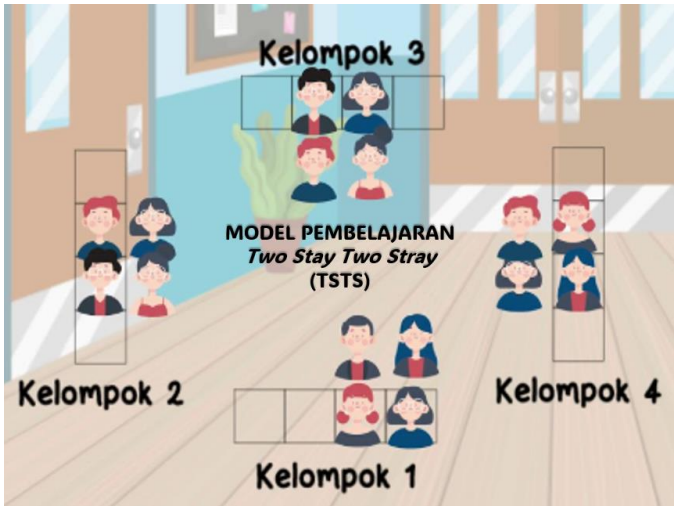

Figure 1. TSTS Learning Model Pattern

The next stage involves the implementation of the Stay and Stray strategy, where two members of the group remain on-site to explain the outcome of their discussion, while the other two members visit the other group to seek additional information. After this activity is completed, each group presents the results of their discussion in front of the class and draws conclusions based on the learning that has taken place. This process ensures that each student actively participates, whether in demonstrating concepts, exchanging information, or drawing conclusions together.

The preparation of learning media such as teaching modules and PowerPoint started at the first meeting, followed by an opening that included greetings, prayers, attendance, and apperceptions that connected the material that had been learned with the new topics to be delivered. In the core activity, the teacher delivered the material using PowerPoint and demonstrated how to solve the problem, followed by a group division that discussed the given questions. However, at this first meeting, there were several obstacles, such as

time that did not go according to plan, and most students did not fully master the stages of the TSTS model. Many students are still passive in discussions, especially guest groups, who copy more answers than discuss. Some students also seem to be less focused in explaining the material to their friends.

In the second meeting, the researcher made improvements by preparing teaching modules and additional materials such as Post-tests for data collection. Learning begins with greetings and prayers, followed by the repetition of the previous material. In the core activity, the teacher delivered material through PowerPoint and demonstration questions, followed by a more structured group division. At this second meeting, students began to show a better understanding of their duties as receptionists and guests, as well as more confidence in explaining the material to their friends. Group discussions are also more active, where students not only copy answers but also discuss the results received and confirm incorrect information to the teacher. Although the time spent was still not fully according to plan, overall, learning at the second meeting showed significant improvement compared to the first meeting, both in terms of students' understanding of their assignments and their activeness in the discussion. Reflections from this meeting show that better time management is still an aspect that needs to be improved to make learning more effective.

After the implementation of the TSTS learning approach combined with the demonstration method, data related to student learning success was collected through Post-test tests that had passed the previous validity and reliability tests. The data from the post-test results are used as material to be analyzed in this study. In the initial analysis stage, preliminary tests were carried out to ensure the suitability of the data with relevant statistical assumptions. One of the tests applied is the normality test, which serves to evaluate have a normal distribution. In this context, the data is considered to be normally distributed if the significance value is more than 0.05. Conversely, if the significance value is less than 0.05, the data is considered to have no normal distribution. To carry out the normality test, the SPSS version 16.0 application was used with the Shapiro-Wilk test method, because the number of samples in this study was less than 50.

Table 2. Normality Test Results

		Kolmogorov-Smirnov			**Shapiro-Wilk**		
Learning Outcomes	Test Class	Statistic	Df	Sig.	Statistic	Df	Sig.
	Control Class	.211	25	.005	.935	25	.116
	Experimental Classes	.158	25	.109	.944	25	.185

The Shapiro-Wilk of normality results indicated that the learning achievement data in the control group had a significance value of 0.116, while the experimental class obtained a significance value of 0.185. Since both values exceed 0.05, it can be concluded that the distribution of learning achievement data in both groups is under normal conditions. Thus, the assumption of normality has been met, so that the data can be analyzed using

parametric methods such as t-tests to test the difference in learning outcomes between the control and experimental classes.

The next stage is to carry out homogeneity testing to ensure that the two groups of samples have uniformity of variance. This test was carried out by utilizing Post-test scores from the results of mathematics learning in both classes. If the significance value of the homogeneity test is greater than 0.05, it can be concluded that the data has uniformity in variance, or in other words, the data shows consistency in its variation. Conversely, if the significance value is less than 0.05, the data is considered inconsistent or has different variances. To ensure that the data met the homogeneity assumptions, this study used SPSS software version 16.0.

Table 3. Homogeneity Test Results

Learning Outcomes	**Test of Homogeneity of Variances**		
Lavene Statistic	df1	df2	Sig.
.440	1	48	.510

Based on the results, the statistical value of Levene is 0.440 with degrees of freedom (df) 1 and 48, and the significance value (Sig.) is 0.510. Since the significance value obtained exceeded 0.05 (0.510 > 0.05), it can be concluded that the variance between the two groups did not show a significant difference. In other words, the variance of math learning outcomes in the experimental group and the control group can be considered equal or consistent. This indicates that the two groups have almost identical levels of variation in learning outcomes, which makes it possible to continue the comparative analysis of learning outcomes between the two groups without any concerns about differences in variance that could affect subsequent test results.

The next stage is to carry out a hypothesis test using the Independent Sample T-Test method To find out if there is a significant difference in the average between the two independent groups, namely the experimental class and the control class, the post-test results are used as the basis for the analysis. The results of the Independent Sample T-Test are determined using two criteria as a reference:

1. If the significance value (sig. 2-tailed) < 0.05, then Ho is declared invalid and Ha is accepted, which indicates a significant influence.
2. If the significance value (sig. 2-tailed) > 0.05, then Ho is accepted and Ha is rejected, which means that there is no significant effect.

Next, the results of statistical analysis from the Independent Sample T-Test became evaluation data to measure the difference in average learning outcomes between the two groups tested.

Table 4. Hypothesis Test Results

Learning Outcomes	Lavene's Test for Equality of Variances		Test for Equality of Means						
	F	Sig.	t	df	Sig (2-Tailed)	Mean Difference	Std Error Difference	95% Confidence Interval of the Difference	
Equal Variances Assumed	.449	.510	-3.045	48	.004	-9.400	3.078	-15.590	-3.210
Equal Variances Assumed			3.045	45.204	.004	-9.400	3.078	-15.590	-3.210

Referring to the results of hypothesis analysis carried out through the t-test, information was obtained that in Levene's test for variance equality, the significance value obtained was 0.510. Since the value obtained is higher than 0.05, it can be concluded that the variance of the data between the control class and the experimental class is homogeneous or balanced. Therefore, the analysis can be continued using the assumption that both groups have equal variance.

Based on the results of the t-test, a t-value of -3.054 was obtained with a degree of freedom (df) of 48 and a significance value (2-tailed) of 0.004. Since the significance value is below 0.05, it can be concluded that there is a significant difference between the learning outcomes of students in the control class and the experimental class. The mean difference value of -9,400 indicates that the average learning outcomes of the experimental class were higher than those of the control class. The 95% confidence interval for the average difference is in the range of -15,590 to -3,210, which indicates that the difference is statistically significant. Therefore, the alternative zero (H_1) hypothesis is accepted. This indicates that the learning strategies applied in the experimental class gave better results on learning achievement than the methods used in the control class.

B. Discussions

The TSTS learning model combined with the demonstration method has been proven to have a significant influence on the achievement of student learning outcomes. The results of the study show that the combination of these two approaches is able to increase students' enthusiasm during the learning process, which directly affects their understanding and learning outcomes. The demonstration method plays a role in overcoming the limitations of the TSTS model by providing clearer directions to students in solving problems and answering questions. In addition, this approach provides a balance between students' freedom of thinking and guidance from teachers, so that students' edusocial abilities (Hannan & Eynon, 2025) and the concept of math material is easier to understand (Chen et al., 2025). Because in learning, teachers play the role of facilitators who provide direction without limiting students' exploration, so that they can develop analytical and creative skills optimally (Widaryanti et al., 2025).

In line with previous research by Elisabet et al. (2020), The TSTS model has been shown to improve student learning achievement, especially in the guest and reception stages. This is in line with the paradigm by Gun & Bossé (2025), With learning that adheres to the right taxonomy of learning, students feel responsible for understanding the material as they have to explain it back to their group. In addition, discussion activities in this model also train students' speaking skills, which contributes to a deeper understanding of the material. The results of data analysis using the Independent Sample T-Test showed a sig (2-tailed) value of 0.004, which was below the significance level of 0.05 confirming a significant difference in student learning outcomes after the application of the model. With this approach, students not only receive the material passively, but also engage more in group discussions and practical demonstrations, so that the understanding of concepts becomes more in-depth. These findings underscore the importance of innovation in teaching methods to improve the quality of learning outcomes. Said by Deymi et al. (2025), That is the importance of innovation in teaching mathematical concepts to make it easier for learners. According to Pathuddin et al. (2025), learning innovations that have an impact on the achievement of mathematics learning outcomes are a reflection of the quality of system management in the implementation of applied mathematics learning.

Furthermore, these findings are supported by research from Sutrisno et al. (2015), which confirms that the TSTS model has various advantages, such as encouraging students to be more active, training courage in expressing opinions, increasing confidence, and honing speaking skills. With this approach, students can discuss the material more freely, but remain under the guidance of the teacher who helps them solve problems (Chaiarwut et al., 2025) and master the concept more deeply (Boom-Cárcamo et al., 2024; Conesa et al., 2022). Learning that was previously considered difficult by students has become more interesting and easy to understand thanks to the use of the TSTS model combined with the demonstration method.

The findings of similar research from Isnain & Arko (2023) also further strengthen the evidence that the TSTS model is effective in improving student learning outcomes. With a higher average score in the experimental class than in the control class, as well as a significant t-test result (0.000), this study confirms the superiority of TSTS over conventional methods. This approach not only improves academic achievement but also encourages student participation in a more interactive learning process. In addition, research from Une et al. (2023) also showed that students who used the TSTS model with the support of video media achieved higher mathematics learning achievement compared to students who did not use the media. The results of the analysis using the t-test showed a t-value of 2.30, which exceeded the table t-value of 2.09, indicating a significant difference in learning achievement. These findings underscore the need for an innovative and multimodal approach in the learning process to achieve more optimal outcomes (Hähnlein et al., 2025; Liu et al., 2025).

Research conducted by Nurhasanah et al., (2021), Regarding the impact of the demonstration method in online learning, it was revealed that the average student score increased from 46.76 in the Pre-test to 73.82 in the Post-test. This indicates that the demonstration method is able to significantly improve students' understanding. Research by Arifuddin & Arrosyid (2017) also showed that the use of the demonstration method was able to improve student learning outcomes on addition and subtraction materials, with an increase in the level of learning completeness from 21% before improvement to 68% in cycle I and reached 90% in cycle II. Other research by Amrul (2022) has shown that grade VI students of SD Negeri 4 Kerinci who applied the demonstration method in mathematics learning managed to achieve classical learning completeness with an average score of 76.37 out of a total of 22 students.

In general, the findings of this research play an important role in the advancement of science and technology in the field of basic education. The use of the TSTS model combined with the demonstration method can be one of the more efficient learning strategies to improve student learning achievement. This approach not only supports students' deeper understanding of the material, but also helps build the social and cognitive skills needed in the future learning process.

As a result of this study, the application of creative learning models in elementary schools needs to be studied more deeply through follow-up research. Future research can investigate the effectiveness of this model in various fields of study and evaluate its effects using more comprehensive assessment methods, such as Pre-test and Post-test, to observe improvements in student learning outcomes before and after the application of the model. In this way, this research not only opens up new perspectives in the world of education, but also becomes a foothold for the development of more efficient learning strategies at the elementary school level.

CONCLUSIONS

The application of the Two Stay Two Stray (TSTS) learning model combined with the demonstration method has been proven to have a positive influence on student learning outcomes at UPT SDN 2 Pakunden. This model increases student engagement and enthusiasm in group discussions as well as the delivery of discussion results. Although initially lacking confidence, at the next meeting students were able to convey the material more clearly. The results of the hypothesis test show that this model has a significant influence on mathematics learning outcomes. Thus, it is recommended to apply the TSTS model with a wider demonstration, especially in subjects that are considered difficult. Further research is recommended to increase the number of observers in order to obtain a more in-depth analysis of the effectiveness of this model in various learning conditions.

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