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Effectiveness of Problem-Based Cooperative Learning Model to Overcome Students' Difficulties in Solving Story Problems on Chance Material in Class X

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Abstract

This study aims to determine the use of an effective problem-based collaborative learning model to overcome students' difficulties in solving story problems in class X of SMK Negeri 5 Medan. The research used is quantitative, this type of research is quasi-experimental research. The population in this study were all students of class X of SMK Negeri 5 Medan consisting of 11 classes. By using the cluster random sampling technique, the sample in this study was obtained as an experimental class (X TKR 2) and as a control class (X TKR 1). The instruments used were tests and observations. After conducting the research, the results of students' difficulties in solving story problems from the quality of learning showed that there was a difference in effectiveness between the collaborative problem-based learning model and the regular learning model. Based on the results of the calculation of the average pretest score in the control and experimental classes, 44.23 and 43.03 and the average posttest score in the control and experimental classes were 57.49 and 89. Then the results of the normality test and homogeneity test stated that the sample was normally distributed. Likewise, the hypothesis test on students' difficulties in solving story problems showed that the significance value <0.05, so the conclusion was that H_0 was rejected and H_a was accepted. So the conclusion is that the Problem-Based Collaborative Learning Model is effective in overcoming students' difficulties in solving story problems on the material of probability in class X of SMK Negeri 5 Medan in the academic year 2024/2025.

Keywords : Problem-Based Collaborative Learning Model, Student difficulties

INTRODUCTION

Education is a process aimed at broadening horizons, increasing capacity, and shaping changes in the knowledge and behavior of individuals or groups, with the aim of improving the nation's life through learning activities. Based on Law Number 20 of 2003 concerning the National Education System, education is defined as a conscious and planned effort to

create an environment and learning process that enables the creation of a conducive learning atmosphere. Utari et al. (Muttaqin, Yoesoef, & Abdullah, 2018) state that teaching is an effort to empower individuals to develop their potential through the learning process or through other socially recognized means. Learning is understood as a series of processes designed to facilitate students so they can carry out learning activities optimally. Furthermore, learning can be understood as a form of assistance provided by teachers so that students are able to acquire attitudes, knowledge, and skills. One form of learning that contributes significantly to improving the quality of the teaching process in Indonesia is mathematics learning (Septarianto, Astutik, Kurnianto, Kantun, & Pangastuti, 2022).

Mathematics is a basic discipline that plays a strategic role in supporting the development and advancement of various other scientific fields. Furthermore, mathematics serves as a tool for developing a scientific mindset. Simanjuntak et al. (1993: 72) suggest that students tend to enjoy learning mathematics in the early stages, when they are introduced to simple mathematical concepts. As the level of education increases, the complexity of the mathematical material studied also increases, resulting in a decline in student interest in learning mathematics (Wahyuni, 2021). However, this situation also contributes to the perception that mathematics is a complex, difficult, and often confusing discipline. Various negative views have developed regarding mathematics, such as the assumption that "mathematics involves a lot of calculations," "it is difficult to understand," "learning mathematics is boring," and "mathematics teachers are difficult to understand." These various views contribute to the formation of negative perceptions among students, that mathematics is a subject synonymous with difficulty. The various obstacles faced by students in the process of learning mathematics often result in an inability to complete assignments and problems related to the material.

The concept of probability is a crucial topic in mathematics learning that students must master. This is due to its applicability and relevance to everyday life, particularly in estimating the likelihood of an event occurring. Therefore, mastering probability is crucial for students. Rohaeti and colleagues (Nisa, Disman, & Dahlan, 2022)emphasized that understanding probability is crucial for students, given that this topic will be encountered again at higher levels. According to Abdurrahman (Nurfauzan, 2022) many students face challenges in solving story problems. Story problems in mathematics refer to problems presented in narrative form and contain contextual issues related to everyday situations or events. The purpose of presenting these types of problems is to introduce students to the application of mathematics in real life and hone their ability to solve mathematical problems in relevant contexts. This approach is also expected to increase students' interest in mathematics learning, as they begin to understand the relevance and usefulness of mathematics in everyday activities. However, not all students are able to solve these story problems easily.

Students often experience difficulties working on story-based problems, particularly in understanding the narrative content while reading and in transforming it into a mathematical model. They tend to struggle when problems are presented in narrative form, making it difficult to translate and construct mathematical sentences. Furthermore, students

are not accustomed to recording information contained in story problems, often read in a rush, and are less thorough in their calculations (MASKURIN, 2020).

Based on interviews conducted by researchers with mathematics teachers at SMK Negeri 5 Medan, it was revealed that in lessons involving mathematical story problems, students consistently question the meaning of the problems. This is due to the limited understanding of most students in converting verbal statements into mathematical models. Students are generally able to solve problems if information about what is known and what is being asked is presented explicitly. However, when problems are presented in narrative form, they tend to have difficulty identifying and writing down the information that is known and what is being asked. Thus, students' inability to understand the meaning of story problems and to transform them into mathematical models is a major factor hindering their solution. Furthermore, the teacher's role is crucial in providing support and increasing active student participation during the learning process. Inaccurate selection of learning models by teachers also contributes to low satisfaction with mathematics learning outcomes, and this requires attention. Meaningfully designed learning will help students not only memorize material but also deepen their understanding of concepts. This deeper understanding will ultimately contribute positively to students' ability to solve mathematical story problems (Riyanta & Kurniati, 2022).

To address this, the collaborative problem-based learning model is seen as an effective learning alternative. This approach is an instructional strategy that uses problems as a starting point to train and develop students' ability to solve problems collectively through group collaboration (Prasetyo, Utami, & Amanda, 2021). Tarmizi and Bayat explain that collaborative problem-based learning has several characteristics, including: students learn in small groups, and the learning process is designed to activate prior knowledge through group discussions, making the teacher a facilitator in the learning process, and gaining access to various learning resources that support problem-solving according to each student's cognitive ability level. Through the application of this model, each student is expected to be encouraged to make maximum efforts in understanding the learning material within their group. The implementation of the collaborative learning model provides opportunities for more effective interactions between students, by grouping individuals with different backgrounds and ability levels into small groups to achieve learning objectives together. In addition, collaborative learning also encourages the formation of multidirectional interactions, both between students within the same group, between students from different groups, and between students and the teacher as a whole. The integration of collaborative learning approaches and problem-based learning creates learning activities that enable students to have high-level thinking processes that are relevant to real-life situations (Halil, Ibrahim, Madjid, & Hafel, 2024a).

Based on the description above, the researcher is interested in conducting research with the title "The Effectiveness of the Problem-Based Collaborative Learning Model to Overcome Students' Difficulties in Solving Story Problems on Probability Material in Class X of SMK Negeri 5 Medan in the 2024/2025 Academic Year".

RESEARCH METHODS

The type of research that will be used is quantitative research using a quasi-experimental research method to see the effectiveness of the problem-based collaborative learning model to overcome students' difficulties in solving story problems. According to Sugiyono (Halil, Ibrahim, Madjid, & Hafel, 2024b) quasi-experimental research is a way to find a causal relationship between two or more variables that are intentionally caused, but does not function fully to control external variables that affect the implementation of the experiment because it is difficult to obtain a control group used in the research.

The design used in this study was a pre-test post-test control group design. The pre-test was used to determine students' learning outcomes before being given treatment. Thus, knowledge will be known accurately because it can be compared with the situation before being given treatment (Arrohim et al., 2022). The post-test was used to determine students' learning outcomes after being given treatment. The implementation of this study began with the provision of a pre-test first in both groups, then given treatment in the form of learning using a collaborative problem-based learning model in the experimental class, while in the control class learning was carried out using conventional learning. After being given treatment, each group was given a post-test to determine student learning outcomes.

This research was conducted at SMK Negeri 5 Medan, located at Jalan Timor No. 36, Gaharu, Medan Timur District, Medan City, North Sumatra 20235. This research was conducted in the Even Semester of the 2024/2025 Academic Year. Garaika (2019:48) explains that a population is a generalization that includes research subjects or objects with specific characteristics determined by the researcher and used as the basis for drawing conclusions. In this study, the population included all 10th-grade students at SMK Negeri 5 Medan.

Meanwhile, Sugiyono (Hendikawati, Sunarmi, & Mubarok, 2022) defines a sample as a part of a population that, with certain numbers and characteristics, is able to represent the entire population. This study applies the Cluster Random Sampling technique, namely a sample selection procedure in which each class has an equal chance of being selected; as a result, two classes X with relatively equal initial abilities were determined as research samples . This study uses two types of data analysis techniques, namely: (1) inferential analysis, which aims to determine the quality of learning by testing the differences in effectiveness between the collaborative problem-based learning model and the conventional learning model in overcoming students' difficulties when solving story problems; and (2) descriptive analysis, which is used to assess the extent to which the learning level and the available time allocation match. Assessment of the suitability of the learning level is carried out based on the results of observations from three observers who evaluate the alignment of teacher activities in implementing the learning model used. Meanwhile, analysis of time use is carried out based on the results of observations from three observers who evaluate the effectiveness of teachers in managing learning time, which is compared with the ideal time standards as stated in the applicable curriculum or syllabus (Pradnyana, Agustini, & Santyasa, 2021).

RESULTS AND DISCUSSION

Research result

This research was conducted at SMK Negeri 5 Medan which is a quasi-experimental research with the aim of determining the effectiveness of the Problem-Based Collaborative Learning model to overcome students' difficulties in solving story problems on the material of probability in class X SMK Negeri 5 Medan. The research activities were carried out on March 13, 2025 to March 27, 2025. A total of four meetings were held for two classes, namely the experimental class and the control class. The experimental class consisted of 35 students in class X TKR 2 who were taught by the researcher using the Problem-Based Collaborative Learning model while the control class consisted of 35 students in class X TKR 1 who were taught by the teacher using the conventional learning model. The material taught by the researcher was the material of probability to determine students' difficulties in solving story problems so that a final test (post-test) consisting of 10 essay-shaped questions was given (Siregar, Mulyono, & Surya, 2023).

Instrument Trial Results

Before the test is used on the research sample, the questions are first tested to see the validity of the questions, the reliability of the questions, the level of difficulty of the questions and the discriminating power of the questions.

Data Analysis Results

Quality of Learning Level

Pre-test and *Post-test* Results Data in the Experimental Class and Control Class

pre-test instrument was used to determine the students' difficulties in solving story problems before being given treatment in the experimental and control classes. While *the post- t- test* was conducted to determine the students' difficulties in solving story problems after being given treatment, assessed by answering 10 *post -t- test* descriptive questions that had been tested for validity (Appendix 14 and 15). *The pre-test* and *post -t- test* data of class X TKR 2 students who were given treatment using the Problem-Based Collaborative Learning model and in class X TKR 1 students who were given treatment using conventional learning, showed that the average *pre-test score data* of students in the experimental class was 44.23 then increased to the average *post-test score* to 89. Meanwhile, in the control class, the average score *The pre-test* of the control class was 43.03 then increased to the average *post-test score* in the control class to 57.49 (Fitriyanti, Maasawet, & Boleng, 2021).

Normality Test

The normality test is used to determine whether the test instrument data (*Pre-test* and *Post-test*) are normally distributed or not. The normality test calculation was carried out using *SPSS software version 2.5.0 using* the Kolmogorov-Smirnov test (Appendix 16). The following are the results of the normality test analysis in *the* experimental and control classes (Swandewi, Gita, & Suarsana, 2019).

Table 1. Results of the Normality Test of Pre-test and Post-test Data in the Control Class and Experimental Class

No	Data	Significance Kolmogorov-Smirnov	Information
1	*Pre-test* of Control Class	0.147	Normal
2	*Post-test of* Control Class	0.200	Normal
3	Experimental Class *Pre-test*	0.200	Normal
4	*Post-test* of Experimental Class	0.200	Normal

Based on the results of the table above, the significant value of Kolmogorov-Smirnov at *The pre-test* and *post-test* of the control class obtained significant Kolmogorov-Smirnov values of 0.147 and 0.200 . Thus , it was obtained $0{,}147 > 0{,}05$ and$0{,}200 > 0{,}05$ It was concluded that *the pre-test* and *post-test data* of the control class were normally distributed. Then, in the results data *pre-test* and *post-test* of the experiment were 0.200. Thus $0{,}200 > 0{,}05$, it can be concluded that *the pre-test* and *post-test data* of the experimental class were normally distributed (Fadilah Pane & Sugiharti, 2022).

Homogeneity Test

The homogeneity test is used to determine whether the variance of the two research samples is homogeneous or not. In this study, the homogeneity test is used to determine whether the variance of the pre-test data of the experimental and control classes is homogeneous or not. The calculation of the homogeneity test is carried out using *SPSS 2.5.0 software (* Appendix 16) using *the Levene test* . The following are the results of the analysis of the homogeneity test results in the experimental and control classes.

Table 2. Results of *the Pre-test* and *Post-test* Data Homogeneity Test in the Control Class and the Experimental Class

No	Mark	Leneve Statistics	df_1	df_2	Sig.
1	Based on Mean	2,751	1	68	0.102

(Based on average)

Based on the results of table 4.6 above, the significance value of *the Levene test* on *the pre-test* of the experimental class and the control class based on the average value (*mean*) of 0.102 . So it can be concluded that the $0{,}102 > 0{,}05$*pre-test* data of the experimental class and the control class are homogeneous.

Hypothesis Testing

Hypothesis testing is used to show whether there is a significant difference between the experimental class and the control class regarding students' difficulties in solving story problems , then an *independent* sample t-test is conducted using the *post-test scores* from the experimental class and the control class. With the help of *SPSS software version 2.5 . it* is shown that the Sig. (2-tailed) value of the *independent sample t-test* is $0{,}002$. Based on this significant value, it is shown that the significant value $< 0{,}05$, so it is concluded that there is a significant difference between the use of the Problem-Based Collaborative Learning model and the conventional model to overcome students' difficulties in solving story problems on the material of probability. In accordance with the provisions of decision making is based on several provisions, namely: 1). If $Sig. < 0{,}05$or $t_{hitung} < t_{tabel}$, then H_0it is rejected and H_a accepted. In conclusion, there is a significant difference in students' difficulty in solving story problems in the experimental class and the control class. 2) If $Sig. > 0{,}05$or $t_{hitung} > t_{tabel}$, then H_0accepted and $H_a$rejected . In conclusion , there is no significant difference in students' difficulty in solving story problems in the experimental class and the control class (Harahap, Mushlihuddin, & Afifah, 2022).

Learning Level Quality Results

To determine the quality of learning levels, we can see the differences between problem-based collaborative learning models and conventional learning models in overcoming students' difficulties in solving story problems. To determine the differences in the use of problem-based collaborative learning models, we need to consider the differences in the use of problem-based collaborative learning models. and conventional learning models to overcome students' difficulties in solving problems, a hypothesis test was conducted. Based on the significant value obtained through the hypothesis test, it was shown that the significant value $< 0{,}05$, so it was concluded that there was a significant difference between the use of the Problem-Based Collaborative Learning model and the conventional model to overcome students' difficulties in solving story problems on the topic of probability (Utami & Dafit, 2021).

Observation Results of the Suitability of Learning Levels

To determine the suitability of the learning level, it can be seen through observations of the teacher's ability to manage learning using the Problem-Based Collaborative Learning

model using an observation sheet. Based on the calculation of the average value of the observation sheet for the suitability of the learning level using Excel found in Appendix 19, the suitability of the learning level produces a value of 4.3 . Based on the results of observations of the suitability of the learning level of the Problem -Based Collaborative Learning model 4,3 $<$ 5so that conclusions are drawn in the "Good" category.

Time Observation Results

To determine the time, it can be seen through observations of teacher allocation in the Problem-Based Collaborative Learning model using an observation sheet. Based on the calculation of the average value of the learning time allocation sheet using Excel found in Appendix 20, the time allocation produces a value of 4,67 . Based on the results of observations of the allocation of learning time for the Problem-Based Collaborative Learning model , the time allocation... 4,67 $<$ 5so that conclusions are drawn in the "Good" category. This shows that the time used for problem-based collaborative learning is good.

Determination of Learning Effectiveness

In determining learning effectiveness, it is necessary to establish criteria for determining the effectiveness of the learning model used according to the effectiveness indicators. The results of this study indicate that the effectiveness indicators are met, namely 1). There is a significant difference between the use of problem-based collaborative learning models and learning conventional, after being studied, it turns out to have differences where the data from the results of normality are normally distributed and homogeneity is homogeneous so that it is continued with a t-test which is valuable 0,002 $<$ 0,05or it can be said that there is a difference (Aisyah & Madio, 2021). 2). The suitability of the learning level is categorized as good according to the criteria because it produces values 4,3 $<$ 5from the results of teacher observations using the Problem-Based Collaborative Learning model . 3). Learning time is categorized as good according to the value criteria 4,67from the results of time observations (Simamora, Simamora, & Dewi, 2022). Based on the explanation above, it is concluded that the problem-based collaborative learning model is effective in overcoming students' difficulties in solving story problems on the material of probability.

Research Discussion

This research was conducted at SMK Negeri 5 Medan, a quasi-experimental research with the aim of this research is to determine the effectiveness of the Problem-Based Collaborative Learning model to overcome students' difficulties in solving story problems in class X of SMK Negeri 5 Medan. The sampling technique in this study was *cluster random sampling* , that is, each class has the same opportunity to be used as a sample. This research was conducted in 3 meetings from March 1-3, 2025 - March 27, 2025 , Even Semester of the 2024/2025 Academic Year , to two groups of students, namely the experimental group and the control group. The experimental group consisted of 35 students in class X TKR 2 who were taught by researchers using the Problem-Based Collaborative Learning Model , while

the control group consisted of 35 students in class X TKR 1 who were taught with conventional learning (Pardede, D. L., Pardede, L., Siahaan, M., Alexander, I. J., & Sirait, 2024).

The material taught in this study is probability . To determine students' difficulties in solving story problems , a pre -*test* and a post -*test* were given , consisting of 10 descriptive questions. The purpose of this study was to determine the effectiveness of the Problem-Based Collaborative Learning Model in overcoming students' difficulties in solving story problems on probability . The hypothesis in this study is "Learning using the problem-based collaborative learning model effective to overcome students' difficulties in solving story problems on the material of probability in class X SMK Negeri 5 Medan ". To achieve this goal, the researcher gave *a post-test* to determine the final abilities of students in the experimental class (X TKR 2) and also the control class (X TKR 1). Based on the results of the *pre-test data* conducted before the treatment was given, the data showed that the two classes had different difficulties in solving story problems (Asmara & Sari, 2021).

After *the pre-test* was conducted and showed different results between the two classes, the researcher then provided treatment to the samples where class X TKR 2 received treatment with the Problem-Based Collaborative Learning Model and class X TKR 1 received treatment with conventional learning. After each sample was given treatment, *a post-test was conducted* to see the students' abilities after being given the treatment. So that the learning outcomes were obtained in the experimental class (X TKR 2) using the Problem-Based Collaborative Learning Model. to overcome students' difficulties in solving problems , the average value is 89. Meanwhile, for the control class (X TKR 1) using conventional learning, the average value is 57,49.

After calculating the average, the hypothesis test will be conducted. Before conducting the hypothesis test, the *post-test data* obtained will be tested against prerequisites . The prerequisite test will be The normality test and homogeneity test were conducted to determine which hypothesis test would be used. After the normality test was conducted, it was found that *the post-test* data were normally distributed, as were the data in the hypothesis test. can be homogeneous. Therefore, the researcher continued with a parametric test, namely the t-test in the study, which produced data $Sig.(2-tailed)$ $0{,}002 < 0{,}05$. Based on the significance value, it was shown that the significance value $< 0{,}05$, so the conclusion was drawn that H_0it was rejected andH_a accepted, or concluded that there is a significant difference between the use of problem-based collaborative learning models and conventional learning models to overcome students' difficulties in solving story problems on the topic of probability (Arief, Zarory, Jufrizel, & Mursyitah, 2024).

Furthermore, to determine the effectiveness of the collaborative problem-based learning model, it is seen from the suitability of the learning level. The suitability of the learning level on students' difficulties in solving story problems is categorized as good according to the results of teacher observations with a value of $4{,}3 < 5$. Likewise, the effectiveness of the collaborative problem-based learning model can be seen from the learning time (Meriza, Mulbasri, & Nurhayati, 2023). The learning time is categorized as good according to the criteria 4,67 from the time observation results. Therefore, it is concluded that the collaborative problem-based learning model is effective in overcoming

students' difficulties in solving story problems on the topic of probability in class X of SMK Negeri 5 Medan in the 2024/2025 academic year.

CONCLUSION

Based on the results of the research and discussion of data analysis that have been presented in the previous chapter, it can be concluded that the problem-based collaborative learning model is effective in overcoming students' difficulties in solving story problems on the material of probability in class X of SMK Negeri 5 Medan in the academic year 2024/2025. This can be seen from the acquisition of scores (*Sig*)and *post-tests* , so that the sig value <0.05 or 0,002 < 0,05it can be concluded that there is a significant difference between the problem-based collaborative learning model and ordinary learning to overcome students' difficulties in solving story problems on the material of probability in class X of SMK Negeri 5 Medan in the academic year 2024/2025.

Suggestion

Based on the conclusions obtained from this research, the researcher puts forward several suggestions as follows:

1. In implementing mathematics learning, it is hoped that teachers will be able to implement learning that is more student-centered so that students can be active and motivated in participating in mathematics learning.
2. Teachers at school are expected to apply problem-based collaborative learning models in learning, especially in mathematics subjects, so that the mathematics learning process is more effective.
3. Researchers are expected to conduct further research on problem-based collaborative learning models in the field of mathematics or other fields of study in order to improve the quality of education in general.

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