

THE INFLUENCE OF DEEP LEARNING -BASED PROBLEM SOLVING MODELS ON ABILITY SOLUTION PROBLEM MATHEMATICAL STUDENTS ON QUESTIONS STATISTICS MATERIAL STORY IN CLASS X OF SMA NEGERI 12 MEDAN FOR THE 2025/2026 ACADEMIC YEAR

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ARTICLE INFO	ABSTRACT
Diterima: 05 September 2025 Direvisi: 10 September 2025 Disetujui: 18 September 2025 Tersedia Daring: 30 Juli 2026 Keywords: Keywords: Policy evaluation; Poverty reduction; Community empowerment; Joint Business Group (KUBE); Entrepreneurship	<i>This study aims to determine the effect of the deep learning-based problem solving model on students' mathematical problem-solving ability in statistics story problems in class X of SMA Negeri 12 Medan. The research used a Quasi-Experimental method with a population of all grade X students consisting of 10 classes. The sample was determined through cluster random sampling, resulting in class X-E2 as the experimental class and class X-E4 as the control class. Data were collected using a mathematical problem-solving ability test. Data analysis using the Liliefors normality test, F homogeneity test, and t-test showed a significant difference between the pre-test and post-test scores of problem-solving ability in both classes, with a sig. (P(T<=t) two-tail) value of 0.0076 < 0.05. The average post-test score of the experimental class reached 67.3000, while the control class was 46.0333, indicating that students' mathematical problem-solving ability was in the high category. Based on the calculation of Effect Size (Cohen's D), a value of 3.539734 was obtained, which means that using the problem-solving model based on deep learning on students' mathematical problem-solving abilities has a high influence on improving students' ability to solve mathematical problems.</i>

ABSTRACT
Kata Kunci Problem Solving, Deep Learning, Kemampuan, Pemecahan Masalah, Statistika Penelitian ini bertujuan untuk mengetahui pengaruh model problem solving berbasis deep learning terhadap kemampuan pemecahan masalah matematis siswa pada soal cerita materi statistika di kelas X SMA Negeri 12 Medan. Penelitian menggunakan metode Quasi Eksperimen dengan populasi seluruh siswa kelas X yang terdiri dari 10 kelas. Sampel ditentukan melalui cluster random sampling, menghasilkan kelas X-E2 sebagai kelas eksperimen dan kelas X-E4 sebagai kelas kontrol. Data dikumpulkan menggunakan tes kemampuan pemecahan masalah matematis. Analisis data dengan uji normalitas Liliefors, homogenitas F, dan Uji t-test menunjukkan perbedaan yang signifikan antara nilai pre-test dan post-test kemampuan pemecahan masalah pada kedua kelas, dengan nilai sig. (P(T<=t) two-tail) sebesar 0,0076 < 0,05. Rata-rata nilai post-test kelas eksperimen mencapai 67,3000, sedangkan kelas kontrol 46,0333, menunjukkan kemampuan pemecahan masalah matematis siswa berada pada kategori tinggi. Berdasarkan perhitungan Effect Size (Cohen's D), diperoleh nilai sebesar 3,539734 yang artinya menggunakan model problem solving berbasis deep learning terhadap kemampuan pemecahan masalah matematis siswa memberikan pengaruh yang tinggi terhadap peningkatan kemampuan siswa dalam memecahkan masalah matematis siswa.



1. INTRODUCTION

Education is the primary foundation in shaping individuals capable of facing global challenges in the modern era. Education is a means or method used by each individual to hone knowledge and develop their personal potential through the learning process (AE Simbolon et al., 2024). Education is a basic right for every child with the aim of achieving collective ideals. Based on Law Number 20 of 2003, education is defined as a learning process that enables students to actively develop their internal potential. This development includes the spiritual dimension, self-control skills, personality formation, intellectual intelligence, noble character, and skills necessary for personal development, social life, national life, and statehood (Devi & Putra, 2024). One of the subjects that has an important role and is always found at various levels of education from lower to higher is mathematics. Mathematics is a basic necessity for solving everyday problems, from simple arithmetic operations such as subtraction, addition, multiplication, and division to the application of more complex mathematical concepts (Agustini & Pujiastuti, 2020). Mathematics is an exact science with practical applications in everyday life. According to Susanto (Mirayani et al., 2021), mathematics is taught at every level of education. Therefore, mathematics instruction plays a crucial role in developing students' mindsets. Learning mathematics is not merely about memorizing formulas and practicing arithmetic skills, but also aims to equip students with logical, analytical, systematic, critical, and creative thinking skills, as well as collaborative skills.

However, students often consider mathematics a difficult and boring subject (Rizqi et al., 2025). This is because mathematics instruction tends to emphasize memorizing a series of formulas, with students' lack of ability to understand the material being a major contributing factor. Many students initially enjoy mathematics because, at that stage, the material taught feels simpler. One of the learning skills students must possess is mathematical problem-solving. Problem-solving is a way to address difficult and challenging issues, where the solution cannot be found using conventional, known steps (Risma & Kafuji, 2023). Mathematical problem-solving is a process consisting of understanding the problem, formulating a strategy, implementing the plan, and evaluating the results of the solution (Saputra et al., 2025).

The results of the *PISA (Programme for International Student Assessment)* is an international program held every 3 years by the *Organization for Economic Cooperation and Development (OECD)* which aims to measure the ability of 15-year-old students in applying their abilities and skills in everyday life (OECD, 2017) in the field of mathematics, around 71% of students do not reach the minimum level of competency in mathematics. This means that many Indonesian students still have difficulty in facing situations that require problem-solving skills using mathematics. (Sinaga, 2024). *The Trends in International Mathematics and Science Study (TIMSS)* also indicates that students tend to be able to solve routine problems, but experience difficulties with non-routine problems that require reasoning and the application of concepts in real-world contexts. This condition indicates that mathematics learning does not fully encourage in-depth conceptual understanding. (Zain et al., 2026).

However, until now, students' abilities in solving mathematical problems are still relatively low (Purba et al., 2026) . This statement is relevant to research (Roesdiana, 2023) that students' mathematical problem-solving abilities, especially in word problems, are still in the very low category. The main causes of students' low mathematical problem-solving abilities are due to a lack of interest in learning mathematics, students' lack of familiarity with solving problems related to real life, the learning model applied by teachers is not optimal in guiding students to solve problems, and students' perception that mathematics is a difficult and uninteresting subject (Gultom et al., 2022). The purpose of giving word problems is to attract students' interest in mathematical material related to real experiences they have experienced, witnessed, or heard. To solve word problems systematically, students need to understand the problem, identify the known and asked information, create a mathematical model, and finally solve the problem. (Ebrahim & Brown, 2022).

Based on interviews and observations conducted by researchers at SMA Negeri 12 Medan, it was shown that students' mathematical problem-solving abilities in story-based problems are still low. The lack of student interest in working on math story problems is clear evidence of this. The perception that mathematics is a difficult subject leads to decreased motivation and hinders the development of their critical thinking skills. Without teacher guidance, students tend to be reluctant to solve problems independently. Students rarely ask for alternative solutions, so they rely solely on the methods taught by the teacher. As a result, there is no desire to explore answers with their own thinking or generate diverse solutions. The teacher's habit of frequently providing example problems and solutions also contributes to students' learning. This causes students to tend to imitate these patterns without developing a personal approach to solving problems (M. Simbolon et al., 2017) .

One of the topics taught in high school mathematics, especially in grade 10, is statistics. Statistics is the science of collecting, organizing, and interpreting numerical data to make the best decisions amidst uncertainty (Pandriadi et al., 2023). The purpose of studying statistics is to facilitate understanding of various social phenomena by providing methods for collecting and processing data, thus enabling generalization of results and supporting better decision-making processes. However, statistics learning outcomes still face challenges, with the majority being at the intermediate to low level (Syahrotus et al., 2024) . This is evidenced by high levels of student error, difficulty in solving statistical problems, and a weak understanding of basic concepts such as data distribution, probability, and random variables.

A thorough understanding of the problem content is also crucial, as misinterpreting the problem can lead to misapplication of mathematical concepts. Solving word problems is crucial for the development of critical and mathematical thinking. For example, in statistics, students need to be able to solve problems using appropriate strategies, starting with understanding the problem, recording the data obtained, converting it into a mathematical model, and completing the calculations. Addressing these challenges requires a more interactive and contextual learning approach.

One effort to improve students' skills in solving mathematical problems can be done by implementing a creative and innovative learning model needed to improve the quality of the learning process. This model is chosen because it allows students to play an active role and helps develop students' mathematical problem-solving abilities, namely *deep learning- based problem solving*. According to Chotimah (Triyanti et al., 2024), the *problem-solving* learning model is a learning approach that applies strategies, methods, or systematic steps in dealing with new situations, with the aim that these situations can

be resolved according to the expected results. Implementing learning using the *problem-solving learning model*, where students are required to be active in solving problems in the learning process. In the *problem-solving learning model*, students are trained to find solutions to problems given by the teacher actively, logically, and creatively starting from search for data to draw conclusions (Umar et al., 2022).

problem solving learning model is expected to be able to realize the objectives of learning mathematics, namely to solve mathematical problems. The best problem-solving approach is used to solve word problems or math problems. One relevant approach to achieving this goal is *deep learning*. *Deep learning*, as a relevant approach, is defined as a learning process oriented towards creating mindful, meaningful, and joyful learning experiences (Bambang et al., 2025). *Deep learning* is not only a term in artificial intelligence, but also a learning approach that emphasizes conceptual understanding, connections between materials, emotional engagement, and reflective skills in learning.

deep learning approach focuses on building a more comprehensive understanding, where students not only memorize information but also apply it to real-life situations (Rizqi et al., 2025). This approach is designed to help students think deeply, apply knowledge to new situations, and develop reasoning skills through complex problem-solving. In mathematics learning, this approach provides teachers with flexibility in developing content, processes, and learning products, so that each student can develop optimally according to their individual potential.

Based on the background that has been explained, the researcher is interested in conducting research with the title "The Effect of *Deep Learning* -Based *Problem Solving Model* on Students' Mathematical Problem Solving Ability on Statistics Material Story Questions in Class X of SMA Negeri 12 Medan in the 2025/2026 Academic Year".

2. METHOD

This research uses a quantitative method as explained by (Sugiyono, 2020), namely as a research method based on the philosophy of positivism, which is used to research certain populations or samples, sampling techniques are generally carried out randomly, empirically (the method used can be observed by human senses), and systematically (the steps are logical). (Suhendri, 2015).

The type of research used in this study is a *quasi-experimental* design with a *pre-test* and *post-test, control group design*. This design involves two groups, namely the experimental group given treatment and the control group not given treatment, where both are given a *pre-test* and *post-test*. The purpose of this design is to see the difference in results between the two groups so that the effect of the treatment given can be known. This research was conducted at SMA Negeri 12 Medan in the academic year 2025/2026. Location at Jl. Cempaka No. 75, Medan, Medan Helvetia District, Medan City, North Sumatra Province. The reason researchers chose this research location was because of the low mathematical problem-solving ability of students in story-based questions.

According to Sugiyono (Wijayanto et al., 2024) Population is a subject or object that has certain qualities and characteristics determined by researchers to draw conclusions. In this study, the population used was all students of class X SMA Negeri 12 Medan for the academic year 2025/2026, which consists of 10 classes. According to Sugiyono (Wijayanto et al., 2024) a sample is part of the total properties/characteristics possessed by a population that is carried out statistically and based on research estimates to determine how large a sample will be taken for a research study. (Aulia et al., 2022). The sampling technique used is *cluster random sampling*, namely sampling based on class

groups. (Setianingrum & Novitasari, 2015). Of the 10 existing classes, 2 classes were randomly selected to be used as research samples.

The next step is testing the hypothesis that researchers can put forward. as following:

H_0 : There is no influence of the *deep learning*- based *problem solving model* on students' mathematical problem solving abilities on story problems in Statistics material in class X of SMA Negeri 12 Medan.

H_a : There is an influence of the *deep learning*- based *problem solving model* on students' mathematical problem solving abilities in story problems on Statistics material in class X of SMA Negeri 12 Medan.

The statistical hypothesis in this research is formulated as follows:

$$H_0 : \mu_1 = \mu_2$$

$$H_a : \mu_1 \neq \mu_2$$

Information :

μ_2 : Average mathematical problem solving ability for the experimental class

μ_2 : Average mathematical problem solving ability for the control class

Statistical research procedures to test the research hypothesis are used if the data meets the assumptions of normality and homogeneity.

3. RESULTS AND DISCUSSION

Time and Place of Research

This research was conducted on February 13, 2026 – March 4, 2026 in the 2025/2026 academic year in class X-E2 and X-E4 of SMA Negeri 12 Medan located in SMA Negeri 12 Medan for the academic year 2025/2026. The location is Jl. Cempaka No. 75, Medan, Medan Helvetia District, Medan City, North Sumatra Province. The population in the study was in class X, which consisted of 10 classes.

Research Instrument Trial Results

The results of the instrument trial were used to determine whether the instrument used was suitable and appropriate to measure the abilities being studied. The purpose of this trial was to assess the validity, reliability, discriminatory power, and level of difficulty of the questions. The instrument trial test was conducted outside the experimental class and the control class. The instrument trial questions consisted of 8 descriptive questions. After the instrument trial was conducted, the next stage was *the pre-test*, learning process, and *post-test* in the experimental and control classes. The data from the test instrument trial results in this study can be seen in the test validity, test reliability, test discriminatory power and level of difficulty, as follows: Validity testing is carried out to determine whether each item on the test instrument is valid. An item is declared valid if the value r_{hitung} is greater than the value r_{tabel} , with a significance level of 0.05. This validity test uses *the product moment formula*. The calculation results for each item in the table are as follows: After the questions were given to students with a research sample of 30 students, all items showed a *product moment correlation value* greater than 0.361 ($r_{hitung} > 0.361$) at a significance level of 0.05. This proves that items number 1 to 8 have met the valid criteria and represent all indicators of problem-solving ability, through the same method as the test of 8 items in *the pre-test* on (Pramestika et al., 2020) .. Thus, this instrument is declared suitable for measuring students' mathematical problem-solving abilities.

Data Analysis Prerequisite Test

Normality Test

Normality Test of *Pre-test* of Students' Mathematical Problem Solving Ability in Experimental Class

Pre-test results data applied with *problem solving model* based on The normality of *deep learning* in class X-E2 was tested using the *Liliefors test*. The results of the normality test are listed in Appendix 15, while Table 4.7 presents the detailed results of the normality test calculations as follows:

Table 1. *Liliefors Test Results for the Experimental Class Pre-test*

Amount of Data	30
Average	36.53
Standard Deviation	5,3093
L_{hitung}	0.1116
$L_{0,05;30}$	0.1618

Based on Table 4.7, the value $L_{hitung} < L_{tabel}$ that is $0.11\ 16 < 0.1\ 618$ then It can be concluded that the *pre- test data on students' mathematical problem-solving* abilities in the experimental class were normally distributed. Furthermore, after ensuring the normality of the *pre- test data*, further analysis was conducted in the form of a homogeneity test and the application of parametric statistical tests.

Homogeneity Test

The homogeneity test aims to evaluate whether the variances of the two sample groups are uniform. Both groups are considered homogeneous if the calculated test value is greater than the table value at the 5% significance level. If this condition is met, the variances of the two groups can be considered equal.

Homogeneity Test of Variance of *Pre-test Results* of Students' Mathematical Problem Solving Ability

Based on the results of the normality test, the distribution of *pre-test data* on students' mathematical problem-solving abilities in both the experimental and control classes was declared normal. Furthermore, the analysis continued with a homogeneity test of variance for both groups using the *F test*, as listed in Appendix 19 with a significance level of 0.05. The results of the homogeneity test calculation are presented in Table 4.11.

Table 2. F-Test Results for Students' Mathematical Problem-Solving Ability *Pre-test Results*

F_{hitung}	0.971
F_{tabel}	1,861
Variance 1	28,189
Variance 2	29,030

Hypothesis Testing

Based on the requirements test, the data group was proven to meet the requirements. Under these conditions, hypothesis testing can be continued using an independent two-sample *t- test*, also known as a *paired samples t-test*.

Determining the Research Hypothesis

H_0 : There is no influence of the *deep learning*- based *problem solving model* on students' mathematical problem solving abilities on story problems in Statistics material in class X of SMA Negeri 12 Medan.

H_a : There is an influence of the *deep learning*- based *problem solving model* on students' mathematical problem solving abilities in story problems on Statistics material in class X of SMA Negeri 12 Medan.

The above hypothesis will be tested using a *t*-test, where the statistical hypothesis test is as follows:

$H_0: \mu_1 = \mu_2$:There is no significant difference between the *deep learning*- based *problem solving model* and students' mathematical problem solving abilities.

H_a :There is a significant difference between $\mu_1 \neq \mu_2$ the *deep learning*- based *problem solving model* and students' mathematical solving abilities.

t-test decision-making criteria are:

If $t_{hitung} > t_{tabel}$, then H_0 rejected and H_a accepted

If $t_{hitung} \leq t_{tabel}$, so H_0 accepted and H_a rejected

Accept H_0 , if the significance value > 0.05

Reject H_0 , if the significance value is < 0.05

t-test

After conducting the hypothesis prerequisite test, the next step is to find out whether there is a difference. *Deep learning* - based *problem solving model* on problem solving ability problem Students' mathematical understanding of Statistics material at SM A Negeri 12 Medan. The results are presented in (Appendix 21).

Table 3. Results of the *t*-test of problem-solving ability Problem Student Mathematics *t*-Test-Sample Assuming Equal Variances

t-Test: Two-Sample Assuming Equal Variances			
	Variable 1	Variable 2	
Mean	67,3000	46,7667	
Variance	15,6655	51,6333	
Observations	30	30	
Pooled Variance	33,6494		
Hypothesized Mean Difference	0		
df	58		
t Stat	13,7093		
P(T<=t) one-tail	0,0038		
t Critical one-tail	1,6716		
P(T<=t) two-tail	0,0076		
t Critical two-tail	2,0017		

Based on the table, the *t*-test produces a sig. value ($P(T \leq t)$ two-tail) of 0.00 76, which is smaller than 0.05. From the *t*-test distribution in Appendix 21 with $df = 58$, the value obtained is t_{tabel} of 2.0017. Because the sig. value ($P(T \leq t)$ two-tail) = 0.0076 < 0.05 and $t_{hitung} = 13.7093 > t_{tabel} = 2.0017$, it is H_0 rejected, which indicates a difference in problem-solving ability. problem mathematical The difference between the *pre-test* and *post-test* averages of the experimental class and the control class. This difference is caused by different learning treatments, namely the application of a *deep learning*- based *problem solving model*. compared to conventional learning. Thus, it can be concluded that the *problem solving model based on deep learning* has an influence on problem solving

ability problem students' mathematical understanding of Statistics material at State Senior High School 12 Medan.

Effect Size (Cohen's D)

Table 4. Effect Size Results (Cohen's D)

	Mean	SD	n
X1 (Eksperimen)	67,3000	3,957969	30
X2 (Kontrol)	46,76667	7,185634	30
M1-M2	20,53333		
Pooled SD	5,800812		
Cohen's D	3,539734		

Based on table so mark *Effect Size (Cohen's D)* including in criterion $d \geq 1.3$, which means mark *Effect Size (Cohen's D)* is classified as very large. So that can concluded that The effect of *deep learning-* based *problem solving* model on students' mathematical problem solving abilities on story problems in Statistics material in class X of SMA Negeri 12 Medan. 3.53973 and the criteria is very large.

Observation Sheet Results

Based on results observation teacher activities in managing *problem* models problem-based *solving deep learning* show value 98.6% in (Appendix 6) or "Very Good" category. This is show that learning using *the problem* model problem-based *solving deep learning* in very good category that can used in learning.

Research Discussion

This research was conducted at SMA Negeri 12 Medan in the academic year 2025/2026 using the method quasi-experimental. The study aims to analyze the influence of *the problem model solving* based *deep learning* on the mathematical problem-solving ability of class X students, especially on Statistics material (Measure of Central Order Data). *The study population included all class X students, while the sample was selected through cluster random sampling, so that two classes were selected, namely X-E2 and X-E4.* The study took place in four meetings from February 13, 2026 to February 4, 2026 in the even semester. (Vera et al., 2021) .

The experimental class X-E2 consisted of 30 students who were taught by researchers using a *deep learning-* based *problem solving* model, while the control class X-E4 consisted of 30 students who were taught using conventional methods. (Pramestika et al., 2020) . From the results of the descriptive test instrument trial of 5 questions conducted in class XI-F4 with a sample of 30 people, it turns out that all the questions were declared valid and reliable to test students' mathematical problem-solving abilities in the two research classes. (Harefa et al., 2020b) . Furthermore, each class received treatment according to the applied learning model, namely a *deep learning-* based *problem solving model* for the experimental class and a conventional learning model for the control class. (Bagassi & Macchi, 2020) .

Before treatment, a *pre-test* was conducted to determine students' initial abilities. The *pre-test results* showed that both classes had low problem-solving abilities, with an average of 36.5333 in the experimental class and 27.7333 in the control class (Miller & Maellaro, 2016) . Furthermore, each class received treatment according to the applied method, namely a *deep learning-* based *problem-solving model* for the experimental class and a conventional method for the control class. (Herutomo & Masrianingsih, 2019) .

Based on results sheet observation, activity students in class experiments using *the problem model problem-based solving deep learning* show a value of 98.6% which is in the very good category. This is show significant improvement. The research findings based on indicators of mathematical problem-solving ability show results for each indicator, namely :

1. Understanding the Problem

Based on this indicator, most students were able to understand the questions well. They were able to write down what was known and what was asked in the story problem. This indicates that students are becoming accustomed to reading and understanding problems before solving them.

2. Planning Problem Solving

Students have begun to be able to determine the steps to be used in solving problems. However, some students are still confused about choosing the right method. However, compared to before the lesson, students' ability to plan solutions has improved. (Miksan Ansori, 2019) .

3. Completing the Solution Plan

At this stage, most students were able to solve the problem according to the planned steps. Mistakes were usually due to inaccurate calculations, not a lack of conceptual understanding. This indicates that students' understanding was quite good. (Harefa et al., 2020a) .

4. Rechecking Results

In this indicator, many students are still not accustomed to double-checking their answers. They tend to immediately submit their results without ensuring their accuracy. However, after implementing this learning model, improvements began to be seen, although not yet optimal.

After the treatment, *a post-test was conducted*, which showed an increase in students' mathematical problem-solving abilities. The average *post-test* of the experimental class increased to 67.3000 (Appendix 17), while the control class became 46.0333. Before the hypothesis test, the data from *the pre-test* and *post-test* were tested for normality and homogeneity prerequisites, with the results showing normal data distribution (Appendix 15, 16, 17, and 18) and homogeneous variance ((Sopian & Afriansyah, 2017) . Based on the *t- test*, the sig. (2-tailed) value was obtained = $0.0000 < 0.05$ and $t_{hitung} = 13.7093 > t_{tabel} = 2.0017$, so that there is difference ability solution problem mathematical student between class experiments and classes control. Difference This caused by the method established learning, namely *deep learning- based problem solving* models compared method conventional.

In addition, the value *Effect Size (Cohen's D)* as big as 3.53973 shows that *the problem solving* model is based on *deep learning* give very big influence to solution problem mathematical students on the question story material statistics. With thus, it can concluded that *the problem solving* model is based on *deep learning* give the effect size (*Cohen's D*) is very large to ability solution problem mathematical students at State Senior High School 12 Medan.

CONCLUSION

Based on the formulation of the problem and the proposed hypothesis as well as the research results based on data analysis and hypothesis testing, the conclusions that can be conveyed in this research are:

1. *the deep learning- based problem solving* model on students' mathematical problem-solving abilities in story problems on Statistics material in class X of SMA Negeri 12 Medan.
2. Influence The effect of *deep learning- based problem solving* model on students' mathematical problem solving abilities on story problems in Statistics material in class X of SMA Negeri 12 Medan of 3.53973 shows that *the problem solving* model is based on *deep learning* give a huge contribution to ability Students' mathematical problem solving on story problems in Statistics material in class X of SMA Negeri 12 Medan.

Suggestion

In order to improve the quality of learning and the success of the teaching and learning process, especially in improving problem-solving skills. students ' mathematical abilities, researchers provide the following suggestions:

1. In mathematics learning, it is hoped that teachers can apply models *problem deep learning- based solving* engaging. This aims to make each student's needs and learning styles more appealing and encourage participation in the learning process. This model, while time-consuming, can increase the efficiency of learning time.
2. For future researchers, it is hoped that they can conduct further research on the *problem model. Deep learning- based solving* in other mathematics materials to improve the overall quality of education in Indonesia

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