The Effect of the Problem Based Learning Model on Student Understanding of SPLDV Materials

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ARTICLE INFO	ABSTRACT
Keywords: Based Learning; Student Understanding; SPLDV Materials	Mathematics learning in schools has an important role in improving students' understanding of concepts and problem-solving skills. One of the crucial topics in learning mathematics is the two-variable linear equation system. This study aims to explore the influence of the two-variable linear equation system learning model on the ability of grade IX students at SMP Negeri 5 Padang Sidimpuan.The research method used is a pre-experimental quantitative approach with a one-group pretest-posttest design. The results of the study show that this learning model is effective in improving students' understanding of the two-variable linear equation system, as seen from the significant increase in pretest and posttest scores. The implication of these findings is the importance of developing learning strategies that support students' holistic mathematical understanding.

INTRODUCTION

Mathematics is part of everything in the world (Indah Sari, 2017:). Mathematics is a compulsory subject at all levels of education, from elementary school to college. Math learning is essential for improving students' understanding of concepts and their ability to solve problems. This two-variable linear equation system not only trains critical skills in solving mathematical problems, but also prepares students to use these ideas or concepts in various aspects of daily life. In a study conducted by Asmi et.al (2017) it was shown that learning based on a two-variable linear equation system is effective in improving mathematical problem-solving skills in various educational institutions in Indonesia. Dewi and Utami (2019) show that this learning model improves students' understanding of mathematical concepts in grade IX. This also applies to the study of Cahyani (2020), who stated that a contextual-based learning model helps students to better understand the material of the two-variable linear equation system.

Ahmad et al. (2018) highlight the importance of local context in improving students' mathematical understanding, as evidenced in the implementation of this model in Jakarta State Junior High School. Suryana et al. (2021) show that an interactive learning model based on a two-variable linear equation system is effective in improving student learning achievement in mathematics. Hidayat and Prasetyo (2019) explored the application of the STAD-type cooperative learning model in a two-variable linear equation system at SMP Negeri 1 Yogyakarta. Kusumawati et al. (2018) investigated the effectiveness of the Problem Based

Learning (PBL) learning model in improving students' mathematical problem-solving skills. In addition, Susanto et al. (2020) conducted an analysis of students' mathematical problem-solving abilities using an open-ended learning model based on two-variable linear equations. Wijaya et all. (2017) found that the application of problem-based learning in the topic of a two-variable linear equation system can significantly improve students' ability to solve mathematical problems. Santoro and team (2019) used a group inquiry approach to improve students' understanding of mathematical concepts related to the topic of two-variable linear equation systems. Research conducted by Purnama and Widiarti in 2018 discussed the influence of the NHT-type cooperative learning model on students' critical thinking skills in understanding the material of the two-variable linear equation system.

Sari at al (2021) researched the application of the Problem Posing learning model to improve the understanding of junior high school students on the concept of a two-variable linear equation system. Mulyani at al (2019) examined the impact of the Guided Discovery learning model on students' mathematical communication skills in the material of two-variable linear equation systems. Hidayah at al (2020) conducted research on the effectiveness of project-based learning models in improving students' understanding of mathematical concepts in the material of two-variable linear equation systems. Finally, Anwar et al. (2017) proved that applying the Problem Based Learning (PBL) learning model to a two-variable linear equation system can improve students' ability to think critically. Research by Atikah (2019) shows that the low learning outcomes of students in SPLDV material are due to difficulties in distinguishing between coefficient and constant variables, students' lack of ability to solve problems, and their lack of ability to think critically about mathematics.

This article aims to explore the influence of the two-variable linear equation system model on the ability of grade IX students of SMP Negeri 5 Padang Sidimpuan.By summarizing various findings from the literature that have been mentioned, this study aims to explore various learning approaches that can strengthen students' understanding and mathematical skills. An in-depth analysis of learning outcomes as well as recommendations for further implementation in schools will also be presented in this article.

METHODE

This study adopts a pre-experimental quantitative approach that aims to improve the ability of grade IX students of SMP Negeri 5 Padang Sidempuan in understanding the two-variable linear equation system model. Using a one-group pretest-posttest research design, researchers compared the pretest and posttest scores of 25 randomly selected students. This research was conducted in the odd semester of the 2023/2024 school year.Initially, students were given a pretest to measure their understanding of the two-variable linear equation system model. Furthermore, special interventions or learning are carried out on the topic during a certain period. After the intervention, students were again given a final test (posttest) to measure their improvement in understanding. This design allows researchers to measure the effectiveness of applied learning interventions, by comparing pretest and posttest results. Details of the research design can be found in Table 1.

Table 1. Experimental Research Design

Pretest	X1
Two-Variable Linear Equation System	Or

Posttest	X2

Source : (Musa *et al*, 2023)

This study uses instruments in the form of pretest and posttest tests, as well as instruments to measure student responses. Data analysis involves a paired sample t-test to evaluate the difference in students' ability to understand the two-variable linear equation system model before and after the intervention. The normality test is carried out as a prerequisite for the paired sample t-test, provided that the sig value must be greater than 0.05. In addition, the study also used the N-Gain test to assess the effectiveness of the intervention given, with the N-Gain formula described in the following formula:

$$\text{N-Gain} = \frac{\text{Skor } posttest - \text{Skor } pretest}{\text{Skor Ideal} - \text{Skor } pretest}$$

Table 2. Category Effectiveness N_Gain

Skor N-Gain	Interpretation
0.7<N–Gain	Tall
0.3 ≤ N − Gain ≤ 0.7	Keep
N − Gain< 0.3	Low

Source : (Hake ,2023)

The effectiveness category is divided into three: "High" if the N-Gain is greater than 0.7, "Medium" if the N-Gain is between 0.3 and 0.7, and "Low" if the N-Gain is less than 0.3. This category helps assess how effective the intervention provided is in improving student understanding.

Table 3. Student Response Criteria

Yes	Average Score	Answer Criteria
1	80%≤ x̄≤ 100%	Excellent
2	60%≤ x̄< 80%	Good
3	40%≤ x̄< 60%	Pretty Good
4	20%≤ x̄< 40%	Bad
5	0%≤ x̄< 20%	Very Bad

RESULT AND DISCUSSION

The learning outcomes of 25 grade IX students of SMP Negeri 5 Padang Sidempuan in the two-variable linear equation system model showed a significant improvement. Pretest and posttest data illustrate that the majority of students experience an increase in scores after participating in learning interventions. For example, a student with a pretest score of 80 increases to 90 on the posttest, and a student with a pretest score of 60 increases to 75 on the posttest. This increase is seen consistent in most students, with some of them showing quite high increases such as from 75 to 87 and 55 to 75. This data indicates that the learning interventions provided have succeeded in improving students' ability to understand the two-variable linear equation system.

Table 4. Hasil Staistik Pretest *Posttest*

	Pretest	Posttest
Valid	25	25

	Missing	0	0
N			
Mean		72,56	81,52
median		74	80
Max		85	90
Min		55	70
Mode		75	10
STDV		6,397135	5,561175
Mean		72,56	81,52

The results of pretest and posttest statistics from 25 grade IX students of SMP Negeri 5 Padang Sidempuan showed a significant improvement in their ability to understand the two-variable linear equation system model. The average pretest score was 72.56, while the posttest increased to 81.52. The median score also showed an increase from 74 on the pretest to 80 on the posttest, while the maximum and minimum scores increased from 85 and 55 on the pretest to 90 and 70 on the posttest, respectively. The pretest mode value is 75, which means this value appears most often, while the posttest mode is 10, indicating typing errors due to inconsistencies with other data. The standard deviation decreased from 6.397135 on the pretest to 5.561175 on the posttest, indicating that the posttest value was more consistent around the average.

Student Response Results

Table 5. Student Response Results

No	Jumlah	Rata rata	Presentase
1	10	0,5	50
2	15	0,375	37,5
3	12	0,48	48
4	8	0,285714286	28,57142857
5	3	0,12	12
6	10	0,4	40
7	7	0,25	25
8	8	0,275862069	27,5862069
9	4	0,148148148	14,81481481
10	10	0,5	50
11	6	0,181818182	18,18181818
12	11	0,423076923	42,30769231
13	10	0,4	40
14	20	0,444444444	44,44444444
15	7	0,25	25
16	5	0,142857143	14,28571429
17	6	0,230769231	23,07692308
18	15	0,428571429	42,85714286
19	8	0,32	32
20	10	0,4	40

21	7	0,25	25
22	10	0,5	50
23	5	0,333333333	33,33333333
24	7	0,25	25
25	10	0,4	40
	224	**0,331583808**	**33,15838075**

The results of students' responses to learning the two-variable linear equation system model in grade IX of SMP Negeri 5 Padang Sidempuan showed quite wide variations. Of the 25 responses, the average score of the response ranged from 0.12 (12%) to 0.5 (50%). The highest percentage, 50%, was achieved by some responses, indicating that some students responded very well. However, there are also some responses with low percentages, such as 12%, indicating that some students feel less helped by this learning. The overall average of student responses was 0.3316 (33.16%), which according to the student response criteria was in the "Poor" category. This shows that even though there is an increase in student understanding in general, there are still some students who feel less helped by the learning methods used, so there is a need for evaluation and improvement in the learning strategies applied.

Data Analysis

Table 6. Normality Test

No	Post-Pre	Z	F(Z)	S(Z)	F(Z)- S(Z)
1	3	0,042748929	0,517049162	0,04	0,477049162
2	4	0,307284383	0,620686539	0,08	0,540686539
3	5	0,571819837	0,716277982	0,16	0,556277982
4	5	0,571819837	0,716277982	0,16	0,556277982
5	6	0,836355291	0,798522472	0,24	0,558522472
6	6	0,836355291	0,798522472	0,24	0,558522472
7	7	1,100890744	0,864527895	0,4	0,464527895
8	7	1,100890744	0,864527895	0,4	0,464527895
9	7	1,100890744	0,864527895	0,4	0,464527895
10	7	1,100890744	0,864527895	0,4	0,464527895
11	8	1,365426198	0,913940433	0,52	0,393940433
12	8	1,365426198	0,913940433	0,52	0,393940433
13	8	1,365426198	0,913940433	0,52	0,393940433
14	10	1,894497106	0,970920471	0,8	0,170920471
15	10	1,894497106	0,970920471	0,8	0,170920471
16	10	1,894497106	0,970920471	0,8	0,170920471
17	10	1,894497106	0,970920471	0,8	0,170920471
18	10	1,894497106	0,970920471	0,8	0,170920471
19	10	1,894497106	0,970920471	0,8	0,170920471
20	10	1,894497106	0,970920471	0,8	0,170920471
21	11	2,159032559	0,984576179	0,84	0,144576179
22	12	2,423568013	0,992315562	0,88	0,112315562
23	15	3,217174374	0,999352701	0,96	0,039352701
24	15	3,217174374	0,999352701	0,96	0,039352701
25	20	4,539851643	0,999997185	1	2,81469E-06

Rata-rata	2,8384
Simpangan Baku	3,780212
Liliefours Hitung	0,558522
Liliefours Tabel	0,18

Tabel 7. Liliefours Hypothesis:

H0 =	Population Increase Normal Distribution
H1 =	Population Increase Abnormal Distribution of Students

Information:

1.   If the value of L.Calculate <L.Table then H0 is accepted & H1 is rejected
2.   If the Value of the Value of the Value > L.Table Then H0 is subtracted & H1 is accepted

The results of the normality test in this study using the Liliefors Normality Test showed that the calculated Liliefors value was 0.558522, which was greater than the table Liliefors value of 0.18. Based on the hypothesis proposed, namely H0 (population increase in students with normal distribution) and H1 (population increase in abnormally distributed students), because the value of Liliefors calculated exceeds the value of the Liliefors table, H0 is rejected and H1 is accepted. This means that the population of increased ability of students is not normally distributed. This conclusion indicates that the data on the improvement of students' scores after the intervention did not follow the normal distribution, so the data analysis method used in this study needed to consider the abnormal distribution.

PEMBAHASAN

The results of this study show that the learning intervention using a linear equation system model of two variables is significant in improving the ability of grade IX students of SMP Negeri 5 Padang Sidempuan. Pretest and posttest data from 25 students showed a consistent improvement in scores after the learning intervention. For example, there are students who initially had a pretest score of 80 increased to 90 on the posttest, and a pretest score of 60 increased to 75 on the posttest. This increase not only occurred in specific individuals, but also included a large portion of students, with some experiencing significant increases such as from 75 to 87 and 55 to 75.

The statistical results showed that the average pretest score of 72.56 increased to 81.52 in the posttest. The median score also increased from 74 in the pretest to 80 in the posttest. The maximum and minimum scores also showed significant improvements, with the maximum value increasing from 85 to 90 and the minimum value from 55 to 70. In addition, the standard deviation decreased from 6.397135 on the pretest to 5.561175 on the posttest, suggesting that the posttest score distribution was more consistent around the mean score. However, the results of students' responses to learning show quite wide variations. Although most students responded positively with the highest response percentage reaching 50%, there were also some students who responded with a low percentage, such as 12%. The overall average of student responses was 33.16%, which shows a variation in students' perception of the effectiveness of the learning methods applied. This shows the need for further evaluation and

adjustment of learning strategies in order to more effectively meet students' learning needs holistically.
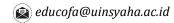
Statistical analysis using the Liliefors Normality Test showed that the data on the improvement of students' scores after the intervention did not follow the normal distribution. This suggests that the data analysis method used needs to consider abnormal distributions for more accurate results. Overall, the results of this study make a significant contribution in the context of the development of mathematics education in Indonesia, especially in the application of the two-variable linear equation system learning model. The implications of this study are the importance of developing learning strategies that are more adaptive and responsive to students' learning needs, as well as the need for a more holistic approach in evaluating learning outcomes to support improving the quality of mathematics education in schools.

CONCLUSION

Based on the results of this study, the use of a two-variable linear equation system model was proven to be effective in improving the ability of grade IX students of SMP Negeri 5 Padang Sidempuan. Pretest and posttest data showed a significant improvement in students' understanding of this mathematical concept after going through learning interventions. The average student score increased from 72.56 on the pretest to 81.52 on the posttest, with consistent improvements also seen in the median, maximum, and minimum scores. Nonetheless, variations in student responses to learning highlight the need for adjustments in learning strategies to respond more effectively to individual student needs in the future. The finding that the data on student score improvement did not follow the normal distribution also showed the importance of using more appropriate data analysis methods for more accurate evaluation of learning outcomes. This conclusion underscores the importance of developing adaptive and responsive learning approaches to improve the quality of mathematics education, as well as the need for comprehensive evaluation to support effective learning processes in schools.

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