JOURNAL OF EDUCATIONAL REVIEW AND RESEARCH
Vol. 6 No. 1, Juli 2023. Page: 70 – 77
e-ISSN: 2597-9760, p-ISSN: 2597-9752

IMPLEMENTATION OF PROBLEM BASED LEARNING (PBL) MODEL TO IMPROVE STUDENT'S CRITICAL THINKING ABILITY IN TWO VARIABLE LINEAR EQUATION SYSTEM MATERIALS

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Keywords :
Student critica thinking skill, *Problem Based Learning* (PBL), Two variable linear equation system (SPLDV)

ABSTRACT
The aim of the research is to find out the application of the problem based learning model to students' critical thinking skills. The type of research used is quantitative. The research design used was the One Group Pretest-Posttest Design. The results of the implementation research using the problem based learning model showed that at the first meeting 75.93% had good criteria and 85.19% the second meeting had very good criteria, the results of data analysis using the t-test, obtained a t_count value of 6.60 and a t_table of 2.045 with a significant level of 5%, because (t_count > t_table) it can be said that the alternative hypothesis (Ha) is accepted and the null hypothesis (Ho) is rejected. So it can be said that the application of the problem based learning model can improve students' critical thinking skills. The calculation of the completeness of student learning outcomes after using the problem based learning model is 82.76% above the specified classical completeness of 70%. The results of the student response questionnaire calculations as a whole gave a positive response to the problem based learning model in the material of the Two Variable Linear Equation System (SPLDV) which was applied ranging from good to very good criteria.

INTRODUCTION

Education is something that cannot be separated from human life. Education plays an important element in preparing students through various activities in accordance with Law Number 2 of 1989 concerning the National Education System which reads "Education is a conscious effort to prepare students through guidance, teaching and or training activities for their future roles" (Wahyudin, 2007 :16).

In this modern era, high quality students are needed to have high intellectual, high morals, capable, critical and creative thinking who are able to communicate and connect ideas in solving any problems

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Vol. 6 No. 1, July 2023: 70 – 77
e-ISSN: 2597-9760, p-ISSN: 2597-9752

that arise. This is supported by Sumarmo (Indarti, 2014: 120) that students must have intelligent mathematical abilities, think and act critically, be creative and careful, object and be open, respect, the beauty of mathematics, and curiosity. One of the efforts in the field of education that can be done to produce quality students is by getting used to forming a culture of critical thinking in the learning process. The purpose of training students' critical thinking skills is to prepare students to become critical thinkers, able to solve problems and make decisions appropriately and responsibly. However, efforts to train students' critical thinking skills often escape the attention of the teacher. This can be seen from the learning activities carried out by the teacher providing more information with the lecture method, students will have more knowledge but that knowledge is only received from teacher information, as a result learning becomes less meaningful because the knowledge gained by students is easily forgotten.

Based on the results of interviews and observations on October 16 2022 with the mathematics teacher in class VIII SMPN 10 Singkawang. Researchers get the fact that one of the results of the class VIII students' daily tests is still very far from good. The average learning outcomes of students who score below the Minimum Completeness Criteria (KKM) in mathematics daily tests are around 93.10%, while students who achieve classical completeness are 6.90%. According to information from the mathematics teacher, when given examples of questions and how to solve them, students seemed to understand and understand, but after being given practice questions, students found it difficult to solve them. This condition occurs because students' learning patterns tend to memorize formulas. Student still unable to solve the problem and do not understand the meaning of the problem (Buyung, 2021).

Based on this, an effort is needed to improve students' critical thinking skills. One model that allows students to think critically in mathematics is a problem based learning model. In the learning process using the problem-based learning model, the teacher acts only as a facilitator, on the other hand students as active learners seek sources which then take responsibility for the sources they have obtained in the form of discussions and critical arguments.

According to Suyatno (Indarti, 2014: 122) states that a problem-based learning approach is a process in which the starting point of learning begins based on problems in real life students are stimulated to study problems based on prior knowledge and experience to form new knowledge and experiences. . The same thing was also stated by Seng (Sudiyasa, 2014: 157) stating that problem-based learning applied to students can improve critical thinking skills. According to Arends (2008: 57) problem based learning consists of 5 phases and behaviors. These phases and behaviors are patterned actions. This pattern was created so that learning outcomes with the development of problem-based learning can be realized. Stages of problem-based learning are presented in Table 1 as follows.

Table 1 Stages of Problem Based Learning

Learning Stages	Teacher Behavior
Phase 1: Student orientation on the problem	The teacher conveys the learning objectives described as important logistical needs and motivates students to engage in problem solving activities.
Phase 2: Organizing student learning	Teachers help students define and organize learning tasks related to the problem.
Phase 3: Guiding individual and group investigations	Teachers encourage students to get the right information, carry out experiments, and seek explanations and solutions.

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e-ISSN: 2597-9760, p-ISSN: 2597-9752

Phase 4: Develop and present the work	The teacher assists students in planning and preparing appropriate artifacts, such as reports, videotapes, and models and helps them to convey them to others.
Phase 5: Analyze and evaluate the problem solving process	The teacher helps students reflect on their investigations and the processes they use.

According to Amir (2009: 27-29) suggests some of the benefits of problem based learning as follows. (a) Become more memorable and increase their understanding of the teaching material. (b) Increasing focus on relevant knowledge. (c) Encouraging to think. (d) Building teamwork, leadership, and social skills. (e) Building learning skills (life-long learning skills). (f) Motivating students.

Thinking is the ability to analyze, criticize, and reach conclusions based on good inference or judgment (Arends, 2008: 43), whereas according to Liputo (Susiyati, 2014: 172) states that thinking is a mental activity that is realized and directed for a specific purpose. The goals that can be achieved in thinking are understanding, making decisions, planning, solving problems and assessing actions. According to Norris and Ennis (Fisher 2009: 4) defining critical thinking is reasonable and reflective thinking that focuses on deciding what to believe or do, whereas according to Paul, et al (Fisher 2009: 4) defining critical thinking is a model of thinking about things , any substance or problem in which the thinker improves the quality of his thinking by skillfully dealing with the structures inherent in thinking and applying intellectual standards to them.

According to Mulyana (Jayadipura, 2014: 126) put forward indicators of critical thinking in the form of (a) Ability to identify assumptions given (know problems). (b) The ability to formulate the main issues. (c) The ability to determine the consequences of a provision taken. (d) The ability to detect bias based on different points of view. (e) The ability to reveal data into definitions or theorems to solve problems. (f) Ability to evaluate relevant arguments in solving a problem. So, based on the indicators above, the researcher took four of the six indicators of critical thinking skills, namely (a) Identifying the assumptions given (knowing the problem). (b) Formulate the main issues. (c) Applying data to definitions or theorems to solve problems. (d) Ability to evaluate relevant arguments in solving a problem.

If there are two linear equations of two variables in the form ax + by = c and dx + ey = f , then these two equations are said to form SPLDV. The solution to the Two Variable Linear Equation System (SPLDV) is the pair of numbers (x, y) that satisfies the two equations.To solve problems in the System of Two Variable Linear Equations (SPLDV) can be done in several ways, namely the substitution method, the elimination method, the graphical method and the combined method. But in this study the authors limited the material on the System of Two Variable Linear Equations (SPLDV) to the sub-material of elimination and substitution (Prihatingtyas, N. C., & Nurhayati, N. 2022).

1. Research Hypothesis

Based on the formulation of the existing problems, the hypothesis proposed in this study is as follows.

Ho: The application of the problem-based learning model cannot improve students' critical thinking skills in the matter of two-variable linear equation systems (SPLDV).

Ha: The application of problem-based learning models can improve students' critical thinking skills in the matter of two-variable linear equation systems (SPLDV).

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METHODS

The form of research used by researchers is Pre-Experimental Designs. The research design used was the One Group Pretest-Posttest Design. The research was conducted at SMPN 10 Singkawang. The population in this study were all students of class VIII consisting of 5 classes. Sampling in this study used non-probability sampling, namely a sampling technique that does not provide equal opportunities or opportunities for each element or members of the population to be selected as samples (Sugiyono, 2013: 84). The nonprobability sampling technique used is purposive sampling, which is a sampling technique with certain considerations (Sugiyono, 2013: 85). So that class VIII B was determined as the experimental class.

This study consists of two variables, namely the independent variable and the dependent variable. The independent variable in this study is the problem based learning model while the dependent variable is students' critical thinking skills. Data collection techniques to be used in this study are as follows. (a) Measurement techniques (b) Direct observation techniques (c) Direct communication techniques (d) Indirect communication techniques. For the purpose of collecting data in this study the following instruments were used. (a) Critical thinking ability test (b) Observation sheet (c) Interview.

Before the test instrument is used in research, the test instrument that has been made is tested first. After testing the instrument, it is then processed or analyzed. The following describes what is used to determine whether or not the research test instrument is feasible or not as follows.
(1) The validation used in this research is content validation. This content validation was tested by experts in the field concerned, namely two mathematics education lecturers at STKIP Singkawang and one junior high school mathematics teacher. Based on the validation analysis of pretest and posttest questions, lesson plan validation and questionnaire response material validation of the Two Variable Linear Equation System (SPLDV) was carried out by calculating the overall average validation and presented in Table 2 as follows.

Table 2 Overall Validation Average Results

Validation	Result	Criteria
Validation of pretest and posttest questions	4,14	Good
RPP Validation	4,19	Good
Response Questionnaire Validation	4,37	Very good

(2) To find out the level of reliability used in this study, the questions that have been validated will be tested first at SMPN 18 Singkawang, where the average ability of the students is the same as the school that will be studied. After the reliability is carried out, the reliability value of the item is r_{11}= 0,81 which is located between $0{,}80 < r_{11} \leq 1{,}00$ The questions are included in the category of very high reliability.
In this study the data analysis techniques used are as follows. (1) To answer the first sub-problem regarding the implementation of the problem-based learning model in the material of the Two-Variable Linear Equation System (SPLDV) data processing will be carried out by finding the percentage of problem-based learning model implementation as measured using a Likert scale. (2) To answer the second sub-problem regarding improving students' critical thinking skills before and after the application of the problem-based learning model to the material of the Two-Variable Linear Equation System (SPLDV) to make it clearer the data obtained is analyzed using a gain calculation and continued by testing the hypothesis using t test one sample with the provision that the sample must be normally distributed, to find out whether the sample is normal or not the researcher uses the Liliefors test. (3) To answer the third sub-problem, namely the completeness of student learning outcomes after applying the problem-based learning model to the material of the Two-Variable Linear Equation System (SPLDV) will be analyzed by first converting scores into grades and then looking for percentages. (4) To answer the fourth sub-problem regarding student responses to the problem-

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based learning model in the material of the Two-Variable Linear Equation System (SPLDV) data processing will be carried out by finding the percentage of student responses as measured using the Guttman scale.

RESULTS AND DISCUSSIONS

1. Observation

Observations made in this study were to determine the implementation of learning using the problem-based learning model on the material of the two-variable linear equation system (SPLDV) in the lesson plan. Based on the five stages of learning that the problem based learning model has, it is developed into 18 indicators which will be observed and carried out in two meetings.

If presented at each meeting, then the observational data regarding the implementation of the problem based learning model at each meeting is shown in Table 3 as follows.

Table 3 Implementation of the Learning Process at Each Meeting

Learning model	Meeting to	
	1	2
Problem Based Learning	75,93%	85,19%
Criteria	Good	Very Good

From Table 3 it can be seen that there is an increase in the implementation of the problem based learning model from the first meeting to the second meeting with a difference 9,26%.

2. Students' Critical Thinking Ability Test

a. Gain *Calculation*

Gain is the difference between the pretest value and the posttest value. To strengthen the conclusions and to measure the significant increase in students' critical thinking skills after learning. Based on the data on the average pretest, posttest and experimental class gain, it is presented in Table 4 as follows.

Table 4 The average value of the experimental class

Class	Nilai Rata-rata		
	Pretest	*Posttest*	*Gain*
Experiment (VIIIB)	37,28	80,39	0,685

The gain data for each student is categorized according to the gain category provided, then it is presented in Table 5 as follows.

Table 5 Experiment Class Gain Category

Gain category	Experiment class
High	15 student
Medium	14 student
Easy	No

b. Normality test

The results of the pretest normality test are presented in Table 6 as follows.

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e-ISSN: 2597-9760, p-ISSN: 2597-9752

Table 6 Pretest Normality Test

Grup	Sample	Average	SD	L_{hitung}	L_{tabel}
Experiment	29	37,28	10,59	0,1295	0.161

The test was carried out at a significant level of 0.05 for n = 29. From Table 6 above it can be concluded that the pretest data is normally distributed, because $L_{hitung} < L_{tabel}$. The posttest normality test results are presented in Table 7 as follows.

Table 7 Post-test Normality Test

Grup	Sample	Average	SD	L_{hitung}	L_{tabel}
Experiment	29	80,39	6,89	0,1515	0,161

The test was carried out at a significant level of 0.05 for n = 29. From Table 7 above it can be concluded that the posttest data is normally distributed, because $L_{hitung} < L_{tabel}$.

c. Hypothesis testing
The following results of the calculation of the hypothesis test for the pretest and posttest data for the experimental class are presented in Table 8 as follows

Table 8. Pretest and Posttest Hypothesis Testing

Information	Kelas Eksperimen	
	Pretest	*Posttest*
Sample	29	29
Average	37,28	80,39
Standard Deviation	10,59	6,89
L_{hitung}	-16,69	6,60
L_{tabel}	2,045	2,045
Conclusion	Ho accepted, Ha rejected	Ho rejected, Ha accepted

From the calculation of the pretest and posttest of the experimental class, the pretest with L_{hitung} -16,69 and L_{tabel} 2,045 then -16,69 < 2,045 this means that at a significant level 0.05 Ho is acepted and Ha is rejected, while the posttest results withL_{hitung} 6,60 and L_{tabel} 2,045 then 6,60 > 2,045 this means that at a significant level of 0.05 Ho is rejected and Ha is accepted thereby meaning that the application of the problem based learning model can improve students' critical thinking skills. Sonia, S., Kurniawan, Y., & Muliyani, R. 2021).

3. Completeness of Student Learning Outcomes
The number of students in the experimental class was 29 people, students who scored above the Minimum Completeness Criteria (KKM), namely 24 students who scored above 70, while students who scored below the KKM were 5 people. Then the classical completeness in the experimental class after the application of the problem-based learning model to the two-variable linear equation system material (SPLDV) obtained a percentage of 82.76% so that it was declared complete because it was more than the specified classical completeness which was above 70% (Buyung, 2021).

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e-ISSN: 2597-9760, p-ISSN: 2597-9752

4. Student Response Questionnaire
   Based on the results of giving a questionnaire to class VIIIB students, an analysis of the question indicators is presented in Table 9 as follows

Table 9 Student Response Questionnaire Results

Question	Percentage of Each Indicator	Criteria
1	82.76	Very good
2	79.31	Good
3	65.52	Good
4	75.86	Good
5	65.52	Good
6	68.97	Good
7	86.21	Very good
8	93.10	Very good
9	82.76	Very good

Based on Table 9 it is known that overall the results of student responses gave a positive response to the problem based learning model in the applied two-variable linear equation system (SPLDV) material, while the results of the questionnaire student responses for each aspect are presented in Table 10 as follows.

Table 10 Questionnaire Results of Student Responses to the 4 Aspects Asked about Experimental Class (VIII B)

Aspect	Percentage (%)	Criteria
Interest in participating in learning with a problem based learning model	73.79	Good
Student motivation in learning	77.59	Good
Student activeness in learning	93.10	Very Good
Understanding of the material being taught	82.76	Very Good

CONCLUSION AND SUGGESTION

Based on the results of research data processing, in general it can be concluded that the application of the problem-based learning model can improve students' critical thinking skills in the matter of the two-variable linear equation system (SPLDV) for class VIII students of SMP Negeri 10 Singkawang.

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