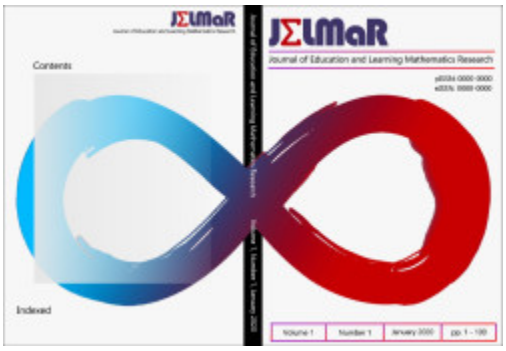

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Implications of Problem Based Learning Model on Students' Critical Thinking Ability in Arithmetic Sequence

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***Abstract**: Effective education requires an approach that encourages ability to analyze critically, particularly when learning mathematics which is often considered challenging by students. Problem Based Learning model is considered capable of developing students' critical thinking abilities through real problem solving and collaboration. The purpose of this study is to find out how the Problem Based Learning approach affected the critical thinking abilities of Grade X students at SMAN 1 Driyorejo in the subject of arithmetic sequences throughout the 2024–2025 school year. The research employs an appropriate experimental design, namely the pretest-posttest control group design, and takes a quantitative approach.. The sample includes two classes: class X-6 as the experimental group implementing the Problem Based Leaning model, and class X-7 as the control group applying conventional teaching methods. Critical thinking assessments were used to gather data both before and after the intervention. To ascertain whether there was a significant difference between the two groups, the data were examined using a t-test. The findings indicated that the average pretest scores for the control and experimental classes were 31,91 and 58,71, respectively, while the average posttest scores were 46,48 and 90,05. Before testing the hypothesis, students' critical thinking test scores must be checked for normality and homogeneity to ensure the data is normally distributed and has the same variance. The data analysis's findings demonstrate the worth of $t_{count} > t_{table}$, result is $|-19{,}826 > -1{,}995|$ for pretest questions and the value of $t_{count} > t_{table}$, result is $|-48{,}278 > -1{,}995|$ for posttest questions. Thus, when compared to conventional teaching approaches, the data analysis results demonstrate that the Problem Based Learning model significantly improves students' critical thinking abilities.*
Keyword: Problem Based Learning, Critical Thinking Abilities, Arithmetic Sequence

INTRODUCTION

Critical thinking abilities in mathematics are very important to enhance students' understanding of the subject matter thoroughly and solve problems with proper reasoning. Critical thinking skills are abilities that are able to overcome a problem, communication, collaboration, innovation, creativity, and life skills that have been recognized as educational goals in various countries (Elis, 2022). Critical thinking skills have many benefits that can be applied to students. One of the benefits of critical thinking is to develop concept understanding and improve critical thinking abilities aimed at finding solutions various math problems (Susanti, 2025). Based on observations during PLP activities at SMAN 1 Driyorejo, it was found that there are still many students who have difficulty using logic and systematic thinking, which reflects low mathematical critical thinking abilities.

This is according to the outcomes of research (Syamratulagi et al., 2025) that the development of pupils' critical thinking abilities is still far from even lower than expected. Improving this skill is urgent because critical thinking in mathematics supports the formation of analytical thinking needed in everyday life. Research results by (Runtu et al., 2025), also found that students still have difficulty in critical thinking. Referring to the outcomes of Research on Improvement of System Education (RISE) in the article (Ratnawati et al., 2020) stated that when it comes to solving mathematical problems, where students' problem-solving abilities are still less applicable, Indonesia now has inadequate critical thinking capabilities. Learning mathematics with direct learning methods without the use of learning media with the teacher being the center of all classroom activities is another factor that causes students' critical thinking skills to be low (Zetriuslita & Putri, 2025).

A number of factors, including the methods, tactics, and learning models employed, can be used to assess efforts to enhance critical thinking abilities. Innovation in the development of this skill can be achieved through Problem Based Learning techniques, including Problem Based Learning, which promotes autonomous, critical, and reflective thought in students. The goal of Problem Based Learning is to develop critical thinking abilities in pupils by using real-world issues and emphasizing teamwork. Motivating students to participate in problem solving exercises is the aim of the Problem Based Learning methodology. Through this situation, students have the opportunity to directly apply the knowledge learned in their respective fields of study by identifying relevant problems (Andini et al., 2024; Qondias et al., 2022).

Several studies have shown that the Problem Based Learning approach can impact pupils' capacity for critical thought. This is due to the fact that, unlike children who are taught using the conventional direct learning technique, students educated using the Problem Based Learning model have a distinct grade of critical thinking capacity. When compared to pupils who were not taught utilizing the Problem Based Learning approach, the model has a bigger impact. Using the Problem Based Learning technique, students can also create or alter mathematical models to address mathematical problems (Irawati & Mahmudah, 2024; Purba et al., 2022; Shylvia et al., 2025).

Numerous studies have used the Problem Based Learning paradigm to improve critical thinking abilities of students with arithmetic sequence subject. However, the majority of these studies are still restricted to high school and solely concentrate on material mastery. Thus, this study looks at how students in class X SMAN 1 Driyorejo who are studying arithmetic sequences have their critical thinking skills impacted by the Problem Based Learning paradigm. It is anticipated that using the Problem Based Learning approach will enhance students' critical thinking skills abilities will improve in light of the issues that have been explained. Additionally, problem-based learning can make learning more efficient and engaging. Therefore, the researcher took the research title, namely "Implications of Problem Based Learning Model on Students' Critical Thinking Ability in Arithmetic Sequence".

METHOD

This research apply both a true experimental approach and a quantitative methodology. The pretest-posttest control group research design used is displayed in Table 1 below.

Table 1. Design of Research

Sample	Pretest	Treatment	Posttest
Experiment ($\boldsymbol{R_1}$)	Y_1	X_1	P_1
Control ($\boldsymbol{R_2}$)	Y_2	X_2	P_2

Description:

$\boldsymbol{R_1}$: Experimental class
$\boldsymbol{R_2}$: Control class
$\boldsymbol{Y_1}$: Results of the experimental class pretest
$\boldsymbol{Y_2}$: Results of the control class pretest
$\boldsymbol{X_1}$: Problem Based Learning model
$\boldsymbol{X_2}$: Conventional learning model
$\boldsymbol{P_1}$: Results experimental class posttest
$\boldsymbol{P_2}$: Results control class posttest

All class X pupils of SMAN 1 Driyorejo during the 2024–2025 school year made up the study's population. Because the population's characteristics were uniform, the sample was chosen using simple random sampling. Two classes X were included in the study's

sample: class X-6, which used a problem-based learning model as an experimental group, and class X-7, which used a traditional learning model as a control group.

The independent and dependent variables are the variables used in this research. In the specialty of the research described, "Problem Based Learning Model" is set as the independent variable (X) because it is considered as a factor that affects or causes changes in students' critical thinking abilities. Meanwhile, "critical thinking ability" is determined as the dependent variable (Y) because it is an aspect that is influenced or becomes the result of the Problem Based Learning learning model's implementation.

In order to gather data for this study, tests were used a pretest and a posttest were used to evaluate learning outcomes. The test included five open-ended essay questions and was validated by two expert lecturers. Data analysis involved the Chi-Square test for normality, the F-test for variance homogeneity, and the t-test to evaluate the research hypothesis.

RESULT AND DISCUSSION

This study used arithmetic sequence material from SMAN 1 Driyorejo and used the pretest and posttest findings from two groups: class X-7, which is the control group, and class X-6, which is the experimental group. The following is the data analysis for the two courses.

Table 2. Pretest Data Analysis for

Description Statistics	Experiment	Control
Quantity of Pupils	36	36
Mean	46,48	31,91
Max. Score	72	50
Min. Score	32	15

Experimental Group and Control Group

Table 3. Posttest Data Analysis for Experimental Group and Control Group

Description Statistics	Experiment	Control
Quantity of Pupils	36	36
Mean	90,05	58,71
Max. Score	100	80
Min. Score	78	39

Based on the research results, students in the experimental and control classes had average pretest scores of 58,71 and 31,91 respectively, while the control class's average posttest scores were and experimental class were 46,48 and 90,05. From these average outcomes as can be shown, the experimental class outperformed the control class in terms of scoring. The normality test results of the control class obtained pretest value $X^2{}_{count} = 6{,}8768$ and $X^2{}_{table} = 11{,}0705$, then $X^2{}_{count} < X^2{}_{table}$ so that the data is normally distributed and the posttest value $X^2{}_{count} = 0{,}1209$ and $X^2{}_{table} = 11{,}0705$, then $X^2{}_{count} < X^2{}_{table}$ in order for the data is normally distributed. While from the experimental class obtained pretest value $X^2{}_{count} = 4{,}3803$ and $X^2{}_{table} = 11{,}0705$, then $X^2{}_{count} < X^2{}_{table}$ in order for the data is normally distributed and the posttest value $X^2{}_{count} = 8{,}022$ and $X^2{}_{table} = 11{,}0705$, then $X^2{}_{count} < X^2{}_{table}$ so the data is normally distributed.

The outcomes of the pretest scores' homogeneity test between the experimental and control classes obtained $F_{hitung} = 1{,}1567$ and $F_{tabel} = 1{,}77207$, then $F_{hitung} < F_{tabel}$ so that H_0 is accepted (homogeneous variance). While the posttest value of the control class and experimental class obtained $F_{hitung} = 1{,}3868$ and $F_{tabel} = 1{,}7175$, then $F_{hitung} < F_{tabel}$ so that H_0 is accepted (homogeneous variance). The pretest and posttest results for the control

and experimental classes were homogeneous and regularly distributed, according to the results of the normality and homogeneity tests. Furthermore, the t-test was obtained on the pretest value of $t_{hitung} = -19{,}826$ and the value of $t_{tabel} = 1{,}995$. Because $|-19{,}826 > -1{,}995|$ then the conclusion is that the experimental class's average pretest score differs from the control class's. While on the posttest value $t_{hitung} = -48{,}278$ and $t_{tabel} = 1{,}995$. Because $|-48{,}278 > -1{,}995|$ then the conclusion is that the experimental class's average posttest score differs from that of the control class.

The scores of the experimental class and the control class differed, according to the t-test results of the pretest and posttest outcomes. Where the experimental class using the Problem Based Learning learning model outperforms the control class using the traditional learning model in terms of average learning results. Thus, researchers may conclude that students' critical thinking skills are positively impacted by the Problem Based Learning approach.

CONCLUSION

According to the experimental group's (which employed the idea of Problem Based Learning) average learning results for students, which were statistically superior to those of the control group (which used conventional learning model). The result of the hypothesis testing and data analysis, show that the t_{count} value is higher than the t_{table} value result is $|-19{,}826 > -1{,}995|$ for the pretest question and the t_{count} value is higher than the t_{table} value results is $|-48{,}278 > -1{,}995|$ for the posttest question. Thus, H_0 is denied H_1 is approved. Thus, it can be stated that implementing of the Problem Based Learning paradigm particularly affects students' capacity to critically evaluate the content utilized to teach arithmetic sequences.

Through the process of locating and investigating ideas linked to the given challenge, this might give students the chance to actively expand their own knowledge. Teachers must also embrace a more innovative teaching approach and provide students with opportunities to actively engage in the process of learning through a variety of exercises. Such as investigation, problem solving, and exploration of other teaching materials, in order to assist students in developing a more thorough comprehension of the ideas presented. For academics wishing to investigate how students' critical thinking abilities are impacted by the Problem Based Learning approach, this study is anticipated to be a valuable resource.

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