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The Effect of Problem Based Learning Assisted by Padlet on Students Collaboration and Critical Thinking Skills

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Abstract:

This research is motivated by the finding that indicate a low collaboration and critical thinking skills of students, allegedly caused by students tendency to be passive and only receive instructions during learning, the learning models used such as simple discussions with LKPD and presentation media that are less supportive do not provide optimal learning experiences. This research was conducted in Class X TJKT using a quasi-experimental design. Data were collected through observation sheets and tests. The analysis of the research data employed an independent sample t-test. The results of the collaboration ability assessment revealed a thiut value of 19.507 with a significance level (Sig. 2-tailed) of 0.000, indicating that the t-count value was greater than the t-table value of 1.667. Similarly, the analysis of students' critical thinking ability yielded a t_{count} value of 6.025 with a significance level (Sig. 2-tailed) of 0.000, confirming that the t_{count} value exceeded the t_{table} value of 1.667. Therefore, it can be concluded that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. The Problem-Based Learning model, assisted by Padlet, has a significant effect on students collaboration and critical thinking skills.

Keywords: Problem Based Learning; Padlet; Collaboration Skills;Critical thinking

1. Introduction

21st century learning is based on the principle of combining science, individual skills, technology and research. Efforts to achieve this paradigm emphasize students as the focal point of the learning process, so that education is not just a means of delivering information, but also as a platform for developing individuals who can adapt to and contribute meaningfully within a technology-driven society. Two skills that are indispensable today are collaboration and critical thinking [1].

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Collaboration skills are essential social competencies for students, facilitating an effective learning process by enhancing interaction, sharing ideas, and critical thinking. The development of critical thinking skills is imperative, because students can understand ideas easily, are sensitive to problems so they can understand and solve problems, and can apply ideas in various situations [2]. Teachers play an important role in facilitating the development of these skills through activities that encourage interaction, peer feedback, problem solving through discussion, and collaboration in groups. Meanwhile, critical thinking skills are an important element in learning that can be learned and developed. Critical thinking skills help students solve various problems, particularly in the professional realm [3], [4]. However, to improve collaboration and critical thinking skills, various obstacles often arise, such as learning models that are still teacher-centered and lack active student participation, endering them inadequate to meet contemporary learning needs.

Based on unstructured interviews conducted by researchers with teachers of Vocational Fundamentals of Computer Network Engineering and telecommunications, several problems were found that were thought to be the cause of students' low collaboration and critical thinking skills, among others, students tend to be passive and only receive instructions during learning, learning models used such as simple discussions with LKPD and presentation media that are less supportive do not provide optimal learning experiences. This model limits passive mastery of material and does not provide enough space for students to discuss, criticize information, and develop ideas collaboratively. The DDK subject itself is a core vocational subject that plays a role in developing students' abilities in the field of Computer Network Engineering and Telecommunications, while also strengthening their logical reasoning abilities and understanding of technology [5].

The previously described issues indicate that the learning models employed by teachers, such as Project Based Learning, Discovery Learning and Problem Based Learning have not been implemented optimally, both in terms of planning, implementation and evaluation. The use of learning media that has not adjusted to technological developments, this makes learning boring and less able to stimulate students to critical thinking because they are accustomed to receiving material passively. Some learning models that are known to encourage the development of collaboration and critical thinking skills include Project Based Learning, Discovery Learning, and Problem Based Learning. All three have a student-centered approach, they exhibit fundamental differences in terms of focus, stages, and methods of knowledge construction.

The Project Based Learning model utilizes project media within a certain time, so this model is more supportive to stimulate students' creativity and critical thinking. Meanwhile, the discovery learning model in its implementation can

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foster curiosity and independence, but in its implementation it still tends to be individualistic. Collaboration between students is not the main focus, which limits its effectiveness in training cooperation and facilitating in-depth group discussions [6], [7].

Based on the analysis of several learning models, the Problem Based Learning model is considered the most appropriate to overcome these problems. The Problem Based Learning model applies collaborative and contextual learning. This model encourages students to be active, think critically, and work together in finding and processing information to find solutions to the problems they face. Through involvement in problem solving, students are trained in critical thinking and finding solutions together, thus helping students to improve their collaboration and critical thinking skills. In the application of the Problem Based Learning model learning process, learning media is needed to enrich the learning experience and improve students collaboration and critical thinking skills. Proper utilization of digital media and appropriate implementation strategies have proven to be effective in learning. This media helps students obtain information in a varied and enjoyable way, and supports efficient and adaptive teaching. Therefore, choosing the right digital media is key to the success of 21st century education [8], [9].

Padlet is a flexible and innovative digital media to support learning. The use of Padlet encourages students to actively participate in discussions, share ideas and provide immediate feedback, especially improving critical thinking skills. In addition, Padlet's features support collaboration between group members, helping students appreciate their friends contributions, hone communication and improve collaboration skills relevant to today's learning [10].

Based on these considerations, the Problem Based Learning model assisted by Padlet is the answer to this problem. Previous research by Dita and Fitriana (2024) on "Problem Based Learning learning model assisted by Padlet multimedia on critical thinking skills of vocational students" showed that the application of this model had a significant effect on students' critical thinking skills[1]. The school has adopted the Problem Based Learning model, but the implementation is still not optimal. Therefore, this study seeks to apply a Problem Based Learning-based learning model assisted by Padlet to improve students' collaboration and critical thinking skills in the subject of Vocational Fundamentals of Computer Network Engineering and Telecommunications. Researchers hope that the Problem Based Learning model assisted by Padlet can improve students collaboration and critical thinking skills.

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2. Material and methods

2.1 Research Design

This research employs the Quasi Experimental Design method, which is a type of experimental research that involves a control group however,it is not fully capable off controlling external variables that might affect the course of the experiment [11]. This study used a Nonequivalent Control Group Design. This design is similar to the pretest-posttest control group design. The difference lies in that the selection of experimental and control groups is not randomized.

Table 1. Rancangan Penelitian

Kelas	Pretest	Perlakuan	Posttest
Eksperimen	O_1	X	O_2
Kontrol	O_3	-	O_4

This study involved two selected groups, namely the experimental group and the control group. The experimental class group received treatment using the Problem Based Learning model assisted by Padlet, while the control group was Problem Based Learning.

2.2 Population and Sampling Technique

Population refers to the entire set of object or subject that is the target in a study, which the researcher chooses to analyze and serve as the basis for drawing conclusions [11]. The population in this study consisted of students from the X TJKT class at SMK Negeri 3 Padang,comprising 36 students from X TJKT 1 and 35 students from X TJKT 2. This study uses the Total Sampling technique, which involves using the entire population as a sample due to it's relatively small size. The study included two classes as samples, one served as the experimental group and the other as the control group.

2.3 Data Collection Instruments and Procedures

The research instruments use in this study include observation sheets to assess collaboration skills and tests in the form of essay questions designed to measure students critical thinking levels. These tests are administered to students as a basis for evaluating the extent to which the subject matter has been mastered [12]. Meanwhile, the observation sheet was used to assess the level of students collaboration skills during the application of the Problem Based Learning model assisted by Padlet. In addition, documentation was used to complete information related to the implementation of research at SMK Negeri 3 Padang.

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2.4 Instrument Testing

The instrument trials in this study assesed students collaboration and critical thinking skills. The observation sheet instrument was validated by two expert lecturers and the result indicated a "very valid" rating based on the Guttman scale. Meanwhile, the test instrument was tested for validity using Pearson correlation technique on 35 respondents outside the research sample, resulting in 10 items being declared valid ($r_{count} > r_{table} = 0.334$). The reliability test using the Cronbach's Alpha formula resulted in a value of 0.946 which indicates that the instrument has a very high level of reliability. In addition, the analysis difficulty level revealed that 3 questions were classified as easy, 4 as medium, and 3 as difficult. Furthermore, the differential analysis indicated that 6 questions were categorized as good and 4 questions as sufficient. These findings indicate that the instrument used in the study is suitable for assessing students collaboration and critical thinking skills.

2.5 Data Analysis techniques

The data analysis technique in this study was carried out statistically by utilizing IBM SPSS software version 16. The analysis began by describing the results of students collaboration skills and data on the scores of pretest and posttest results conducted by students. Then descriptive analysis was carried out to provide a clearer and more structured explanation of the data studied [13]. The data obtained were then analyzed using the Shapiro-Wilk method normality test which is known to be more sensitive for small to medium sample sizes. Furthermore, a homogeneity test was conducted to determine the similarity of variance between the two sample groups [14]. After that, hypothesis testing was carried out using the independent sample t-test in order to measure the mean difference between two different and unrelated sample groups.

3. Results and discussion

This research was conducted in the even semester of the 2024/2025 academic year at SMK Negeri 3 Padang. The research sample consists of two classes, namely class X TJKT 1 as an experimental class that applies the Problem Based Learning model assisted by Padlet and class X TJKT 2 as a control class that applies the Problem Based Learning model.

3.1 Collaboration Ability Test Results

Testing of students collaboration skills begins with prerequisite tests in the form of normality and homogeneity tests. These two tests are essential to ensure that the data meets the assumptions of parametric statistics before proceeding to the analysis using the independent sample t-test. The normality test uses the Shapiro-Wilk test with a significance level (α) = 5% or 0.05.

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Table 2. Normality Test of Collaboration Ability

No	Class	Nilai Signifikansi
1	Experiment	0,293
2	Control	0,473

Based on table 2, the normality test shows that the test results in the experimental class have a significance of 0.293 and the test results in the control class have a significance value of 0.473. The normality test carried out has a significance value> 0.05 so it can be concluded that the data is normally distributed. Then the homogeneity test of the two sample classes was carried out.

Table 3. Homogeneity of Collaboration Capabilities

Variabel	Based on Mean	Significance Value	Description
Learning Outcomes	0,316	0,05	Homogeneous

Table 3 of the homogeneity test of collaboration ability shows a significance value based on the mean of 0.316. Because the significance value is greater than the significance level of 0.05 (0.316> 0.05). Thus, the homogeneity assumption is met and the independent sample t-test can be continued.

Table 4. Collaboration Ability Hypothesis Test Results

Independent Samples Test		
t	**df**	**Sig. (2-tailed)**
19,507	69	0,0000

Based on the results of the Idenpendent Sample t-test above, the t_{count} value is 19.507 with a degree of freedom (df) of 69 and a significance value (Sig.2-tailed) of 0.000. To determine the t_{table} value, a t distribution table is used with a significance level (α) of 0.05 and degrees of freedom (df) = $n_1 + n_2 - 2$, namely 36 + 35 - 2 = 69, so that the t_{table} value is obtained (1.667). The value of t_{count} (19.507) is greater than t_{table}, so it is concluded that H0 is rejected and Ha is accepted.

3.2 Critical Thinking Ability Test Results

Testing of critical thinking skills commences with a descriptive analysis to provide a clearer and more structured explanation of the data under study, thereby facilitating a better understanding of the information contained therein [13].

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Table 5. Mean, Median, Mode and Standard Deviation of Experimental Class

Test Type	Mean	Median	Modus	Standard Deviation
Pretest	50,6	50	45	5,87
Posttest	84,14	85,5	70	9,45

Based on table 5, it is known that the pretest learning outcomes of class X TJKT 1 students in the experimental group have an average value of 50.6, with a median value of 50 and a mode of 45. The standard deviation value for pretest results is 5.87. Meanwhile, the final learning outcomes (posttest) showed an increase, with an average of 84.14, a median of 85.5, and a mode of 70. The posttest standard deviation value of 9.45 indicates that the distribution of values after treatment tends to be more concentrated than during the pretest. This indicates an increase in the homogeneity of student learning outcomes after following the learning process in the experimental group by 66.28% after being treated through the Problem Based Learning learning model assisted by Padlet.

Table 6. Mean, Median, Mode and Standard Deviation of Control Class

Test Type	Mean	Median	Modus	Standard Deviation
Pretest	45,44	45	45	6,55
Posttest	71,91	72,5	67	9,51

Based on table 6, it is known that the pretest learning outcomes of class X TJKT 2 students in the control group have an average value of 45.44, with a median value of 45 and a mode of 45. The standard deviation value for pretest results is 6.55. The final learning outcomes (posttest) show an increase, with an average of 72, a median of 72.5, and a mode of 67. The posttest standard deviation value is 9.51. Then after calculating the percentage increase in student learning outcomes, there was an increase in the control class of 58.25%. Furthermore, the normality test of the pretest and posttest data of the two samples was carried out using the Shapiro-Wilk test. The normality test results are in table 7.

Table 7. Normality Test of Critical Thinking Ability

No	Class	Learning Outcomes	Significance Value
1	Experiment	Pretest	0,144
		Posttest	0,074
2	Control	Pretest	0,903
		Posttest	0,127

The test results in table 7 show that the results in the experimental class have a significance of 0.144 on the pretest and 0.074 on the posttest. Meanwhile, the control class has a significance value of 0.903 for the pretest and 0.127 for the posttest. Meanwhile, the control class has a significance value of 0.903 for the pretest and 0.127 for the posttest. Because the significance value> 0.05, it can be concluded that the data on the results of critical thinking skills in experimental and control classes are normally distributed and can be tested for homogeneity.

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Table 8. Homogeneity Test of Critical Thinking Ability

Variable	Based on Mean	Significance Value	Description
Hasil Belajar	0,629	0,05	Homogeneous

Based on table 8, a significance value of 0.629 is obtained, because the significance value is greater than the significance level of 0.05 (0.629> 0.05), it can be concluded that the two sample classes are homogeneous and data analysis can be continued using the independent sample t-test. Hypothesis testing in this study was used to measure the effect of Problem Based Learning assisted by padlet on students critical thinking skills. The results of the hypothesis test are in table 9.

Table 9. Hypothesis Test of Critical Thinking Ability

Independent Samples Test		
t	**df**	**Sig. (2-tailed)**
6,025	69	0,0000

Based on the results of the Idenpendent Sample t-test in table 31, the tcount value is 6.025 with a degree of freedom (df) of 69 and a significance value (Sig.2-tailed) of 0.000. To determine the t_{table} value, the t distribution table is used with a significance level (α) of 0.05 and degrees of freedom (df) = $n_1 + n_2 - 2$, namely 36 + 35 - 2 = 69, so that the t_{table} value is obtained (1.667). The t_{count} value (6.025) is greater than the t_{table}, so it is concluded that H_0 is rejected and H_a is accepted.

3.3 Discussion

The results showed that there was an influence on students collaboration and critical thinking skills after applying the Problem Based Learning model assisted by Padlet. The results of the collaboration ability hypothesis test using the Independent Sample t-test showed a significance value (Sig.2-tailed) of 0.000 <0.05. In addition, the average difference of 24.33 shows that the collaboration ability of the experimental class is higher than students who follow learning in the control class. These results indicate that the application of the Problem Based Learning model assisted by padlet encourages the formation of stronger cooperation between students in solving problems together so as to improve students collaboration skills. This finding is in line with research conducted by Tahtihal (2023) which proves that the Problem Based Learning model has an effect on improving collaboration skills and student science literacy. This is supported by the results of hypothesis test analysis using Ancova, which shows a significance value (2-tailed) of 0.000 <0.05 [15].

Factors that influence this increase include the use of padlet media that provides more open collaboration space, as well as the Problem Based Learning model that requires active involvement of each group member. This result is in line with Mahendro's (2023) opinion that Padlet features support collaboration between group members, help students appreciate friends contributions, hone

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communication, and improve collaboration skills that are relevant to current learning [10].

Meanwhile, the test of students critical thinking ability also shows the results of the significance test (Sig.2-tailed) 0.000 <0.05, the average difference of 12.93 shows that the critical thinking ability of the experimental class is higher than students who follow learning in the control class. After learning with the Problem Based Learning model assisted by padlet was applied, the average posttest score of students in the experimental class increased to 84.14, this shows that students have met the predetermined KKTP. This increase in student learning outcomes indicates an increase in students critical thinking skills, especially in the ability to identify problems, analyze information, and compile arguments in DDK subjects.

The results of the control class analysis, it was found that the average pretest score was 45.17 and posttest 71.2, although there was an increase, the value still did not fully show an increase in developing students critical thinking skills because it did not meet the KKTP standards set by the school. This is also evidenced by the results of hypothesis testing which shows a significance value (Sig.2-tailed) of 0.000 <0.05. In addition, the average difference of 12.93 shows that the critical thinking ability of the experimental class is higher than students who take part in learning in the control class. This finding aligns with the research of Dita Rahmawati (2024) which shows that the Problem Based Learning model assisted by multimedia padlet affects students critical thinking skills, this is evidenced by the hypothesis test, gain test, and significance value (2-tailed) of 0.000 <0.05 [1].

Overall, these results reinforce the finding that the Problem Based Learning model assisted by padlets is able to improve students critical thinking because it puts them in real situations to solve problems, develop logical arguments, and think reflectively. This findinf aligns with the perspective of Dhitasarifa (2023) This model encourages students to be actively involved, think critically, and cooperate in digging up information to find solutions to the problems faced. By facing real problems, students are trained in critical thinking and finding solutions together, thus helping students to improve their collaboration and critical thinking skills [3].

4. Conclusion

This study aims to determine the effect of the application of the Problem Based Learning model assisted by padlet on the collaboration and critical thinking skills of students in class X TJKT SMK Negeri 3 Padang. The results showed that there was an effect of applying the Problem Based Learning model assisted by padlet on students collaboration and critical thinking skills. This finding is evidenced by an increase in collaboration skills observed during the learning

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process by observers and an increase in critical thinking skills assessed using tests in the form of essays.

The findings emphasize the importance of implementing learning models combined with digital media such as padlets in learning, to improve students' collaboration and critical thinking skills. The problem-based learning model encourages students to actively work together and solve problems, while padlet as a collaborative media helps strengthen students real-time interaction and engagement. This combination is proven to be effective in developing collaboration and critical thinking skills.

Nevertheless, this study has some limitations, especially in the scope of the material covered and the number of subjects involved. Therefore, future researchers are advised to conduct further research with a wider scope of material, involving more classes, or combining the Problem Based Learning model with other digital media to obtain more comprehensive results.

Author's declaration

Author contribution

Syintia was responsible for designing the research design, collecting data, and preparing the initial draft of the manuscript. **Mahesi Agni Zaus** contributed in refining the methodology, supervising the data analysis process, and critically reviewing the manuscript in terms of scientific substance. **Vera Irma Delianti** assisted in the interpretation of data and helped develop the literature review framework. **Rizkayeni Marta** provided support in statistical analysis and ensured the accuracy of the results presented. All authors have read and approved the final version of this manuscript.

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Competing interest

The authors declare that there are no competing interests or potential conflicts of interest related to the research, authorship, and publication of this article.

Ethical clearance

This study was carried out in accordance with applicable ethical standards for research involving human participants. Prior to data collection, all participants were informed about the objectives of the study and voluntarily provided their informed consent. The anonymity and confidentiality of all participant data were strictly protected throughout the research process.

AI statement

No generative artificial intelligence (AI) tools were used in the writing, data analysis, or interpretation of this study. All content, including the manuscript, statistical analysis, and conclusions, was produced solely by the authors through original and manual academic work.

Publisher's and Journal's note

Universitas Negeri Padang as the publisher and Editor of Jurnal Vokasi Informatika state that there is no conflict of interest towards this article publication.

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