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Problem Based Learning Assisted by the Padlet Application on Critical Thinking Abilities and Collaboration Skills

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ABSTRAK

Kemampuan berpikir kritis dan keterampilan kolaborasi penting dimiliki peserta didik untuk menghadapi tantangan di abad 21. Namun saat ini masih banyak siswa yang kurang memiliki Kemampuan berpikir kritis dan keterampilan kolaborasi sehingga berdampak pada tujuan pembelajaran yang tidak tercapai secara maksimal. Berdasarkan hal tersebut, penelitian ini bertujuan untuk menganalisis pembelajaran berbasis masalah berbantuan aplikasi Padlet terhadap Kemampuan Berpikir Kritis dan Keterampilan Kolaborasi. Penelitian ini yaitu adalah kuantitatif dengan jenis penelitian quasi eksperimen. Desain penelitian ini menggunakan non-equivalent control grup yang terdiri dari kelompok eksperimen dan kelompok kontrol. Sampel penelitian ini yaitu Kelas eksperimen terdiri dari 35 siswa dan kelas kontrol terdiri dari 35 siswa. Penelitian ini menggunakan teknik pengumpulan data meliputi tes dan observasi. Teknik analisis data yang digunakan adalah uji normalitas, uji homogenitas dan uji ANOVA. Hasil penelitian ini menunjukkan adanya pengaruh yang signifikan pembelajaran berbasis masalah berbantuan aplikasi padlet terhadap kemampuan berpikir kritis dan keterampilan kolaborasi. Disimpulkan bahwa pembelajaran berbasis masalah berbantuan aplikasi padlet dapat meningkatkan kemampuan berpikir kritis dan keterampilan kolaborasi pada siswa.

ABSTRACT

Critical thinking and collaboration skills are essential for students to face the challenges of the 21st century. However, currently, there are still many students who need more critical thinking abilities and collaboration skills, resulting in learning objectives not being achieved optimally. Based on this, this research aims to analyze problem-based learning assisted by the Padlet application on Critical Thinking Abilities and Collaboration Skills. This research is quantitative with a quasi-experimental type of research. This research design uses a non-equivalent control group consisting of experimental and control groups. The sample for this research is the experimental class of 35 students and the control class of 35 students. This research uses data collection techniques, including tests and observations. The data analysis techniques used are the normality test, homogeneity test, and ANOVA test. The results of this research show problem-based learning, assisted by the Padlet application, has a significant influence on critical thinking abilities and collaboration skills. It was concluded that problem-based learning assisted by the Padlet application can improve students' critical thinking abilities and collaboration skills.

1. INTRODUCTION

Critical thinking is an important ability that can be developed in the 21st century. Critical thinking is a person's capacity to think carefully and use advanced cognitive skills (Essalih et al., 2023; Sullivan et al., 2024). Critical thinking is one of the main goals in learning, and it is hoped that it can become the basis for 21st-century workers and world citizens to make meaningful contributions to society (Butcher et al., 2023; Lina & Desnita, 2022; Yamin et al., 2020). Critical thinking involves the application of reasoned reasoning, logic, and judgment in various circumstances (Changwong et al., 2018; Sullivan et al., 2024). Students can approach various problems they may face. When they can conduct research, analyze data, and use it to support or oppose statements and opinions, they are expected to have developed critical thinking skills. Therefore, the tendency to be fair and open-minded, separate facts from prejudice or bias, and accept

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different points of view is called the critical thinking disposition (Pramestika et al., 2020; Tapung et al., 2018).

Apart from critical thinking skills, collaboration skills are also crucial for students to have and develop before entering the world of work. The collaboration skills possessed by students can achieve meaningful results when involved in real life (Andersen & Rustad, 2022; Mantau & Talango, 2023). These conditions enable students to interact competently with others, especially across cultures, in diverse and multinational workplaces and communities in the global and digital era. Collaboration is essential for learning, working, and living in the 21st century (Kembara et al., 2018; Maulana et al., 2022). In an educational context, collaboration occurs when students work together to achieve a common goal in a shared learning environment. Social interaction when collaborating, namely discussing, justifying arguments, and negotiating with others, can help increase individual understanding (Mitra & Purnawarman, 2019; Putra & Sujana, 2020). Learners process information differently when they work in groups compared to when they work independently. However, solutions to enable students to collaborate when working on specific subjects still need to be improved (Andersen & Rustad, 2022; Mantau & Talango, 2023).

However, students in developing countries, including Indonesia, still have low critical thinking skills (Nurnaningsih et al., 2023; Risnawati et al., 2016). Learning in several schools, especially biology subjects in Indonesia, shows that students memorize facts and concepts more than they analyze information critically. Sometimes, students apply a concept to various real-world situations. Students are extrinsically motivated to get good grades and receive awards. Critical thinking teaching and assessment approaches should be addressed in biology learning in schools (Agnafia, 2019; Saparuddin et al., 2021; Sullivan et al., 2024). Biology learning in the 21st century emphasizes producing scientifically literate students, mastering biological knowledge, and developing critical thinking. However, biology learning only focuses on academic achievement in the Indonesian biology curriculum.

This problem was also found at MAN 1 Palu City. Based on interviews with class X biology teachers conducted at MAN 1 Palu City, information was obtained that students' collaborative and critical thinking skills still need to be improved. Group assignments and discussions can demonstrate this; they do not communicate or exchange opinions, cannot solve problems, and do not seek evidence for their answers. Additionally, students still need help explaining why they used their chosen answers. Students' collaboration skills at MAN 1 Palu City still need to be improved because, during discussion activities, students need to be more focused when interacting with their group friends. Students prefer to depend on their group friends when completing work given by the teacher, so their sense of responsibility needs to be increased. From the results of interviews with MAN 1 Biology teachers in Palu City, the problem with group learning is that many students must be more active in group activities. In a group of 5-6 people, only 2-3 members are actively involved in group activities, while the other students hang around and wait for answers from their friends.

The solution offered is to implement an appropriate learning model so that collaboration skills can be developed and students can achieve learning outcomes by responding and being involved through teamwork. In addition, if the learning goal is to support the development of practical critical thinking skills in science education, it is essential to apply learning models to train critical thinking skills (Butcher et al., 2023; Song & Elftman, 2024). One innovative learning model to overcome these problems is the application of problem-based learning (PBL). Problem-based learning is a learning model that allows students to learn concepts and skills by solving problems in the real world rather than just providing theories and facts explained by the teacher (Anjelina Putri et al., 2018; Putri & Prihatnani, 2020). Problem-based learning allows students to become active learners, helping students think critically when solving problems (Hallinger, 2021; Major & Mulvihill, 2018). The problem-based learning model can present authentic and meaningful problems so students can investigate and discover for themselves. The problem-based learning model is one of the learning strategies used by teachers in the process of learning activities by using problems as a step to gather knowledge so that it can stimulate students to think critically and learn individually or in small groups until they find a solution to the problem (Argaw et al., 2017; Saad & Zainudin, 2022). The teacher's role in the problem-learning model is as a facilitator who supports learning activities.

Previous research findings also reveal that PBL effectively improves students' critical thinking abilities (Kurniahtunnisa et al., 2019; Liu, 2022). Other research also states that the PBL model can increase student enthusiasm and learning outcomes (Aufa et al., 2021; Cicilia et al., 2022; Syafira, 2022). The advantage of the PBL model is that it is a problem-based learning model in that the learning process begins by giving students apparent problems rooted in real-world life. Then, students must collect data and information, conduct experiments, and draw conclusions in groups to play a very active role. As a facilitator in learning activities, the teacher observes students' questioning skills. There has yet to be a study regarding problem-based learning assisted by the Padlet application on Critical Thinking Abilities and Collaboration

Skills. Based on this, this research aims to analyze problem-based learning assisted by the Padlet application on Critical Thinking Abilities and Collaboration Skills.

2. METHODS

This quantitative research is a quasi-experimental type with a non-equivalent control design. Quantitative research is systematic scientific research into parts and phenomena and the causality of their relationships (Sugiyono, 2018). Quantitative research aims to develop and use models, theories, and hypotheses related to a phenomenon. Quantitative research with a quasi-experimental type is also used to research various aspects of education. Quasi-experimental research compares groups with different conditions or treatments to find cause-and-effect relationships (Sugiyono, 2018). A non-equivalent group design is a between-subjects design in which participants are not randomly assigned to a condition (Sugiyono, 2018). This research analyzes problem-based learning assisted by the Padlet application on Critical Thinking Abilities and Collaboration Skills. The research sample comprised 70 students from two classes and was obtained using saturated sampling techniques. Data collection methods use observation and tests. The observation guide functions to obtain data on collaboration skills. Meanwhile, tests are used to analyze student work results, starting from the pretest and posttest. The research instrument used was a critical thinking skills essay test with ten questions and a collaboration skills observation sheet, which was then analyzed using the ANOVA test with the help of SPSS version 26. The instrument grid is presented in Table 1.

Table 1. Student Collaboration Skills Research Questionnaire Grid

No.	Aspect	Indicator	Percentage of Collaborative Skills				Detail
			4	3	2	1	
1	Involvement Between Group Members	Focus on the Task Mutual Help Responsibility and Reliability Team Leader Performance					
2	Team Work Engagement	Accuracy Communication Evaluation					
3	Social Relationship Involvement	Honor Modesty Altruism Tolerance Social Sensitivity					

The data analysis technique used in this research is descriptive analysis which is calculated by comparing the average value of each variable. Analysis prerequisite tests use data normality and homogeneity tests, while hypothesis testing is carried out after the prerequisite tests are met. The hypothesis test used is the ANOVA test.

3. RESULT AND DISCUSSION

Result

First, critical thinking. The pretest and posttest measured critical thinking abilities in the experimental and control classes. The data will then be calculated as the average of the pretest and posttest for each class, both the experimental and control classes. Next, the data was subjected to prerequisite tests, namely the normality test and homogeneity test, using SPSS version 26. The normality test was used to determine whether the critical thinking ability data had a normal distribution. This statistical test uses the Kolmogorov Smirnov test using SPSS version 26 with a significance level (α) = 5%. So the decision-making guideline is if the Sig. > 0.05, then the data is usually distributed, and if the Sig. < 0.05, then the data is not normally distributed. Normality Test Results can be seen in Table 2.

Table 2. Normality Test Results Control and Experimental Classes

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Eksperimen	0.088	23	0.200*	0.974	23	0.789
Post Test Eksperimen	0.163	23	0.117	0.922	23	0.072
Pre Test Kontrol	0.157	21	0.192	0.943	21	0.251
Post Test Kontrol	0.147	21	0.200*	0.956	21	0.448

Based on the output table of normality test results for the experimental class, the Sig value is known in the Kolmogorov Smirnov test section. for the pretest value of 0.200 and the Sig. for the posttest value of 0.117. Both Sig values. is more significant than 0.05, the pretest and posttest data for the experimental class are normally distributed. Meanwhile, the output of the normality test results for the control class in the Kolmogorov Smirnov test section shows the Sig value. for the pretest value of 0.192 and the Sig. for the posttest value of 0.200. Both Sig values. is more significant than 0.05, the pretest and posttest data for the experimental class are normally distributed. The following prerequisite test is the homogeneity test. The homogeneity test determines whether the data on critical thinking ability are identical before and after the test. The homogeneity test in this study used SPSS version 26 with a significance level (α) = 5%. The decision-making guideline is if the Sig value. (based on mean) > 0.05, then the distribution is homogeneous, whereas if the Sig. (based on mean) < 0.05, then the distribution is not homogeneous. Homogeneity Test Results can be seen in Table 3.

Table 3. Results of Homogeneity Test for Experimental Class and Control Class

		Levene Statistic	df1	df2	Sig.
Critical Thinking Ability Score	Based on Mean	1.667	3	84	0.180
	Based on Median	1.544	3	84	0.209
	Based on Median and with Adjusted df	1.544	3	72.659	0.210
	Based on Trimmed Mean	1.661	3	84	0.182

Based on the output table of homogeneity test results for the experimental class and control class posttest results, it can be seen in the Sig column. based on the mean, shows a score of 0.180. Sig value. is more significant than 0.05. Based on these results, the experimental and control classes' posttest data are homogeneous. After all pretest and posttest data for both the experimental and control classes meet the normal and homogeneous distribution requirements, they will continue with hypothesis testing, namely the ANOVA test using SPSS version 26. The ANOVA test in this study was carried out using a significance level (α) = 5%. The hypothesis in this research is H0: There is no influence of the problem-based learning model assisted by the Padlet application on students' critical thinking abilities, while for H1: There is an influence of the problem-based learning model assisted by the Padlet application on students' critical thinking abilities. So, the decision-making guideline is if H0 is accepted if Sig > α, and H0 is rejected if Sig < α. The results of the ANOVA test for the experimental class and control class are in Table 4.

Table 4. ANOVA Test Results for Experimental Class and Control Class

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32185.736	7	4597.962	36.596	0.000
Within Groups	21358.786	170	125.640		
Total	**53544.522**	**177**			

Based on Table 4, the output of the ANOVA test, namely for the pretest and posttest for the experimental class, obtained a Sig value. of 0.000. Sig value. is smaller than 0.05 so that H0 is rejected and H1 is accepted, it can show that there is an influence of the Problem-Based Learning model assisted by the Padlet application on students' critical thinking abilities. Second, Collaboration Skill. Collaboration skills were measured in the experimental and control classes using observation sheets. The data will then be calculated as the average for each class, both the experimental class and the control class. Next, the data was subjected to prerequisite tests, namely the normality test and homogeneity test, using SPSS version 26. The normality test was used to determine whether the collaboration skills data had a normal distribution. This statistical test uses the Kolmogorov Smirnov test using SPSS version 26 with a significance level (α) = 5%. So the decision-making guideline is if the Sig. > 0.05, then the data is normally distributed, and if the Sig. < 0.05, then the data is not normally distributed. Normality Test Results can be seen in Table 5.

Tabel 5. Normality Test Results Control and Experimental Classes

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Preliminary Experimental Observations	0.132	23	0.200*	0.929	23	0.106
End of Experiment Observations	0.168	23	0.092	0.939	23	0.174
Initial Control Observations	0.165	21	0.141	0.963	21	0.568
Final Observation of Control	0.174	21	0.098	0.951	21	0.350

Based on the output table of normality test results for the experimental class, the Sig value is known in the Kolmogorov Smirnov test section. for the initial observation value of 0.200 and the Sig. for the final value of 0.92. Both Sig values. is greater than 0.05, it can be concluded that the experimental class's initial and final observation data are normally distributed. Meanwhile, the output of the normality test results for the control class in the Kolmogorov Smirnov test section shows the Sig value. for the initial observation value of 0.141 and the Sig. for the final observation value of 0.98. Both Sig values. is greater than 0.05, so the pretest and posttest data for the experimental class are normally distributed. The following prerequisite test is the homogeneity test. The homogeneity test is used to determine whether or not the collaboration skills data before and after observation are the same. The homogeneity test in this study used SPSS version 26 with a significance level (α) = 5%. The decision-making guideline is if the Sig value. (based on mean) > 0.05, then the distribution is homogeneous, whereas if the Sig. (based on mean) < 0.05, then the distribution is not homogeneous. Homogeneity Test Results in Table 6.

Table 6. Results of Homogeneity Test for Experimental Class and Control Class

		Levene Statistic	df1	df2	Sig.
Collaboration Skills Score	Based on Mean	1.342	7	170	.233
	Based on Median	1.171	7	170	.322
	Based on Median and with Adjusted df	1.171	7	143.326	.323
	Based on Trimmed Mean	1.320	7	170	.243

Based on the output table of homogeneity test results for the final collaboration skills scores for the experimental and control classes, it can be seen in the Sig column. based on the mean shows a score of 0.233. Sig value. is greater than 0.05. Based on these results, the collaboration skills data for the experimental and control classes are homogeneous. After all initial observation data and final observations for both the experimental and control classes meet the normal and homogeneous distribution requirements, they will continue with hypothesis testing, namely the ANOVA test using SPSS version 26. The ANOVA test in this study was carried out using a significance level (α) = 5%. The hypothesis in this research is H0: There is no influence of the problem based learning model assisted by the Padlet application on students' collaboration skills, while for H1: there is an influence of the problem based learning model assisted by the Padlet application on students' collaboration skills. So the decision making guideline is if H0 is accepted if Sig > α; and H0 is rejected if Sig < α. The results of the ANOVA test for the experimental class and control class are in Table 7.

Table 7. ANOVA Test Results for Experimental Class and Control Class

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4690.342	7	670.049	30.242	0.000
Within Groups	3766.517	170	22.156		
Total	**8456.860**	**177**			

Based on Table 7, the output of the ANOVA test, namely for the initial observation and final observation of the experimental class, obtained a Sig value. of 0.000. Sig value. is smaller than 0.05, so H0 is rejected, and H1 is accepted. This shows that the Problem-based Learning model assisted by the Padlet application influences students' collaboration skills

Discussion

Based on the analysis of the use of the learning model in the experimental class, namely the PBL learning model assisted by the Padlet application, there is a significant influence in improving students' critical thinking and collaboration skills compared to using the PBL learning model. Conventional learning models are applied to the control class. This can be seen from the grades obtained by each student. Several

factors cause this. First, the PBL learning model assisted by the Padlet application can improve students' critical thinking skills. The application of the PBL model is reasonably practical compared to conventional learning. PBL provides opportunities for students to enhance their critical thinking skills. The PBL model can influence students' critical thinking abilities (Anggraeni et al., 2023; Praminingsih et al., 2023). This research results align with research stating that PBL influences students' critical thinking abilities (Fitria et al., 2020; Ismail et al., 2018; Liu, 2022). This finding is also supported by research that states that PBL is more effective than conventional learning in encouraging students' critical thinking skills (Amin et al., 2020; Hidayati et al., 2022). In contrast to traditional knowledge, the PBL process allows students to discuss real problems and try to find solutions in groups. Students, in this case, are faced with cognitive conflict. Thus, they face situations where they must interact with their environment and learn from experiences to build new knowledge. High critical thinking skills are obtained because students are more active in using the PBL model during classroom learning. This is related to the characteristics of PBL learning, namely 1) problem-based, 2) problem-solving, and 3) reflective in transferring knowledge (Davidi et al., 2021; Saad & Zainudin, 2022). In this research, online discussions on the Padlet application significantly improve students' critical thinking skills. Interesting findings in this research show that the application of Padlet makes sharing information and learning materials easier (Ambarita, 2021; Hursen, 2020). In addition, the application of Padlet allows collaborative work between students

Second, the PBL learning model, assisted by the Padlet application, can improve students' collaborative skills. The problem-based learning model allows students to expand their knowledge through cognitive processes (Amin et al., 2020; Hidayati et al., 2022). Applying the Problem-Based Learning learning model impacts improving students' collaboration skills. Students can also learn to increase their potential through searching, solving, and discovering a concept. Students' collaboration skills are demonstrated through a sense of shared responsibility, working productively, compromising, and showing respect. Implementing Problem-Based Learning can improve students' collaboration skills (Akbar et al., 2023; Dita et al., 2021; Oktaviani, 2022). In learning with this model, students must conduct investigations to solve problems as a group (Fadillah et al., 2020; Sugihartono, 2019). Apart from that, at the end of the lesson, students are asked to evaluate the results of solving previously created problems in groups. Therefore, students are asked to work collaboratively. The implementation of PBL provides a more structured student collaboration space. Students act individually and in groups, so communication between members becomes important (Suryawati et al., 2020; Umbara et al., 2020). This activity can improve students' skills individually and in groups. Furthermore, students can develop an attitude of helping and complementing each other. An attitude of mutual respect and appreciation for each other is one of the foundations of collaborative learning. The spirit of collaboration arises from the awareness of sharing what one has. Student interaction increases during the PBL process, providing opportunities for students to discuss a problem in groups, and teachers provide instant feedback (Aslan, 2021; Fadillah et al., 2020; Sugihartono, 2019).

Third, the PBL learning model assisted by the Padlet application can increase students' enthusiasm for learning. In learning activities, students also need guidance from the teacher as a facilitator (Amin et al., 2020; Hidayati et al., 2022). Presenting unstructured problems can encourage students' curiosity to solve them. In PBL, students are empowered to conduct research, integrate theory and practice, and apply knowledge and skills to solve problems (Lestari et al., 2016; Shofiyah & Wulandari, 2018). This is why the PBL learning model assisted by the Padlet application can increase students' enthusiasm for learning. The PBL model makes it easier for students to solve problems because it presents contextual problems in the surrounding environment (Fadillah et al., 2020; Sugihartono, 2019). Students actively construct their knowledge through discussions and questions based on actual problems. Students can understand environmental problems, making it easier to conduct investigations to obtain data and find solutions to them. This encourages students' critical thinking abilities to the maximum because it can further develop an attitude of curiosity. Students can also be objective, independent, critical, and analytical individually and in groups (Hendriana et al., 2018; Huda & Abduh, 2019). PBL learning focuses on problems that allow students to develop their knowledge, inquiry, and critical thinking skills (Davidi et al., 2021; Saad & Zainudin, 2022).

Previous research findings state that using the PBL model can develop students' critical thinking abilities and enrich their knowledge (Hussin et al., 2018; Saputra et al., 2019). Other research also states that students who use Padlet have a higher level of critical thinking than students who do not use Padlet (Al Momani & Musa, 2022; Ambarita, 2021). It was concluded that the Padlet application assisted the PBL learning model in learning. However, this research is limited to a small population, so it cannot be generalized. Therefore, further research can be conducted with studies involving participants from various backgrounds, educational levels, and geographic locations to ensure the generalizability and applicability of the findings in different contexts. An interesting finding in this research is that almost all students could

write down the steps to solve the problem according to the direction they were aiming for. This can be seen from the answers written by students, for example, deciphering information, using concepts, and solving the correct steps. This research implies that the PBL model allows students to learn how to solve problems through group discussions. This can be seen in the research and group investigation stages. Students can practice and share ideas when solving problems as a group.

4. CONCLUSION

Based on the description of the results and discussion, this research found that the application of the PBL learning model assisted by the Padlet application significantly affected students' critical thinking abilities and collaboration skills. It was concluded that applying the PBL learning model assisted by the Padlet application improved students' critical thinking abilities and collaboration skills. The PBL model also allows students to conduct discussions and carry out question-and-answer activities to improve their understanding. Solving environmental problems requires activities that follow critical thinking indicators such as analyzing and evaluating. Contributions of ideas from group members increase their knowledge. Therefore, students can share suggestions on how to overcome environmental problems.

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