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THE EFFECT OF PROBLEM-ORIENTED-PROJECT-BASED-LEARNING (POPBL) MODEL ON CRITICAL THINKING SKILLS AT SENIOR HIGH SCHOOL 1 CIBITUNG

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ABSTRAK **doi** https://dx.doi.org/10.17977/um052v15i2p153-161

Keterampilan berpikir kritis adalah keterampilan penting abad ke-21 yang perlu ditingkatkan melalui pembelajaran inovatif. Beberapa literatur menunjukkan bahwa keterampilan berpikir kritis siswa di beberapa wilayah di Indonesia masih dikategorikan rendah. POPBL adalah model pembelajaran inovatif yang berpotensi untuk meningkatkan keterampilan berpikir kritis. Penelitian ini bertujuan untuk menganalisis pengaruh model POPBL terhadap keterampilan berpikir kritis siswa SMA pada pembelajaran biologi. Jenis penelitian yang digunakan adalah eksperimen semu. Populasi dalam penelitian ini adalah seluruh siswa kelas XI MIPA di SMAN 1 Cibitung. Kelas yang digunakan untuk sampel penelitian adalah kelas XI MIPA 7 diajar dengan model POPBL sebagai kelompok eksperimen, kelas XI MIPA 6 diajar dengan model PBL sebagai kelompok kontrol. Teknik pengambilan sampel menggunakan teknik random sampling. Instrumen yang digunakan adalah tes esai keterampilan berpikir kritis terintegrasi dengan rubrik penilaian 1-4. Analisis data menggunakan uji ANCOVA. Hasil uji ANCOVA menunjukkan bahwa penerapan model Problem-Oriented Project-Based Learning (POPBL) berpengaruh terhadap keterampilan berpikir kritis siswa kelas XI. Siswa yang belajar dengan POPBL memiliki nilai rerata berpikir kritis lebih tinggi yaitu sebesar 70,20 dibandingkan dengan siswa dibelajarkan PBL sebesar 53,18.

Kata Kunci : *Keterampilan Berpikir Kritis, Problem Oriented Project Based Learning,* Sekolah Menengah Atas

Critical thinking skills are essential 21st-century skills that need to be enhanced through innovative learning. Several studies indicate that students' critical thinking skills in various regions of Indonesia are still categorized as low. POPBL is an innovative learning model that has the potential to improve critical thinking skills. This study aims to analyze the effect of the POPBL model on high school students' critical thinking skills in biology learning. The research design used is a quasi-experimental design. The population of this study consists of all 11th grade MIPA students at high school 1 Cibitung. The classes used as research samples are class XI MIPA 7, taught with the POPBL model as the experimental group, and class XI MIPA 6, taught with the PBL model as the control group. The sampling technique used is random sampling. The instrument used is an essay test on critical thinking skills, integrated with a 1-4 assessment rubric. Data analysis was conducted using ANCOVA. The results of the ANCOVA test show that the implementation of the Problem-Oriented Project-Based Learning (POPBL) model has an effect on students' critical thinking skills in grade XI. Students who learned with POPBL had a higher average critical thinking score of 70.20, compared to students taught with PBL, who scored 53.18.

Keywords : *Critical thinking skills, Problem Oriented Project Based Learning, high school*

Learning in the 21st century is a framework that develops skills, knowledge, expertise, and support systems, such as the curriculum, needed by students to succeed in work, life, and as citizens. The 21st-century skills that students should possess include creative thinking, communication, collaboration, and critical thinking (Partnership for 21 st Century Skills, 2015: 1). These skills are highly demanded for students to face the challenges of Society 5.0 (Kahar et al., 2021: 68). In Society 5.0,

society is inseparable from information technology, which is not only used for sharing information but has become an integral part of daily life (Aziz, 2022: 66). The excessive use of technology can lead to complex problems (Hashim & Razali, 2019: 338). Moreover, students are required to solve problems and provide solutions to these problems (Simatupang & Ionita, 2020: 245). Therefore, students should be ready to confront intricate challenges that require the application of critical thinking skills (Ratnaningtyas, 2016: 87).

Critical thinking skills involve the ability to think rationally and reflectively, focusing on beliefs and decision-making processes (Ennis, 2011: 1). Critical thinking is essential to develop as it represents a cognitive thinking process (Sardone & Devlin-Scherer, 2010: 410). It is a logical thought process in response to occurring phenomena (Behar-Horenstein & Niu, 2011: 26). Characteristics of students with critical thinking skills include prioritizing rational reasoning, evaluating various perspectives, having an open mind, accepting new evidence and explanations, reviewing acquired information, considering rational possibilities, avoiding bias, and avoiding hasty judgments (Goodwin & Sommervold, 2012: 65). In fact, students still have difficulty understanding and analyzing information (Endang et al., 2021: 155). This indicates that students' critical thinking skills are still low and require serious attention.

Critical thinking skills in several regions of Indonesia are still low. Research on the critical thinking skills of high school students at a school in Batu City shows that 71% of students fall into the low and underdeveloped categories (Mahanal et al., 2019: 418). The level of critical thinking skills at a high school in Riau is also still low (Ferazona et al., 2021: 32). Additionally, the results of students' critical thinking skills at a high school in Bima are still low, with only 55.23% (Putri & Darussyamsu, 2022: 747). This indicates that students need more practice in developing their critical thinking skills (Bouygues, 2018: 12). According to interviews with high school 1 Cibitung's biology teachers, students often face difficulties in problem-solving and are not sufficiently trained in critical thinking skills, indicating the need to cultivate these skills. The preliminary study found that students had an average critical thinking skill score of 51.15, categorizing it as low.

The causes of low critical thinking skills include the evaluation questions used during the learning process not sufficiently promoting the enchancement of students' critical thinking skills (Putri et al., 2021:80). Another reason is that students cannot use information to solve problems, lack confidence in expressing opinions, and struggle to evaluate evidence (Firdaus et al., 2015: 233). One way to enhance students' critical thinking skills is by selecting student-centered learning models (Putri et al., 2021: 80). Student-centered learning models encourage students to develop thinking skills by presenting problems related to daily life (Simanjuntak & Sudibjo, 2019: 109). A potential model for developing critical thinking skills is problem-based learning (PBL). PBL provides opportunities for students to learn analytical thinking and problem-solving (Rusiadi, 2021: 24). The problem-solving process positively impacts students' thinking abilities and understanding. Students build their knowledge through problem-solving related to their lives (Yew & Goh, 2016: 77). The learning model that can be applied to develop critical thinking skills is POPBL. The POPBL model provides opportunities for students to not only be involved in the problem-solving process but also work in groups that encourage them to share ideas and thoughts with each other. In POPBL, students can systematically apply project stages, which strengthens their understanding of the material. Therefore, POPBL is expected to improve critical thinking skills (Bell, 2010: 43).

POPBL is a collaborative learning model that combines project activities with Problem-Based Learning (PBL). The stages of POPBL learning projects include problem orientation, planning, data collection, data analysis, problem-solving, reporting, and evaluation (Rongbutsri, 2017: 30). The main principles of implementing this learning model are problem-oriented, project work, and group work to solve problems (Lehmann et al., 2008: 290). This model is developed based on the principles of thinking from Ileris (1974), including problem-oriented learning, project work, interdisciplinary,

student-centered, and group cooperation (Kolmos et al., 2004: 7). The novelty of this study lies in the implementation of the POPBL model at high school 1 Cibitung to observe the enchancement of critical thinking skills.

METHODS

Research Design

This research method utilizes a Pretest Posttest Non-Equivalent Control Group Design. The instrument employed in this study consists of a test instrument in the form of essay questions. The sample for this research consists of 72 students. The research design can be observed in the following Table 1.

Table 1. ***Pretest-posttest non-equivalent control group design***

Group	*Pretest*	Treatment	*Posttest*
Experiment	O1	X1	O2
Control	O3	X2	O4

Explanation:
X1= POPBL Model
X2= PBL Model
O1= Initial test results of POPBL learning class
O2= Final test results of POPBL learning class
O3= Initial test results of PBL learning class
O4= Final test results of PBL learning class

Population and Sample

The population in this study consisted of all students in Class XI MIPA at high school 1 Cibitung, which included seven classes. The sample for this study was taken from Class XI MIPA 7, designated as the experimental class, and Class XI MIPA 6, designated as the control class. The sample was selected using a random sampling technique, where two classes were randomly chosen from the seven. These two selected classes were considered equivalent based on the results of an equality test and were then designated as the experimental and control class.

Instrument

The instrument utilized in this study consist of 12 essay questions specifically designed to assess critical thinking skills. The instrument is structured according to six indicators of critical thinking skills referring to Ennis (1996): 1) focus, 2) situation, 3) inference 3) reason, 5) clarity, and 6) overview. Student responses are assessed using a rubric adapted from Ennis (1996) and Greenstein (2012) with scores ranging from 1 to 4. The instrument used has undergone validation, with validity and reliability values in the range of 0.352-0.554 and a Cronbach's alpha value of 0.638.

Stages

The research procedure is organized with the following stages: 1) conducting observations at the research site; 2) defining the population and sample for the research; 3) conducting preliminary tests; 4) developing learning materials and research instruments; 5) validating learning materials and research instruments; 6) conducting pre-tests in the experimental and control classes; 7) implementing learning with the POPBL learning model in the experimental group; 8) conducting post-tests; 9) analyzing data; 10) preparing the research report.

Data Analysis

The research data undergoes a comprehensive analysis encompassing both descriptive statistics and inferential statistics. Descriptive statistics play a pivotal role in providing an overview of critical thinking. This involves presenting statistical values such as the highest and lowest averages and elucidating the variance between pre-test and post-test changes. In the realm of inferential analysis, a one-way ANCOVA test is employed with a significance level set at 5% to scrutinize hypotheses. Prior to subjecting the data to the one-way ANCOVA test, prerequisite assessments are undertaken, comprising normality and homogeneity tests. Normality is assessed through the Kolmogorov-Smirnov One-Sample test, while homogeneity is gauged using Levene's Test of Equality Of Error Variance. These preliminary tests contribute to ensuring the robustness and validity of the subsequent inferential analysis.

RESULT AND DISCUSSION

The results of the descriptive analysis of the critical thinking skills of students instructed through the POPBL and PBL models are presented in Table 2.

Table 2. Descriptive Analysis Results

	Critical Thinking Skills			
Model	Pretest	Posttest	Difference	Mean Corrected
POPBL	62,38	70,19	7,81	70,2
PBL	50,81	53,18	2,37	53,18

According to Table 2, it evident that improvement is observed in each learning model. The highest improvement is observed in the POPBL model with a difference of 7,81 and has a mean corrected score of 70,20. The pretest and posttest scores are described in Figure 1.

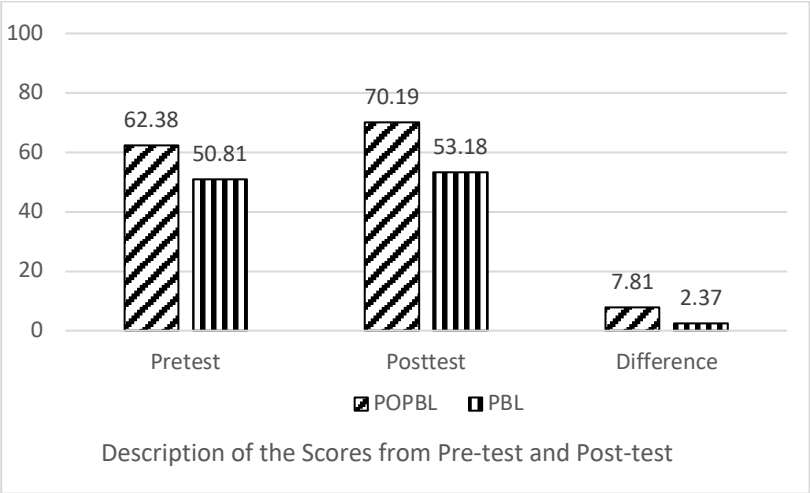

Figure 1. Description of the Scores Pre-test and Post-test

After descriptive analysis, it was followed by inferential analysis. The results of the prerequisite test are shown in Table 3.

Table 3. Prerequisite Test Results

Variable	Test type		N	p	a	Explanation.
Critical thinking skills	Normalitas	Pretest	72	0,79	0,05	Normal
	Normalitas	posttest	72	0,200	0,05	Normal
	Homogenitas	posttest	72	0,66	0,05	Homogenous

The results of the prerequisite tests indicate p-values > 0,05, meaning that the data are normally distributed and homogenous. Since the data is both normal and homogenous, we can proceed with the one-way ANCOVA test. The results of the one-way ANCOVA test are presented in Table 4.

Table 4. Results of One-Way ANCOVA Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7216.164[a]	2	3608.082	42.469	.000	.552
Intercept	2328.224	1	2328.224	27.405	.000	.284
PRE	2005.831	1	2005.831	23.610	.000	.255
MODEL	1640.340	1	1640.340	19.308	.000	.219
Error	5862.081	69	84.958			
Total	287084.250	72				
Corrected Total	13078.245	71				

a. R Squared = .552 (Adjusted R Squared = .539)

The results of the one-way ANCOVA test shown in Table 4 indicate that the p-value is 0, 00 < 0,05, which means that the POPBL model influences the critical thinking skills of high school students in the context of biology learning.

Discussion

The results of the data analysis using ANCOVA indicate a difference in the average scores of critical thinking skills among 11th-grade high school students who underwent biology learning with the Problem-Oriented Project-Based Learning (POPBL) and Project-Based Learning (PBL) models. This can be observed from the corrected mean scores, where students who participated in learning with the POPBL approach demonstrated higher scores compared to those taught using the PBL model.

The difference between PBL and POPBL lies in the focus of each approach. PBL focuses on solving problems by structuring and developing an understanding of the problem, whereas in POPBL, students not only solve problems but are also responsible for project implementation (Bell, 2010: 43). This provides a deeper learning experience and helps students develop stronger critical thinking skills compared to PBL, which focuses more on conceptual problem-solving. POPBL emphasizes detailed project planning, such as determining the schedule, preparing tools and materials, and outlining the stages necessary to achieve the final goal. This encourages students to organize teamwork and ensure the quality of the final product. Evaluation in PBL focuses more on the analysis and problem-solving process carried out by students, whereas in POPBL, it encourages reflection on both the learning process and the final product, allowing students to identify strengths and weaknesses for improving the project (Chang, 2022).

Critical thinking skills can be enhanced through problem-based and project-based learning (Jumrodah et al., 2021: 74). POPBL is a learning model that emphasizes the application of knowledge to solve real-world issues through projects (Husin et al., 2016: 4). This model focuses on students' practical experiences and allows them to enhance critical thinking skills, problem-solving abilities, and teamwork (Ibrahim & Halim, 2013: 64). The syntax of the POPBL model consists of five stages: problem

orientation and formulation, organizing students for learning, designing and implementing projects, and presenting results and evaluation (Rongbutsri, 2017: 30; Yasin & Rahman, 2011: 21).

In POPBL learning, there is an initial stage of problem identification and orientation. In this stage, students are presented with a problem related to their surroundings. Through group discussions, students collaborate to identify issues or questions related to the problem. Improvement is observed in the focus and reason indicators, where students can identify problems well and provide reasons that support the decisions made. This stage aligns with the cognitive theory, which states that students acquire new knowledge through problem identification activities and synthesizing information (Sundari & Fauziati, 2021: 132).

The learning activity of problem identification has a positive impact on constructive and meaningful learning experiences. This can contribute to the improvement of critical thinking skills (Mashudi, 2021: 94). The problems presented originate from the students' surrounding environment. The condition of the environment plays a crucial role in supporting the success of learning process and facilitating students to cultivate problem-solving abilities and critical thinking skills (Saputro et al., 2019: 497).

The second stage of POPBL is organizing students for learning. In this stage, students actively engage in understanding concepts related to the learning material. They participate in group discussions to acquire information, with the hope that the exchange of thoughts and knowledge will enrich their understanding (Amineh & Asl, 2015: 15).

In POPBL learning, the third stage involves designing and implementing projects. This aims to ensure the students' understanding of fundamental concepts. This stage can enhance the inference and situation indicators, where students can draw conclusions and use scientific thinking to respond to problem issues. Designing projects as a solution to specific problems also impacts the improvement of students' critical thinking (Allanta & Puspita, 2021: 165).

The final stage of POPBL is the evaluation and presentation of project results. In this stage, students have the opportunity to present the projects they have developed through various media, such as video, posters, presentations, and so on. This activity supports the echancement of students' critical thinking skills, particularly in the clarity and overview indicators. During the presentation process, students can demonstrate their ability to explain terms or decisions used in the project. Moreover, students can review the decisions made. Steps such as observation, group discussions, analysis, and understanding concepts or learning problems involved in project presentations are efficient in enhancing students' critical thinking abilities (Saripudin et al., 2015: 6). Thus, the activity of presenting project results can train students to think critically, understand the terms used, and evaluate the decisions made in the projects they have undertaken.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the results and discussion, it can be concluded that the application of the Problem-Oriented Project-Based Learning (POPBL) model has an impact on the critical thinking skills of class XI students. Students who learned with POPBL had a higher average critical thinking score of 70.20, compared to students who learned with PBL, who scored 53.18.

Recommendation

Teachers can apply the POPBL model to enhance students' critical thinking skills in biology learning. Schools can integrate digital tools to support the implementation of POPBL. The role of teachers is crucial in implementing POPBL, so it is recommended that special training be provided to help them better prepare for designing and facilitating project-based learning. As for further research,

it is recommended that researchers apply the POPBL model to other subjects, explore different dependent variables, or investigate its effectiveness at different educational levels.

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