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Research Article

The Use of Problem-Based Learning (PBL) and Inquiry Models to Develop Critical Thinking Skills and Improve Cognitive Learning Outcomes of Students at SMP Negeri 13 Lebong

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Abstract. This study aims to determine the effect of Problem Based Learning (PBL) and Inquiry learning models on students'critical thinking skills and cognitive learning outcomes on the topic of the human respiratory system. This research used a quasi-experimental design with a Non-Equivalent Pretest-Posttest Control Group Design. The research subjects were three eighth-grade classes at SMP Negeri 13 Lebong, consisting of two experimental classes taught using the PBL and Inquiry models and one control class using conventional methods. The research instruments included essay tests to measure critical thinking and multiple-choice tests to assess cognitive learning outcomes. Data were analyzed using ANOVA and LSD tests. The results showed significant differences among the three groups. The PBL model produced the highest improvement in both variables, followed by Inquiry, and lastly the control group. Therefore, PBL is proven to be the most Effective model inimproving students' critical thinking and cognitive learning outcomes in science education.

Keywords: ANOVA, Cognitive Learning Outcomes, Critical Thinking, Inquiry, Problem-Based Learning.

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1. Introduction

Education is an essential component of national development because it plays a role in improving the quality of human resources. Education not only functions as a means of transferring know ledge but also of developing individual potential so that individuals are able to face various global challenges (Syahfitri et al., 2018; Fakhriyah, 2020). Entering the era of the industrial revolution 4.0, technology has become an integral part of everyday life, requiring individuals to have 21st-century skills, such as critical thinking, problem solving, creativity, and communication (Zubaidah, 2019; Hadinugrahaningsih, 2017).

These demands have prompted the government to implement the 2013 Curriculum, which emphasizes active, collaborative, and 21st-century skills-based learning. Biology education, as part of natural sciences (IPA), plays an important role in developing students' critical thinking skills through scientific approaches and systematic problem-solving processes (Cristina, 2017; Irwandi, 2020). Unfortunately, the learning process in many schools still focuses on conventional methods that emphasize lecturesand memorization, whichdonot involve students in higher-level thinking processes (Nuryanti et al., 2019).

Observations at SMP Negeri 13 Lebong show that learning is still dominated by lectures and question-and-answer sessions, with students playing a passive role. The lack of critical thinking skills training has resulted in low motivation and understanding of scientific concepts among students. This is reflected in the learning evaluation results, where around 65% of eighth-grade students scored below the Minimum Passing Grade (KKM) in science subjects in the 2023/2024 academic year. Even though the school facilities and infrastructure are adequate, they have not been optimally utilized in the learning process.

Previous studies have shown that junior high school students' critical thinking skills are generally low, which has a negative impact on cognitive learning outcomes (Farcis, 2019; Nuryanti et al., 2019). This weakness can be traced to the dominance of a teacher-centered learning approach that does not encourage active student involvementin learning.As a result,students.

Have difficulty analyzing, evaluating, and solving problems independently (irwandi, 2020). To overcome this problem, the application of the problem-based learning (pbl) and inquiry learning models is a potential alternative. The pbl model encourages students to actively solve real problems in the context of learning, thereby improving critical thinking and collaboration skills (magsino, 2014; husein, 2017). Meanwhile, the inquiry learning model allows students to directly experience the scientific investigation process, thereby deepening their conceptual understanding and fostering analytical thinking (Jafar, 2018).

Based on this description, innovation in biology learning is needed to improve students' critical thinking skills and cognitive learning outcomes. Therefore, the author is interested in conducting research with the title: "The Use of Problem-Based Learning (PBL) and Inquiry Learning Models for Critical Thinking Skills and Cognitive Learning Outcomes of Students at SMP Negeri 13 Lebong.".

2. Materials and Method

This research is a quasi-experiment with a Non-Equivalent Pretest-Posttest Control Group Design involving three groups, namely two experimental groups and one control group. All groups were given a pretest before the treatment, then given treatmen tinac cordance with the established learning model,and ended with a posttest to determine changes in critical thinking skills and cognitive learning outcomes. The first experimental group used the Problem-Based Learning (PBL) model, the second experimental group used the Inquiry model, and the control group used conventional learning.

This study was conducted at SMP Negeri 13 Lebong in the evensemester of the 2024/2025 academic year, specifically from February to March 2025. The population in this study consisted of all eighth-grade students, comprising eight classes, with three classes randomly selected as samples using simple random sampling techniques, namely class VIII-1 as the PBL group, VIII- 2 as the Inquiry group, and VIII-3 as the control group.

Based on interviews with school officials, the three classes have relatively homo gene ous a cademic a bilities. There search instruments werea critical thinking test in the form of an essay consisting of 5 questions compiled based on Ennis' indicators and assessed using a 0-4 scoring rubric, as well as a cognitive learning test in the form of 20 multiple-choice questions compiled based on the C1-C6 cognitive aspects of Bloom's Taxonomy.

The data were analyzed using the Kolmogorov-Smirnov normality test, the Levene homogeneity test, the One Way ANOVA hypothesis test, and the LSD (Least Significant Difference) follow-up test to determine the differences between groups with a significance level of 0.05. The research procedure consisted of a preparation stage (instrument development and coordination with teachers), an implementation stage (administration of pretest, treatment, and posttest), and a final stage (data analysis and conclusion drawing).

3. RESEARCH RESULTS

The results of the pretest of students' critical thinking skills showed thatthe average score in experimental group 1 (PBL) was 4.16; experimental group 2 (Inquiry) was 3.80; and the control group was 3.96. The normality and homogeneity tests showed that the data were normally distributed and homogeneous, with the ANOVA test results showing no significant differences between the three groups (sig. = 0.710 > 0.05). This indicates that the students' initial critical thinking skills were relatively equal before being given different learning treatments. After the treatment, the posttest average critical thinking ability increased significantly, namely PBL group by 15.64; Inquiry 15.40; and control 12.68. The ANOVA test showed significant differences between groups (sig. = 0.000 < 0.05). The LSD follow-up test revealed that there was no significant difference between PBL and Inquiry (sig. = 0.740), but there were significant differences between PBL and control and Inquiry and control (sig. = 0.000, respectively).

These finding sindicate that both the PBL and Inquiry model swere ableto significantly improve students' critical thinking skills compared to conventional learning, but there was no significant difference between the two models. This is in line with the findings of Asra Indah et al. (2021) that PBL can encourage higher-order thinking skills through contextual problem exploration, as well as a study by Sari and Muslim (2020) which confirms the effectiveness of the inquiry approach in fostering students' critical reasoning skills.

As for students' cognitive learning outcomes, the pretest data showed that the average score in the PBL group was 41.60; the Inquiry group was 39.80; and the control group was 38.80. There was no significant difference between thethree groups based on the ANOVA test results (sig. = 0.331 > 0.05), so it can be concluded that the students' initial cognitive abilities were relatively equal. After implementing the learning model, the post-test results showed an increase with an average score of 78.80 for the PBL group, 73.60 for the Inquiry group, and 62.40 for the control group. The ANOVA test results showed a significant difference between groups (sig. = 0.000 < 0.05). The LSD follow-up test showed that all comparisons between groups were significant, including between PBL andInquiry (sig. = 0.024), PBL and control (sig. = 0.000), and Inquiry and control(sig. = 0.000).

These results confirm that the use of problem-based learning and inquiry models has a positive impact on students' cognitive learning outcomes compared to conventional learning, and that the PBL model provides higher improvement than the Inquiry model. These findings are reinforced by Rahmawati's (2022) research, which shows that the PBL approach can improve students' cognitive achievement through active engagement and problem solving, as well as Nurhasanah and Wicaksono's (2020) study, which confirms that the inquiry strategy plays an important role in strengthening students' conceptual understanding.

4. DISCUSSION

The results of the analysis show that the improvement in students' critical thinking skills after the treatment indicates that the Problem-Based Learning (PBL) and Inquiry models have a greater influence than conventional learning. The average posttest scores for critical thinking skills in the PBL (15.64) and Inquiry (15.40) groups were consistently higher than those in the control group (12.68). The PBL model allows students to be actively involved in solving authentic problems that require logical analysis and evaluation skills, while the inquiry model provides space for students to explore and investigate problems through a scientific approach.

The LSD statistical test results show that the difference between the PBL and Inquiry groups is not significant ($p = 0.740$), but both are significantly different from the control group ($p < 0.05$), indicating that although the effectiveness of the two models is almost equivalent in improving critical thinking skills, both are far superior to the conventional approach, which tends to be passive. These finding sares up ported by Putra and Hasanah(2022),whostatethat student involvement in reflective processes and active problem-solving through PBL can improve critical thinking skills. Lestari and Yulianti (2023) also emphasize that the inquiry approach is effective in encouraging logical and systematic thinking. Similar support is found in the research of Hartati et al.(2021) and Sari and Ramadhan (2023), which shows the significant contributionof problem-based and inquiry-based active learning models in the development of higher-order thinking skills.

In addition, students' cognitive learning outcomes also experienced a significant increase after the treatment. The average posttest scores for the PBL groupreached 78.80, the Inquiry group scored73.60, and the control group scored 62.40. The results of the ANOVA and LSD tests confirmed that there were significant differences between groups ($p < 0.05$), indicating that the PBL and Inquiry models had a positive impact on students' cognitive learning outcomes. PBL provides relevant context-based learning experiences, allowing students to relate scientific concepts to real-life situations, thereby supporting the strengthening of conceptual understanding and better knowledge transfer. Meanwhile, the Inquiry model encourages active student involvement in the process of exploration and experimentation, which builds understanding gradually through direct experience.

Al though bo thare effective, the cognitive learning out comes of students in the PBL group we resigni ficantly higher than those in the Inquiry group. Thisisin line with the research by Nugroho et al. (2022), which shows that PBL can improve students' conceptual understanding and active engagement, as well as Yuliani and Firdaus (2023), who state that PBL has a positive effect on cognitive achievement. Studies by Wulandari and Kurniawan (2021) and Duran and Dökme (2016) also reinforce that the Inquiry approach has a positive impact through student involvement in the scientific process. Based on these results, it can be concluded that the application of the PBL and Inquiry models is more effective than conventional learning, with the PBL model providing the most optimalresults in improving critical thinking skills and cognitive learning outcomes of junior high school students on the subject of the respiratory system.

5. CONCLUSION

Based on the discussion of there search results, it can be con cluded that the Problem-Based Learning (PBL) and Inquiry learning models have a significant effect on improving the critical thinking skills of eighth-grade junior high school students. PBL produced the highest average score, followed by Inquiry, andfinally conventional learning. Both learning models also had a significant effect on students' cognitive learning outcomes, with the PBL model showing the highest statistical achievement. Among the three approaches compared, the PBL model proved to be the most effective in improving students' critical thinking skills and cognitive learning outcomes in respiratory system material, so it is recommended as an alternative learning strategy that can be applied in science learning at the junior high school level.

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