



Enhancing Students' Critical Thinking Skills through Problem Based Learning Integrated with Mindmapping

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ABSTRACT

The critical thinking skills of class 10th from senior high school Banda Aceh students have not been trained in the learning process, students are not given the opportunity to analyze a problem, identify, conclude or come up with new ideas or an action on a problem. In fact, research shows that the learning process of biology in schools does not encourage students to think critically, thus affecting low learning outcomes. The research objective was to determine the increase in critical thinking skills in class 10th skills on the concept of environmental pollution and knowing the differences in critical thinking skills of class 10th students on the concept of environmental pollution in the experimental and control class. Data were collected from March to April 2019. The approach of this research is to use a quantitative, evaluation research type, the method used is quasi-experimental, with a factorial design group pre-test post-test. The sample in this study amounted to 253 students from two high schools in Banda Aceh. Essay questions are used to measure students' critical thinking skills. The data analysis used ANCOVA at a significant level of 0.05. Hypothesis test results show the value of $p < \alpha$, $0.00 < 0.05$. The conclusion of this study is that the application of the PBL integrated with the mindmap can improve students' critical thinking skills. There are differences in students' critical thinking skills using integrated mindmapping PBL, PBL, mindmapping, and conventional.

Keywords: PBL, Mindmapping, Critical Thinking Skills

INTRODUCTION

In the 21st century, information can be accessed quickly by everyone in the world. Every individual must have qualified soft skills to enable them to get into the world of work and be ready to compete. One of the skills that students must possess is critical thinking skills, which can be obtained through education (Ritonga et al., 2020).

The critical thinking skills of class 10th from senior high school Banda Aceh by observing and interviewing the teacher and 10 students have not been trained in the learning process, students are not given the opportunity to analyze a problem, identify, conclude or come up with new ideas or an action on a problem. In fact, research shows that the learning process of biology in schools does not encourage students to think critically, thus affecting low learning outcomes.

To overcome the low critical thinking skills of students, innovation was carried out in the learning process using PBL combined with mind mapping. The use of PBL can significantly improve critical thinking skills before and after learning activities Lapuz & Fulgencio (2020). The PBL model has a higher influence on critical thinking skills and environmental attitudes than the conventional model. The use of the PBL model in solving environmental problems encourages students' critical thinking skills to foster environmental attitudes (Amin, et al., 2020). There is a significant difference in learning outcomes between students who have high and low critical thinking skills (Mulyanto, et al., 2018). The PBL model provides opportunities for learners to discover new knowledge to their prerequisite knowledge for solving problems. Therefore, they participate in an active process of creating innovative solutions to these problems through experience (Yazar, 2015). The PBL model can improve learning achievement (Sartika, 2018). The PBL model is active learning and is very effective in creating knowledge, and can improve analysis, evaluation and creation skills). The PBL model is more effective for teaching than traditional lecture discussions (Tarhan & Ayyildiz, 2015).

METHODOLOGY OF RESEARCH

General Background of Research

This research was conducted at two high schools in Banda Aceh. The research was conducted in the semester of the 2018/2019 school year in class 10th two high schools in Banda Aceh. The approach used is quantitative. This type of research is quasi experimental and uses applied methods. The design used was the pretest posttest control group design.

Subject of Research

The population in this study were all students of class 10th two high schools in Banda Aceh. The reason for choosing the location was because based on the observations of researchers at the school there were still obstacles faced by teachers in learning biology, from the results of the author's interviews with biology subject teachers in class 10th two high schools in Banda Aceh, the learning methods that had been used so far were felt to be very boring so that learning activities become passive and students are less enthusiastic about taking part in learning biology activities in class. The sample in this study amounted to 253 students. Purposive sampling technique was used by looking at the standard deviation value of the homogeneous student pretest results (homogeneous student skills

Instrument and Procedures

The instrument for assessing critical thinking skills is essay questions. Critical thinking skills are a written test consisting of four item essay types. There are 6 questions used, with basic clarification indicators, providing reasons for a decision, concluding, further clarification (Mundilarto & Helmiyanto, 2018). The lattice for critical thinking skills is presented in Table 1.

Table 1. The Grid Instrument of Critical Thinking Skills

Indicator	Sub Indicator	Question Number	Number of items
<i>Elementary Clarification</i>	Able to identify or formulate problems	4,7	2
<i>The Basis for The Decision)</i>	Able to consider the credibility of a source and observe and consider the results of observations.	2,5	2
<i>Inference</i>	Able to make and consider the value of decisions.	1,3	2
<i>Advanced Clarification</i>	Be able to identify terms and consider definitions and refer to unstated assumptions.	6,8	2
Total			8

Data Analysis

The stages of data analysis were: 1) normality test using Kolmogorov-Smirnov, with the criteria for value ($p > 0.05$) declared normal, 2) homogeneity test, using the Levene test and 3) covariance analysis test (ANCOVA). Analysis using the SPSS version 21 program, with the criteria if ($p < 0.05$) then there are differences in students' critical thinking skills.

RESULTS AND DISCUSSION

The values of students' critical thinking skills obtained from the pretest and posttest on the concept of environmental pollution were divided into 4 groups, namely the mindmap-based problem-based learning class, the problem-based learning class, the mindmap class, and the control class.

Pretest aimed to see students' initial skills and posttest to see students' final skills after applying mindmap-based problem based learning to see the average difference between initial skills and final skills of the first sample group students is presented in Figure 1.

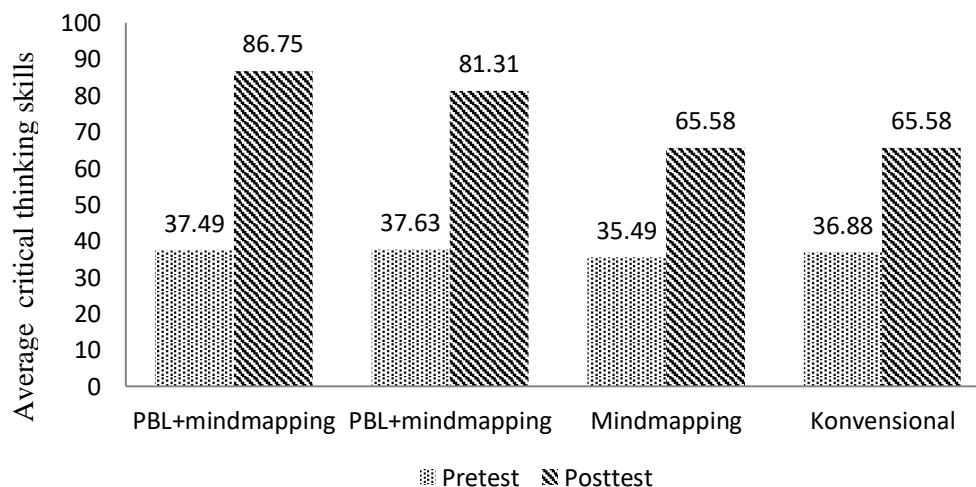


Figure 1. Average Pretest and Posttest Scores for Students' Critical Thinking Skills at the First Sample Group

Figure 1 shows that the average critical thinking skills of students in the integrated mindmapping problem-based learning class are better than those in the problem-based learning class, mindmap class, and control class. Analysis of the thinking skills of students at the second sample group, is presented in Figure 2.

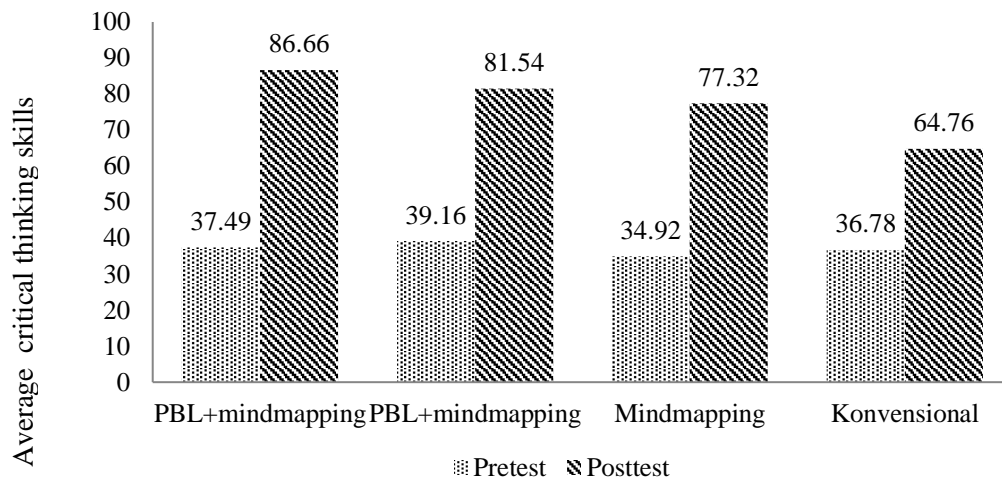


Figure 2. The Average Pretest and Posttest Scores for Students' Critical Thinking Skills at Senior High School 7 Banda Aceh

The Kolmogorov Smirnov test, the levene test, and the ANCOVA test for the critical thinking skills of students at the first sample group are presented in Table 2.

Table 2. Difference Test of Average Pretest and Posttest of Critical Thinking Skills at the First Sample Group

Critical thinking skills	Group	Normality	Homogeneity	ANCOVA
Pretest	PBL+Mindmapping	$\rho (0,100 > \alpha (0,05))$	$\rho (0,61 > \alpha (0,05))$	$\rho (0,74 > \alpha (0,05))$
	PBL	$\rho (0,200 > \alpha (0,05))$		$\rho (0,40 > \alpha (0,05))$
	Mindmapping	$\rho (0,200 > \alpha (0,05))$		$\rho (0,20 > \alpha (0,05))$
	Control	$\rho (0,100 > \alpha (0,05))$		$\rho (0,40 > \alpha (0,05))$
Posttest	PBL+Mindmapping	$\rho (0,200 > \alpha (0,05))$	$\rho (0,75 > \alpha (0,05))$	$\rho (0,00) < \alpha (0,05)$
	PBL	$\rho (0,200 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$
	Mindmapping	$\rho (0,080 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$
	Control	$\rho (0,200 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$

Table 2 shows that students have the same initial critical thinking skills. The ANCOVA test results for critical thinking skills obtained the value of $\rho (0,00) < \alpha (0,05)$. The results of the data analysis test of students at the second sample group in Table 3.

Table 3. The Difference Test for the Average Pretest and Posttest of Students' Critical Thinking Skills at the Second Sample Group

Critical thinking skills	Group	Normality	Homogeneity	ANCOVA
Pretest	PBL+Mindmapping	$\rho (0,070 > \alpha (0,05))$	$\rho (0,81 > \alpha (0,05))$	$\rho (0,74 > \alpha (0,05))$
	PBL	$\rho (0,100 > \alpha (0,05))$		$\rho (0,40 > \alpha (0,05))$
	Mindmapping	$\rho (0,090 > \alpha (0,05))$		$\rho (0,20 > \alpha (0,05))$
	Control	$\rho (0,100 > \alpha (0,05))$		$\rho (0,40 > \alpha (0,05))$
Posttest	PBL+Mindmapping	$\rho (0,070 > \alpha (0,05))$	$\rho (0,93 > \alpha (0,05))$	$\rho (0,00) < \alpha (0,05)$
	PBL	$\rho (0,200 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$
	Mindmapping	$\rho (0,090 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$
	Control	$\rho (0,100 > \alpha (0,05))$		$\rho (0,00) < \alpha (0,05)$

Table 3 shows that students have the same initial critical thinking skills. The ANCOVA test results for critical thinking skills obtained the value of $\rho (0,00) < \alpha (0,05)$. Thus the research hypothesis is stated: there is an effect of the application of the problem based learning model combined with the mindmap on critical thinking skills of students on environmental pollution concept in class 10th Senior High School Banda Aceh.

Learning by using the Problem Based Learning Combined with Mindmaps enable students to find problems in everyday life. Students have the opportunity to solve these problems based on their experiences in making observations. The use of everyday problems successfully attracts the attention of students when studying in class so that students are motivated to learn. With students motivated in learning will affect student learning outcomes. So that students achieve good learning outcomes on environmental pollution concept.

In addition, students can express critical questions, because students receive the concept presented by the teacher, so that their analytical and critical thinking skills become trained. This can train students' thinking skills to be more critical in responding to a concept that is being studied which will have an impact on increasing the skills of students in solving a more complex and contextual problem. Providing opportunities for all students to build their own knowledge, so that the knowledge gained becomes more meaningful.

PBL proved significant in improving students' critical thinking skills. This is because PBL syntax can train children to do higher order thinking processes, one of which is critical thinking. PBL syntax that is carried out according to the correct steps will make learning effective and efficient. The following suggestions come from the conclusions presented above. Teachers can use PBL to equip students for higher order thinking. Teachers must carry out PBL syntax correctly so that learning objectives are achieved (Herzon, et al, 2018).

Problem solving with mind mapping has provided opportunities for all students to build their own knowledge, so that the knowledge gained becomes more meaningful. Classical completeness in the experimental class is higher when compared to the control class because the problem solving learning model requires students to be active in thinking more critically in solving problems so that they are able to help students achieve good learning outcomes compared to students who are given the lecture and discussion learning model only (Ristiasari, 2012).

In line with the opinion of Barrows (2002) students realize that learning is needed to solve and understand very important problems. PBL also helps students acquire skills,

knowledge, and attitudes, and it is an important part of many curricula. Problem-based learning can help students develop skills in giving reasons and thinking when looking for data or information in order to find a solution to a problem. In addition, PBL with an approach to authentic problems can make students compile their own knowledge, develop higher skills, inquiry, independent students, and increase self-confidence (Arends, 2008).

The PBL model can increase the involvement of students themselves in learning, thereby leading to increased critical thinking skills and increased motivation to seek new information (Choi, et al., 2014). PBL can improve students' critical thinking skills, because it involves students in learning processes such as clarifying problems, assessing information needs, identifying relationships between concepts, cooperation between new forms of knowledge, producing possible hypotheses, debating problems related to situations, considering alternative solutions (Yuan, et al., 2014). Problem based video animation instruction is effective in improving critical thinking skills (Ritonga, et al., 2020).

Mindmaps are able to improve critical thinking skills and cooperation between students so that they are able to build a basis for solving problems collaboratively. The strength of mindmaps in combination with PBL is the opportunity for students to compile and formulate problem formulations from a phenomenon and to estimate plans, initial hypotheses and answers in an effort to solve a given problem so as to improve critical thinking skills.

With the combination, the effect of mindmap is better and so is PBL so that the combination of the two models will increase optimality in achieving better critical thinking skills when compared to PBL alone. The combination of PBL and Mindmap is one of the breakthrough learning models in order to improve better critical thinking skills and can be a solution in improving students' critical thinking skills.

CONCLUSION

The conclusion of this study is that the application of the PBL integrated with the mindmap can improve students' critical thinking skills. There are differences in students' critical thinking skills using integrated mindmapping PBL, PBL, mindmapping, and conventional.

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