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PROBLEM-BASED LEARNING: CAN IT IMPROVE HIGHER-ORDER THINKING SKILLS OF PROSPECTIVE ELEMENTARY SCHOOL TEACHER STUDENTS?

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Abstract

Mastery of 21st-century skills is one of the goals in learning activities. One of the factors to consider is that the teacher must have HOTS as the spearhead of learning. This study aimed to improve HOTS, namely critical thinking skills and creative thinking of prospective elementary school teacher students through PBL. This study used a pre-experimental method with a one-group pre-test-post-test design. The research instrument used was a subjective test in form of essay consisted of 15 items. The sample of this research was 30 students. The results showed that the HOTS of prospective elementary school teacher students at STKIP BMS increased by using PBL. The t-test result obtained was $0.00 < \alpha = 0.05$. It indicated that this learning model significantly influences students' HOTS. The gain test result obtained an n-gain value of 0.34 which indicated that the increase in student HOTS was in the "medium" category. The detailed results of each HOTS aspect during the post-test were in the "good" category, namely fluency, flexibility, originality, and evaluation. The other aspects such as elementary clarification, basic support, inference, advanced clarification, strategy and tactics, were in the "sufficient" category. The last HOTS aspect, namely elaboration, was in the "less" category.
Keywords: Higher-Order Thinking Skills, Problem Based Learning

Abstrak

Penguasaan keterampilan abad-21 menjadi salah satu tujuan dalam kegiatan pembelajaran. Salah satu faktor yang meski diperhatikan adalah guru sebagai ujung tombak pembelajaran harus memiliki HOTS. Penelitian ini bertujuan untuk meningkatkan HOTS yakni keterampilan berpikir kritis dan berpikir kreatif mahasiswa calon guru sekolah dasar melalui PBL. Penelitian ini menggunakan metode pre-experimental dengan desain one-group pre-test-post-test. Instrumen penelitian yang digunakan berupa tes uraian berjumlah 15 item. Sampel penelitian ini adalah mahasiswa Prodi PGSD STKIP Bina Mutiara Sukabumi sebanyak 30 orang. Hasil penelitian menunjukkan bahwa HOTS mahasiswa calon guru sekolah dasar STKIP Bina Mutiara Sukabumi mengalami peningkatan dengan menggunakan PBL. Perolehan hasil uji t yang dilakukan yaitu $0,00 < \alpha = 0,05$, menunjukkan bahwa model pembelajaran ini memiliki pengaruh yang signifikan terhadap HOTS mahasiswa. Adapun hasil uji gain memperoleh nilai n-gain sebesar 0,34 yang menunjukkan bahwa peningkatan HOTS mahasiswa berada pada kategori "sedang". Adapun rincian hasil dari setiap aspek HOTS saat post-test yang berada pada kategori "baik" yakni *fluency, flexibility, originality,* dan *evaluation*. Aspek *elementary clarification, basic support, inference, advanced clarification, strategy and tactics*, berada pada kategori "cukup". Aspek HOTS yang terakhir yaitu *elaboration* berada pada kategori "kurang".
Kata Kunci: Higher-Order Thinking Skills, Problem Based Learning

INTRODUCTION

Improving the skills of students in learning is something that must be done in order to achieve an increase in the quality of education broadly. In this effort, the improved skills must be aligned with current needs. Currently, the skills needed by students are 21st-century skills. In general, these skills emphasize applying knowledge possessed by students in an authentic

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context (Larson & Miller, 2011). Furthermore, the essence of 21st-century skills emphasizes problem-solving, creative and innovative thinking, communication and collaboration, and expertise in technology (Larson & Miller, 2011). Based on this, 21st-century skills are urgent to be improved through a series of learning activities at various levels of education. Critical and creative thinking skills require analyzing and synthesizing information, communicating correctly, and finding new ideas to solve the problems at hand. Therefore, these skills are part of HOTS. According to Sanjaya (Nurlaily & Sholihah, 2021) the main purpose of higher-order thinking skills is to improve students' thinking skills related to critical thinking skills in receiving information, thinking creatively in solving problems, and making decisions in complex situations.

HOTS need to be taught correctly to every element of education, including PGSD students who are prospective elementary school teachers. By having high-order thinking skills, it is hoped that they can become teachers who can master and apply creative and innovative approaches, strategies, methods, techniques, and learning models in the future. This can support the improvement of students' HOTS and improve student learning outcomes following 21st-century learning achievements. The achievements of 21st-century learning require the ability to analyze and synthesize information, communicate correctly, and the ability to come up with new ideas to answer the problems faced, both individually and collaboratively.

In addition, in the curriculum of the Indonesian National Qualifications Framework (KKNI), where Bachelor (S-1) graduates need to be directed so that they can master the skills and scientific basis and apply them both in the form of attitudes and works by their scientific fields (Santoso et al., in Kristianto & Hudaya, 2018). Based on this, the improvement of students' HOTS is an effort to assist students in developing knowledge, skills, and attitudes following their scientific fields.

Based on the initial study results, the learning outcomes of Higher-Order Thinking Skills (HOTS) students of PGSD STKIP Bina Mutiara Sukabumi tend to be still low. This can be seen from the results of formative evaluations on several teaching materials for the Science Material Deepening course, most of the students still do not meet the assessment standards that have been set. A total of 18 students out of 30 students got an average score of 63,25. The low tendency of HOTS-oriented learning outcomes in the sub-focus of critical thinking skills and creative thinking is caused. After all, students lack learning experience, for example, because students are not accustomed to working on HOTS-oriented questions and lack learning experience based on problem-solving.

Based on the explanation, the proposed alternative solution is to apply PBL. The PBL can help develop thinking skills, problem-solving skills, think about contextual situations, and present solutions to problems (Nugraha, 2018). The implementation of the PBL is carried out in the Primary Science Material Deepening course. The purpose of implementing the PBL model in teaching courses is so that students' HOTS can be stimulated through a series of lessons. In addition, students' HOTS can be evaluated measurably so that the progress of improving their skills can be seen carefully. Besides, students can get an overview of the concept and implementation of problem-solving-oriented science material so that later it can be taught to students in elementary schools.

Many studies are oriented towards developing HOTS skills, for example, focusing on the challenges of teachers in HOTS learning in elementary schools (Seman et al., 2017), analyzing the HOTS abilities of prospective elementary school teacher students (Yuliati & Lestari, 2018), developing students' HOTS through Problem-Based Learning (Ramdiah et al., 2018), the ability of language teachers to formulate HOTS questions in class (Gozali et al., 2021). In this study, the focus of developing HOTS is on prospective elementary school teacher students, because they will become teachers who will teach elementary school students. The purpose of this study is to determine the HOTS ability of prospective teachers through the implementation of the Problem-Based Learning in the Basic Science Material Deepening course. Furthermore, the goal is that they can design learning oriented to the development of HOTS for elementary school students, and so that they can create a HOTS-oriented evaluation format with a sub-focus on critical thinking and creative thinking skills in science subjects for elementary school students.

1. Critical Thinking Concept

Critical thinking is the ability to think using the rules of logic, probability, creativity, and the ability to increase time effectiveness (Hader, in Karakoc, 2016). On the other hand, according to Horenstein (Larsson, 2017), developing critical thinking skills is considered an educational goal globally and developing self-quality. Critical thinking behavior implies an open-minded tendency to analyze and evaluate information to solve problems, including interpretation, analysis, evaluation, and conclusions (Alghafri & Ismail, 2014). Therefore, critical thinking is part of HOTS which will trigger a systematic process in formulating and evaluating beliefs and opinions.

The characteristics of thinking, according to Ennis (Larsson, 2017), include 1) identifying conclusions, reasons, and assumptions; 2) the judgmental quality of the argument

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including its reasons, assumptions, and evidence; 3) develop and maintain a position on issues; 4) draw conclusions carefully. Still, according to Ennis (Larsson, 2017), aspects of critical thinking indicators are classified into five, namely 1) elementary clarification; 2) basic support; 3) inference; 4) advanced clarification; 5) strategies and tactics.

2. Creative Thinking Concept

According to Torrance (Awang & Ramly, 2008), creative thinking is the discovery of the results of hypotheses in the problem-solving process, which is outlined in the form of new ideas or ideas. Someone who thinks creatively has sensitivity and concern for problems through various series of events, starting from the initial meeting with the emergence of the problem to solving the problem with various solutions. In learning, good creative thinking will produce competent students to apply ideas in detail (Tawil, in Ruspitasari et al., 2017). Experts explain thinking skills differently but contain the same concept generating something or ideas with novel value.

According to Torrance (Yarbrough, 2016), the characteristics/indicators of creative thinking include fluency (fluent thinking ability), flexibility (flexible thinking), elaboration (detailing skills), originality (original thinking), inventive level (creativity level). In line with what was stated by Guilford (Nuswowati et al., 2017), there are four characteristics of creative thinking, namely 1) fluency in dealing with problems; 2) originality, namely being able to produce ideas that are different from others; 3) flexibility, namely being able to change the way of thinking and solving problems with various approaches; 4) elaboration, namely careful thinking or the ability to improve detail.

3. Problem Based Learning (PBL)

According to Redjeki (Nugraha, 2018), PBL is a learning process to develop problem-solving skills and helps students gain the knowledge and skills needed. In line with what was expressed by Akçay (2009), PBL is a learning activity in which students use authentic problems as contexts for in-depth investigations about what they need and know. Problem-based learning (PBL) has been widely adopted in various fields and educational contexts to promote critical thinking and problem-solving in authentic learning situations (Yew & Goh, 2016).

According to Arends (Simamora et al., 2017), some characteristics of PBL include: 1) students must be sensitive to their learning environment; 2) the problem simulation used should be ill-structured and provoke free for inquiry learning integrated into various subjects; 3) the importance of collaboration; 4) learning should foster independence in solving problems; 5) problem-solving activities should represent real situations. The steps of the PBL, according to

Arends (Simamora et al., 2017) is; 1) provide problem orientation to students; 2) organize students to learn; 3) assist with independent and group investigations; 4) develop and present the work, and 5) analyze and evaluate the problem-solving process.

Based on the explanation, in the context of learning-oriented towards increasing HOTS, the PBL is one of the suitable learning models to be implemented. In the stages of the learning process, the PBL emphasizes students' efforts to overcome problems, thus requiring skills in making effective decisions. In addition, skills are needed to analyze problems and choose alternative problem solving according to the context of the learning material.

METHOD

This study uses a pre-experimental method with a one-group pre-test post-test design (Sugiyono, 2014). This design involves one group/sample that is first given a pre-test (O1), then given treatment (X), and at the end of the lesson given a post-test (O2). The research design is as follows.

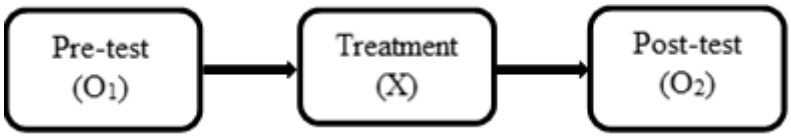

Figure 1. Research Design

This design aims to determine the improvement of HOTS in the sub-focus of critical thinking and creative thinking of PGSD students after applying the PBL. The sample in this study was 30 students of PGSD Semester VI Academic Year 2020-2021 STKIP Bina Mutiara Sukabumi. The Data collection techniques use a test to describe the questions that refer to the indicators of HOTS as many as 15 items. These indicators are as follows.

Table 1. Indicators of HOTS

Aspects of HOTS	Indicators of HOTS	Question Number
Elementary Clarification	Focusing the question	1
	Ask and answer about an explanation or challenge	2
Basic Support	Considering source credibility	3
	Observing and considering the results of observations	4
Inference	Making deductions and considering the results of the deduction	5
	Make decisions and consider the results	6

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Advance Clarification	Identify assumptions	7
Strategy and Tactics	Deciding on an action	8
Fluency	Generating many ideas, answers, problem solving or questions	9
	Always think of more than one answer	10
Flexibility	Can see a problem from different perspectives	11
Originality	Able to give birth to new ideas that have not been thought of by others	12
Elaboration	Able to explore and develop ideas or products	13
	Make decisions in open situations	14
Evaluation	Not only generating ideas, but also implementing them	15

The data analysis technique used is data prerequisite test, hypothesis test, and normalized gain test. At the data analysis stage, the first stage is to test the normality of the data. The data is normally distributed if the significance value (sig) > α = 0.05. The second stage is testing the hypothesis by conducting a t-test. If the value of sig (2-tailed) < α = 0.05, then Ho is rejected and Ha is accepted, meaning there is a significant effect of PBL implementation on the HOTS of prospective elementary school teaching students in the sub-focus of critical thinking skills and creative thinking. The third stage is the gain test to measure the increase in HOTS by looking at the difference in the pre-test and post-test scores. The calculation refers to the formula Hake (Arisa et al., 2020) as follows:

$$\text{N-Gain (each subject)} = \frac{posttest\ \text{score} - pretest\ \text{score}}{max\ \text{score} - pretest\ \text{score}}$$

Next, calculate the average gain value, with the formula:

$$\text{Average value of N-Gain} = \frac{\text{total value of } N\text{-Gain}}{\text{total subject}}$$

In the next stage, to see the effectiveness of the PBL implementation, the average gain value is normalized and adjusted into the increase criteria table (low, medium, or high).

Table 2. Criteria for Increasing N-Gain

Level	N-Gain Value Range
High	$\geq$ 0,7
Medium	0,7 > N-Gain $\geq$ 0,3

Low	< 0,3

Hake (Hartati, 2016)

As for determining the percentage category of student learning outcomes on each indicator of HOTS during the pre-test and post-test, it can use the categorization interval from Arikunto (2010) as shown in the following table:

Table 3. Criteria for Percentage of Learning Outcomes

Percentage (%)	Category
76-100	Good
56-75	Sufficient
40-55	Less
0-39	Not Good

(Arikunto, 2010)

RESULTS AND DISCUSSION

Results

The results of data analysis in this study involved data for normality test, hypothesis testing, and gain test. As for the normality test, the following results were obtained.

Table 4. Data Normality Test

Activity	Kolmogorov-Smirnov[a] Sig. Value	Description
Pre-test	.200*	Normal
Post-test	.200*	Normal

*Significance Level 0.05

Based on the results of the normality test, it can be seen that the significance value of Kolmogorov-Smirnov is 0.2 > α = 0.05. This means that the pre-test and post-test data obtained are normally distributed.

Table 5. Hypothesis Testing Data

HOTS Learning Outcomes	Sig. (2-tailed)	Description
Pair 1 Pre test – Post test	.000	There is a significant difference

*Significance Level 0.05

As for the results of the paired sample t-test, the significance value is 0.00 < α = 0.05. That means Ho is rejected and Ha is accepted, so it can be concluded that there is a significant

effect of PBL implementation on the HOTS of elementary school teacher candidates in the sub-focus of critical thinking skills and creative thinking.

Table 6. N-Gain Test

Aspect	N	Average				Category
		Pre-test	Post-test	Gain	N-Gain %	
HOTS	30	63,80	75,93	0,34	34,35%	Medium

Based on the results of the gain test, the N-Gain value is 0.34 (medium). The results of the percentage achievement of the HOTS got the following description:

Table 7. Description of the Achievement Percentage of HOTS Question Indicators

Aspects of HOTS	Indicators of HOTS	Percentage of Pre-test (%)	Percentage of Post-test (%)
Elementary Clarification	Focusing the question	46,25	61,67
	Ask and answer about an explanation or challenge	65	74,17
	Average	**55,62**	**68**
Basic Support	Considering source credibility	51,11	69,44
	Observing and considering the results of observations	58,75	72,50
	Average	**54,93**	**71**
Inference	Making deductions and considering the results of the deduction	66,11	81,11
	Make decisions and consider the results	58,33	68,33
	Average	**62,22**	**74,8**
Advance Clarification	Identify assumptions	51,67	70
	Average	**51,67**	**70**
Strategy and Tactics	Deciding on an action	66,25	74,58
	Average	**66,25**	**74,58**
Fluency	Generating many ideas, answers, problem solving or questions	89,44	98,33
	Always think of more than one answer	77,22	90,56
	Average	**83,33**	**94,45**
Flexibility	Can see a problem from different perspectives	73,33	84,44
	Average	**73,33**	**84,44**

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Originality	Able to give birth to new ideas that have not been thought of by others	73,33	86,11
	Average	**73,33**	**86,11**
Elaboration	Able to explore and develop ideas or products	36,67	46,25
	Average	**36,67**	**46,25**
Evaluation	Make decisions in open situations	76,67	84,44
	Not only generating ideas, but also implementing them	82,22	93,89
	Average	**79,44**	**89,17**
	Overall average	**63,68**	**75,88**

Below is a graph showing the comparison of the pre-test and post-test percentages of all students in each aspect and indicator of HOTS.

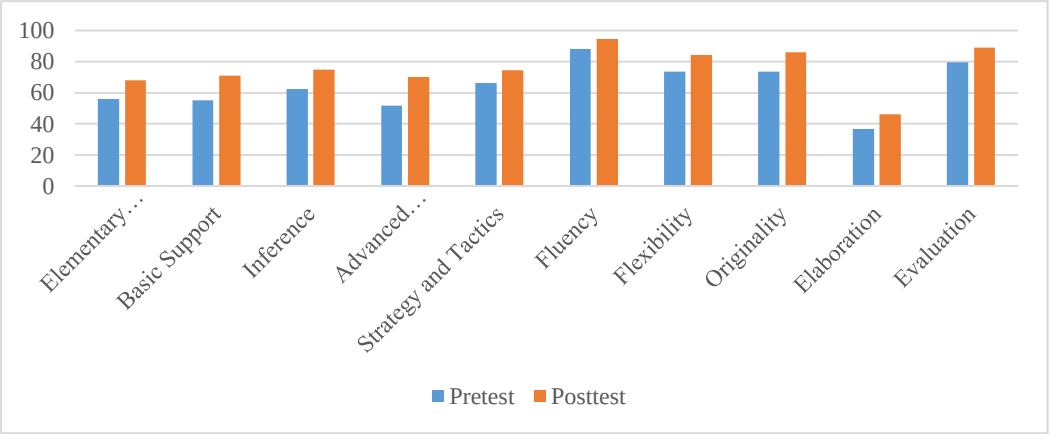

Figure 2. Percentage of Comparison of Achievement of HOTS Indicators

The result of the pre-test and post-test of the HOTS indicator showed an increase. During the pre-test, the average of all indicators of HOTS is 63.68% in the "sufficient" category, while the post-test is 75.88% in the "good" category. The post-test result of the HOTS aspect that got the lowest average percentage was elaboration (46.25%), and the highest was fluency (94.45%).

Discussion

This study confirms the results of research conducted by Miner-Romanoff et al., (2019) that the PBL can show positive results on students' critical thinking skills, creative thinking, and communication skills. Rerung et al., (2017) that PBL can improve student learning outcomes. Also, Pebriana et al., (2017) states a difference between positive critical thinking skills learning outcomes in classes that implement the PBL compared to classes that implement

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conventional learning models. Based on the study results, it can be said that the PBL can improve the HOTS of students.

HOTS in this study focus on critical thinking and creative thinking skills. Students must have critical thinking skills. Someone who masters critical thinking skills usually has social, scientific, and practical skills in solving problems (Shakirova, in Snyder & Snyder, 2008). Creative thinking skills are also essential because they can generate innovative ideas so that in solving problems, one can go through various alternative solutions (Okpara, in Handayani et al., 2021). A successful creativity learning process requires the support of a learning environment that can encourage students to apply the right concepts in solving problems. The development of these skills has relevance to the PBL. Armitage et al., (2015) state that the PBL is a pedagogical approach that encourages students to take part in the process, and act as a supportive agent of change, collaborate with colleagues, as well as individuals who use their creativity in seeking a practical solution to a problem. PBL is learning at a high level, where students understand the world from various perspectives, which in learning requires creative thinking (Lindvang & Beck, 2015).

In implementing the PBL, students are invited to think critically and creatively through problem-solving-oriented learning offerings. In this activity, the first step, students are grouped into six groups. In the second step, each group is given problem-solving exercises in the form of questions related to the material about environmental pollution. In the third step, each group discusses the answers or solutions to questions that contain environmental problems. Problem-solving activities carried out on the PBL are an excellent technique for students to understand the lesson's content. This activity will also make students find their knowledge to become more meaningful and improve students' cognitive competence (Aswan et al., 2018). The PBL can directly facilitate students' reasoning and problems that arise from critical questions and answers and are sourced from learning activities that center student attention (Kashani-Vahid et al., in Rudibyani, 2019).

This grouping and problem-solving activity aim to stimulate students' critical and creative thinking skills. In this context, there is a relevance between the PBL and HOTS as stated by Shakirova (Snyder & Snyder, 2008) that the PBL supports critical thinking skills, which in learning use questioning techniques. It requires students to analyze, synthesize, and evaluate information in solving problems and making decisions. So, critical thinking is a mental habit that requires students to use HOTS, not just memorizing data or just receiving information (Shakirova, in Snyder & Snyder, 2008). According to Birgili (2015), creative thinking is a

series of cognitive activities individuals use according to particular objects, problems, conditions, or types of efforts towards specific events and problems based on individual capacities. In this context, the PBL can encourage students to think creatively to formulate different solutions to various problems. Çetinkaya (2014) suggests that to develop students' creative thinking skills, it is necessary to ask exciting questions above the level of gifted students, turning to different group studies, thus enabling them to express themselves on a particular topic. In addition, the details and elaboration in their answers should be included in the content of the problem-solving process.

CONCLUSION

Based on the results of the study, it can be concluded that: first, the HOTS of prospective elementary school teacher students at STKIP Bina Mutiara Sukabumi has increased by using the Problem Based Learning. This can be seen from the increase in achievement on each HOTS indicator. Second, based on the results of the t-test, it shows that the problem-based learning has a significant effect on students' HOTS. Third, the results of the gain test show that the increase in student HOTS is in the medium-level category. Based on the explanation of the results of the research above, it is expected that prospective teachers, especially prospective elementary school teachers, will get stimulation and training to develop HOTS in each subject. When prospective elementary school teachers are accustomed to higher-order thinking, then when teaching in elementary schools it is expected that they will not experience difficulties in stimulating their students to be able to think at higher levels with the demands of 21st-century skills. As for suggestions for further research, it is expected that they can examine the mastery of HOTS in prospective elementary school teachers on various teaching materials. In addition, there is a need for research on the development of HOTS-based teaching materials to support the success of the learning process.

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