HOTS & PROBLEM-BASED LEARNING (PBL) WITH BLENDED LEARNING

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Abstract – In the world of education, attainment of competence does not only involve increasing knowledge but must be equipped with creative abilities, high-level thinking, strong character, and supported by the ability to utilize information and communication. One way to achieve these competencies is by using blended learning-based problem-based learning methods. This study seeks to review articles on improving students' higher-order thinking skills using blended learning based on problem-based learning methods to investigate the combination of these two methods in increasing students' HOTS.

Keywords: HOTS, Problem-Based Learning, Blended Learning

INTRODUCTION

The learning process should improve knowledge skills, but it also has to enhance students' creative abilities, high-level thinking, strong character, and the ability to utilize information and communication. Students should have great high-order thinking skills to face various challenges in an increasingly complex era of globalization.

This article examines the potentials of blended learning developed on problem-based learning (PBL) in improving Higher Order Thinking Skills (HOTS). PBL is applied to stimulate higher-order thinking in problem-oriented situations (Anazifa, 2016; Bayrak & Bayram, 2011; Utomo et al., 2014). Firmansyah et al. (2015) explained that PBL provides opportunities for students to explore authentic experiences to encourage students to actively and scientifically learn, construct knowledge, and integrate it into the context of learning in school and real life. Blended learning technique is online learning that helps students learn independently without direct teacher guidance, assisting conventional learning carried out by teachers to help students obtain information without face-to-face meetings (Anggraini et al., 2016). Blended learning is also proven to improve and train students' independence in learning and critical thinking skills.

Combining these two methods, namely PBL based on blended learning, can be a new learning strategy since both have a similar goal to improve and train students' higher-order thinking skills. This combination is in accordance with the research conducted (Asmi, 2019) that identifies differences in students' HOTS abilities after using the PBL learning method based on blended learning compared to using the PBL learning method alone, with a significant t-test value of 0.040, smaller than 0.050. This research is also supported by a study from Khusnul (2018) that by using

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this blended learning-based PBL method, the class average higher-order thinking score has increased from the first cycle to the second cycle by 11.8%.

METHOD

This study used literature from articles derived from nationally accredited journals in Indonesia and other countries. The initial criteria in determining the articles to be reviewed were published in the last three years (2018, 2019, and 2020). However, to make the review more complex, we expanded the review of all issues in the journal. The literature review was carried out by discussing previous research on learning using the Problem-based learning (PBL) method based on blended learning to improve students' HOTS. The selected articles are shown in Table 1.

Table 1. List of Articles reviewed

No	Year	Code
1	2019	A1
2	2018	A2
3	2019	A3
4	2019	A4
5	2021	A5
6	2019	A6
7	2020	A7
8	2020	A8
9	2020	A9
10	2019	A10

RESULTS

Table 2 shows the analysis results of the selected articles investigating the blended learning-based PBL methods carried out in Indonesia and other countries. The selected articles show an increase in students' creative abilities after using blended learning-based PBL methods.

Table 2. Results of the Analysis of the Reviewed Articles

Code	Analysis	
	Research sources (place and sample)	Research result
A1	The data sources for this study were 28 students who took cell materials, Biology courses at the Department of Biology at the University of PGRI Madiun.	Blended PBL can train students in improving their critical thinking skills to give simple explanations, build basic skills, provide further explanations, determine problem-solving actions, and draw conclusions correctly. This conclusion is observed from the low decreasing score obtained by students after blended-based PBL is applied. On the other hand, the frequency of students' high scores increases. Before blended-PBL was applied, 97.01% of students got low scores, and only 2.99% got high scores. In contrast, after blended-PBL was applied, the frequency of low scores decreased to 47.4%, while those who got high scores increased to 52.60%.
A2	A stratified sampling technique was applied to select a sample of 388 students (204 boys and 184 girls) drawn from nine second-class private high schools in Lagos State in Southwest Nigeria.	Student achievement in mathematics algebra increases when PBL and BL strategies are used compared to TLM (regular lectures) classes. This finding is based on the post-test mean scores of students on the BL and PBL strategies with higher scores of 34.36 and 24.25, while the TLM is only 17.47.
A3	The experiment was conducted on class XI IA-3 and IA-6 State Senior High School 4 Malang. There were 32 students in the experimental group, 18 women and 14 men. The control class also consisted of 32 students, 17 girls and 15 boys.	Data on students' higher-order thinking skills (HOT) were collected using a test consisting of 20 items. The data are classified according to Bloom's taxonomy, namely, analyze, evaluate, and create. The results showed that the mean value of the Blended PBL class (16.19) is higher than the control class (9.03). The obtained Cohen's d value is 4.831 with an effect size of $r = 0.92$. The analysis shows an increase in students' higher-order thinking skills taught using PBL blended with online learning.
A4	The sample of this study was sixty students majoring in English who took a creative writing course at Chiang Rai Rajabhat University, Thailand. Thirty students were in the PBBL class, and thirty students were in the traditional PBL class.	PBL based on blended learning (PBBL) effectively produces a higher score in creative writing than PBL alone. This finding can be seen from the overall average score of students in the PBBL class, 120.55 out of 180 points, while the average for students in traditional PBL classes is 111.30.
A5	The subjects of this study were students of class X majoring in Office Automation and Governance (OTKP) in Business Economics at the Patriot IV Ciawigebang Vocational High School, which consisted of five classes with a total of 135 students. Two classes were investigated from all the students of class X, namely X OTKP 2 as the experimental class and X OTK 5 as the control class.	Blended learning with a problem-based learning model is more effective in improving students' creative thinking skills than the lecture method, as observed from the N-gain of the experimental class of 0.63, which is higher than that of the control class 0.32.
A6	The sample of this study were students of the State University of Malang. Two classes were selected, namely the experimental and control classes, with 31 students each.	The results of the PBL learning method based on blended learning compared to the PBL learning method alone in improving students' HOTS ability obtain a t-test value with a significance of 0.040, smaller than 0.050.
A7	This research was conducted at SMA Negeri 2 Ungaran, Semarang Regency. There were 36 tenth grade high school students for the 2018-2019 school year.	The application of the blended learning-problem-based learning method showed that 27 out of 36 students (75%) understand the redox concept and nomenclature of compounds, eight students (22%) have misconceptions, and 1 out of 50 students (0.3%) does not understand the redox concept and nomenclature of compounds. Applying the blended learning-problem-based learning model can help students understand redox reaction material and compound nomenclature.
A8	The population in this study were all students of the University of Lampung electrochemistry in 2019, consisting of 50, with 30 female students and 20 male students.	The result of this study shows that the experimental class (A) has a higher n-gain value (0.53) than the control (B) class (0.26), with a higher effect size observed in class A. It can be concluded that problem-based learning significantly increases confidence and mastery of concepts on the electrochemical theme.
A9	The sample of this study consisted of two classes in the Department of Mechanical Engineering, Bali State Polytechnic, assigned as the experimental group (n=59) and the control group (n=58).	The results were derived from the pre-test and post-test results of the two groups after six treatment meetings. The mean post-test score of the control group is 60,759, and the experimental group is 74,711. This finding shows that the blended PBL method is more effective as a learning style to improve conceptual understanding of chemistry.
A10	The research was conducted on four Integrated Natural Sciences public secondary schools in the Philippines. There were two classes for the non-PBL group (50 students with 24 male and 26 female) and two classes for the PBL group (with a total of 46 students, 14 boys and 32 girls)	The average pre and post-test scores for the PBL group class were 0.32 and 0.79, respectively. While the non-PBL grub classes were 0.23 and 0.40, respectively. This shows that the PBL class obtains higher scores. Meanwhile, the effect size of the PBL approach is also higher than the effect size of the non-PBL approach, which is $d = 2.10$, while the non-PBL effect size is $d = 0.85$. These results indicate that the PBL approach is more effective than the non-PBL approach in improving problem-solving skills.

PROBLEM-BASED LEARNING (PBL) AND BLENDED LEARNING

PBL is a good learning strategy to improve student academic achievement, develop their social skills, be active in group discussions, and become independent learners (Argaw et al., 2017). In a PBL strategy, understanding comes from interaction with problem scenarios and the learning environment. The interaction aids students to build their knowledge, thinking skills, engagement with problems, problem-solving processes, and social and collaborative processes (Tan, 2003). Studies in the field of chemistry teaching identify that PBL effectively improves conceptual understanding (Ayyildiz, & Tarhan, 2017; Bilgin, Şenocak, & Sözbilir, 2009; Günter & Alpat, 2016; Overton & Randles, 2015; Taşoğlu & Bakaç, 2014; Valdez & Bungihan, 2019; Yaayin, 2018). The syntax of the PBL method is presented in Table 3.

Table 3. Syntax of PBL Method (Trianto, 2012)

No	Steps	Explanation
1	Familiarizing the students with the problem	The teacher explains the learning objectives asks students to investigate and observe the selected problems.
2	Organizing students to learn	Help students organize assignments related to the problem
3	Guiding individual and group investigations	The teacher helps students collect information that is appropriate to the problem.
4	Develop and present the work	The teacher helps students plan and prepare appropriate models such as reports and so forth.
5	Analyze and evaluate the problem-solving process	Teachers reflect and evaluate their work

Blended learning refers to two aspects, namely face-to-face and computer-based learning (online and offline). According to Watson & Murin (2014), blended learning is a formal education program where students get part of learning through online learning, with controls of time, place, choice of material, speed of learning in the hands of students, and another part of learning is guided learning outside the home. These student learning modalities are interconnected to get an integrated learning experience. Blended learning applied by teachers increases students' curiosity about information and the flexibility of learning while reducing costs used in the learning process (Collins et al., 2003; Garnham & Kaleta, 2010). In addition, students can learn according to their respective learning speeds without being influenced by their friends (Yapici and Akbayin, 2012). Previous research has shown that blended learning techniques affect student learning outcomes (Wong et al., 2014), give positive results on students' problem-solving and understanding of concepts on acid-base material (Kurniawan, 2014).

POTENTIAL PBL METHOD BASED ON BLENDED LEARNING IN INCREASING STUDENT HOTS

a. Definition and Concept of HOTS

The attainment of the HOTS thinking process covers high knowledge that includes the levels of analytical, evaluative, and synthetic thinking. HOTS is an educational reform concept that requires learning methods based on a learning taxonomy, such as Bloom's taxonomy which

involves analysis, evaluation, and synthesis skills. According to Bloom, education should focus on competence (mastery subject) and the achievement of higher-order thinking outcomes.

HOTS questions measure higher-order thinking skills and consist of four indicators, namely: 1) problem-solving skills, 2) decision-making skills, 3) critical thinking skills, and 4) creative thinking skills. Serevin et al. (2019) explain that HOTS questions are prepared based on several indicators, namely: 1) identifying and associating relevant information from a situation, 2) making appropriate conclusions based on information from a situation, 3) finding consistency or inconsistency in operation, 4) assessing operations or relevant products based on criteria, 5) combining ideas or strategies to solve problems, 6) using the right ideas or strategies to solve problems, and 7) developing new alternatives in solving problems.

Creative thinking pedagogy helps students develop more innovative ideas, ideal perspectives, and imaginative insights. HOTS is a major component of creative and critical thinking. HOTS focuses on developing students' ability to analyze and evaluate by concluding existing information and creating (synthesize) something new (Chinedu, Olabiyi & Kamin, 2015). Suprapto et al. (2017) define HOTS as a thinking activity that involves a hierarchy of cognitive levels from Bloom's Taxonomy. The concept of HOTS is derived from several opinions, as shown in Table 4.

Table 4. Concept of Higher-order Thinking Skills

Problem- Solving (Krulik & Rudnic, 1998)	**Bloom Cognitive Taxonomy (1956)**	**Revised Bloom's Taxonomy from Anderson & Krathwohl (2001)**	**Higher-Order Thinking Skills**
Recall Basic (Dasar)	*Knowledge Comprehension Application*	*Remember Understand Apply*	-
Critical Creative	*Analysis Synthesis Evaluation*	*Analyze Evaluate Create*	*Critical Thinking Creative Thinking Problem-Solving Decision Making*

b. The Potential of Blended Learning-Based PBL Learning Methods in Improving Students' HOTS

The HOTS-based instrument is essential because it is effective as an evaluation tool for learning outcomes as it distinguishes students with high, medium, and low abilities. Learning will be meaningful if students are invited to think higher. In addition to the importance of the HOTS ability to compete in the working field and personal life, students must have the ability to think critically creatively and solve problems. The importance of the HOTS assessment instrument is in line with the significance of measuring students' HOTS, especially in chemistry subjects. HOTS is useful to help students improve learning performance and reduce students' weaknesses. Great students are trained with activities that aim to produce good thinking.

A study carried out by Nabila et al. (2018) on the relationship between HOTS and students' academic achievement in acid-base material shows a linear, positive, and strong relationship between HOTS and academic ability. Research conducted by Kusuma et al. (2017) shows that the HOTS instrument effectively trains students' HOTS and measures students' HOTS levels. The

HOTS test instrument can encourage students to think deeply about the learning material so that the HOTS test instrument can be used as a stimulus to develop students' HOTS levels.

PBL has proven to be effective in accelerating students' high-level skills in communication and applying new knowledge and skills appropriate to vocational education (Sada et al., 2015). Flamboyant et al. (2018) and Fatchiyah (2016) show that a PBL model has a moderate positive influence on HOTS. This is also supported in the research of Royantoro et al. (2018), which shows that student learning outcomes in the experimental class taught PBL increase, from 21.33 to 58.5, while the control class taught conventional learning increases 26.66 to 51.21. Statistically, PBL has been confirmed to affect students' HOTS skills significantly. According to a study carried out by Awan et al. (2017), learning chemistry using the PBL model (experimental class) results in better students' scores than the control group in problem-solving ability and achievement tests. Besides, the experimental class also has better critical thinking skills (understanding, analyzing, evaluating, and synthesizing). Blended learning problem-based learning combines learning delivery strategies using face-to-face activities, computer-based learning (offline), and online learning (internet and mobile learning). By using blended learning, teachers/educators can use various sources of information that can be obtained online or offline.

Combining these two methods, namely PBL and blended learning, can be a new learning strategy as they have the same goal, to improve and train students' higher-order thinking skills. This is following research conducted by Khusnul (2018) that by using this blended learning-based PBL method, the class average higher-order thinking score has increased from the first cycle to the second cycle by 11.8%. This is also in accordance with research from Elinira et al (2017) that using the PBL method can increase the percentage of students' caring attitudes on the problem of water pollution by 90%, while the PBL blended method increases the percentage by 92%.

The advantages of the blended learning model are that it can cover the shortcomings of the PBL learning method and work synergistically in achieving learning goals. The lack of a PBL learning model to achieve all its learning objectives include a relatively long time. Thus, it requires combining with another method that provides a shorter period, such as the blended learning method. Blended learning enables the learning to be carried out at any time and anywhere, online or offline. The application of PBL based on blended learning is expected to increase HOTS in a relatively short period. It is expected that the use of PBL learning based on blended learning can realize learning that encourages students to think more critically analytically and have high abilities in solving a problem with several possible solutions. The obtained data suggest that students' HOTS abilities increase and become highly intellectual.

CONCLUSION

Based on several articles that have been reviewed, the use of problem-based learning methods based on blended learning is a more effective learning strategy that can improve learning outcomes and improve students' creative abilities. PBL based on blended learning can achieve the syntax or objectives of the learning method more quickly and efficiently. PBL can help students formulate high thinking skills, improve critical thinking skills, and construct knowledge because, through problem-based learning, students learn to solve real-world problems in a structured way.

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