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IMPLEMENTATION OF A PROBLEM-BASED LEARNING (PBL) MODEL ASSISTED BY ZOOM CLOUD MEETING IN IMPROVING HIGH SCHOOL STUDENTS' CRITICAL THINKING SKILLS AND LEARNING MOTIVATION ON THE CONCEPT OF ENVIRONMENTAL POLLUTION

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui keefektifan model problem based learning (PBL) dalam meningkatkan kemampuan berpikir kritis dan motivasi belajar siswa kelas X SMA melalui pembelajaran berbasis biologi konsep lingkungan dan pencemaran, khususnya pencemaran air dan tanah. Penelitian ini juga bertujuan untuk mengetahui tanggapan siswa terhadap model pembelajaran berbasis masalah. Eksperimen semu dengan kelompok kontrol sebelum dan sesudah tes digunakan untuk melakukan penelitian. Penelitian ini dilakukan selama empat kali pertemuan. Populasi penelitian ini adalah seluruh siswa SMA kelas 10, dengan karakteristik sebagai berikut: siswa kelas 10 SMA kelas 1 merupakan kelas eksperimen yang menerapkan PBL dengan Zoom Cloud Meeting, dan siswa kelas 10 SMA kelas 2 siswa merupakan kelas kontrol dengan model pembelajaran pendekatan saintifik. Tes N-Gain digunakan untuk mengukur kemampuan berpikir kritis sebelum dan sesudah pembelajaran, serta tingkat motivasi di akhir pembelajaran, untuk mengumpulkan data penelitian ini. Hasil penelitian menunjukkan bahwa: 1) Model PBL berhasil diimplementasikan dengan skor 95% menggunakan Zoom cloud meeting. 2) Jika dibandingkan dengan model 5M, pelaksanaan pembelajaran dengan model PBL melalui Zoom Cloud Meetings meningkatkan kemampuan berpikir kritis siswa. Hasil uji N-Gain berada pada kisaran menengah, tepatnya 0,51. 3) Penggunaan Zoom cloud meeting untuk penerapan pendekatan PBL tidak memberikan pengaruh yang berarti terhadap peningkatan motivasi belajar siswa. 4) Siswa sangat antusias mempelajari metodologi PBL menggunakan sesi Zoom cloud

Kata kunci: Pembelajaran Berbasis Masalah; Polusi air; Polusi tanah; Kemampuan berpikir kritis; Motivasi Belajar

ABSTRACT

This study aims to determine the effectiveness of the problem-based learning (PBL) model in improving the critical thinking skills and learning motivation of 10th grade senior high school students through the biology-based learning of environmental concepts and pollution, especially water and soil pollution. This study also aims to determine students' responses to the problem-based learning model. A quasi-experiment with a control group before and after the test is used to conduct the research. This research was done over the course of four meetings. The population of this study consists of all 10th-grade senior high school students, with the following characteristics: the first 10th-grade senior high school students are an experimental class implementing PBL with Zoom Cloud Meeting, and the second 10th-grade senior high school students are a control class with a scientific approach learning model. The N-Gain test was used to measure critical thinking skills before and after learning, as well as the level of motivation at the end of learning, to collect data for this study. The findings showed that: 1) The PBL model was implemented successfully, with a score of 95%, using Zoom cloud meetings. 2) When compared to the 5M models, the implementation of learning using the PBL model through Zoom Cloud Meetings improved students' critical thinking skills. The N-Gain test results were within the middle range, precisely 0.51. 3) Using Zoom cloud meetings to apply the PBL approach has no meaningful effect on increasing students' learning motivation. 4) Students were highly enthusiastic about studying the PBL methodology using Zoom cloud sessions

Keywords: Problem Based Learning, Water Pollution, Soil Pollution, Critical Thinking Skills and Learning Motivation

INTRODUCTION

As the Fourth Industrial Revolution approaches, educational institutions must produce a dependable generation capable of competing globally and possessing the competencies required in the twenty-first century (Luna Scott, 2015). These characteristics include critical thinking abilities, creative thinking abilities, inventiveness, problem-solving abilities, communication abilities, and a strong desire to learn. According to (Gafour & Gafour, 2020), critical thinking abilities are employed not just in the educational process to get excellent grades, but also in dealing with difficulties in everyday life and addressing challenges in the workplace (Khatib & Alizadeh, 2012).

According to Trends in International Mathematics and Science Study (TIMSS) survey in 2015 conducted by the International Association for Evaluation

and Educational Achievement (IEA), Indonesia was ranked 45th out of 48 countries with a score of 397. This indicates that Indonesian students' cognitive abilities are still weak, resulting in poor learning outcomes. In addition, the learning success of students is influenced by their motivation to learn. As stated in one of the national educational goals, which is to produce students with a passion for learning, a spirit of knowledge addition, and an insatiable curiosity, the learning process occurs not only in formal education but also throughout life. (Tokuhama-Espinosa, 2015) distinguished the types of motivation into two, namely intrinsic motivation and extrinsic motivation. If a behavior is based on motivation, interest and desire that comes from within him, it is referred to as intrinsic motivation. Similarly, if the desires and behaviors performed are influenced by others, then it is referred to as extrinsic motivation Click or tap here to enter text.(Deci & Ryan, 2013).

Consequently, a teacher in the learning process must be able to create an effective learning model that can enhance students' critical thinking skills and inspire their learning. It is anticipated that the selected learning model's innovation will provide a fun learning environment that will enhance students' critical thinking and interest in and motivation for studying, hence enhancing their learning outcomes. The problem-based learning (PBL) model is one of the learning models that can be utilized as a guide to improve the critical thinking skills and learning motivation of these pupils (Maba, Perdata, Astawa, & Mantra, 2018).

The PBL model is an interactive, constructivist, and student-centered learning paradigm in which the problem produced by students as a perception is a real-world problem (Ali, 2019) . Problem-based learning is ill-structured, as problem-solving might employ a range of professions. This model's hallmark, namely the use of real-world situations as something students must master, is intended to train and strengthen their critical thinking skills. According to research conducted by (Aryanti, 2017) on the application of PBL to increase students' critical thinking skills in relation to the idea of environmental pollution, PBL was found to significantly improve students' critical thinking skills. In a study conducted by (Lukitasari, Purnamasari, Utami, & Sukri, 2019), it was shown that the PBL model had a substantial impact on the improvement of high school students' critical thinking skills.

On the other side, countries around the world have been dealing with a health problem, notably the COVID-19 pandemic, since the beginning of 2020 Click or tap here to enter text.(Toquero, 2020). The COVID-19 pandemic's influence, which initially exclusively damaged the economic sector, was subsequently felt in the school sector. Dozens of countries have put an end to face-to-face teaching and learning in schools. Such circumstances prompted the Government of the Republic of Indonesia to release Circular Letter (SE) Number 3 for 2020 on March 18, 2020, concerning the policy of prevention of the spread of COVID-19 in the education unit and the implementation of education policy during the COVID-19 emergency. According to the Circular Letter, the learning process is carried out at home through online learning (distance) to provide students with experience (Simamora, 2020).

The accuracy with which internet-based learning media is selected is a factor that can affect the efficiency of digital technology in the learning process, particularly learning with the PBL paradigm (Al-Samarraie, 2019). Learning via videoconferencing can transform traditional face-to-face learning in the classroom into a virtual face-to-face activity using internet-connected applications (Hatip, 2020). The use of video conferences in PBL learning can allow students and teachers to interact face-to-face even when they are in separate locations. Zoom Cloud Meeting is one of the tools that allows teachers to engage with pupils digitally through video conferencing utilizing a laptop, PC, or smartphone. Using this application enables an effective teaching and learning process for developing students' thinking skills as well as their passion for studying. According to research conducted by Kusuma et al. (2020) comparing student learning results using WhatsApp Group and Zoom Cloud Meeting platforms, students who learn using the Zoom Cloud Meeting application achieve better learning outcomes than students who learn using WhatsApp Group.

As with face-to-face learning in the classroom, teachers face challenges in the implementation of distance learning. Through in-depth interview activities using WhatsApp Video Calls, the author's preliminary investigation of distance learning in biology classes at Al-Multazam High School found that teachers and students perceived online learning to be less ideal in its implementation. Due to the limits of learning media in the distant learning process, teachers feel less than optimal. The learning is restricted to delivering the core materials exclusively through an internet-based learning application platform, such as Google Meet, Edmodo, and Zoom Cloud Meeting; the remaining assignments can be performed freely by students at home using the Telegram group platform.

This circumstance leads to the development of critical thinking and the application of learned concepts in the actual world among inadequately trained students. In addition, the learning motivation of students participating in remote education is still rather low, as seen by the fact that when the teacher poses questions during distance education, only a handful of students enthusiastically respond. Another factor is that the climate of learning at home differs from the atmosphere of learning at school, with children not receiving as much support and direction from those around them to study, resulting in less optimally fueled learning motivation.

Consequently, the purpose of this study is to examine the impact of the application of the PBL model supported by cloud meeting zoom on the critical thinking abilities and learning motivation of senior high school students in regard to the idea of water and soil pollution.

RESEARCH METHOD

The quantitative research method was used together with a pre-and post-test control group design and a sort of pseudo-experimental study called quasi-experimental research. In this study, there are two classes with balanced abilities: the experimental class and the control class. Before starting treatment, students in

the experimental and control groups took a pre-test to ascertain their baseline critical thinking abilities. This pre-test verified that the capabilities of both sample classes were evenly distributed.

In addition, experimental grades received a media-supported PBL model of Zoom Cloud Meeting, whereas control class pupils received a scientific (5M) approach assisted by Zoom Cloud Meeting. Furthermore, each experimental class and control class is given a post-test and a questionnaire to measure the students' final critical thinking capacity and motivation for learning, respectively. Students in the experimental class were also asked to fill out a survey about how they felt when a PBL model supported by Zoom Cloud Meeting was put into place.

Tabel 1

Pre-test research design and Post-test Control Group Design

E	**O_1**	**X_1**	**O_2**
K	**O_3**	**X_2**	**O_4**

Description:
O1 : Pre-test of experimental group
X1 : Experimental class learning with PBL model assisted by Zoom Cloud Meeting.
O2 : Post-test provision of experimental group
O3: control group pre-test
X2 : Control class learning with Zoom Cloud Meeting-assisted 5M approach.
O4 : Provision of post-test control group

Excel and SPSS version 26 are utilized to apply quantitative methodologies to student pre- and post-test results on tests of critical thinking skills. On the basis of observation sheets, motivation surveys, and student replies, qualitative data analysis is conducted.

In order to reach a conclusion, authors need to interpret percentages derived from data analysis into sentences. Table 2 contains the criteria for calculating the proportion of occurrences on the observation sheet.

Table 2
Percentage of Occurrences on observation sheet

No.	Range	Classification
1.	76% - 100%	Good
2.	56% - 75%	Enough
3.	40% - 55%	Not Good

4.	0% - 39%	Not Good

The results of analyzing the learning activity observation sheet can be used as a guide to identify learning activities by using a PBL model supported by Zoom Cloud Meeting during the learning activities.

RESULT AND DISCUSSION

The results demonstrated an improvement in students' critical thinking skills in both experimental and control classes after the cloud-meeting zoom-assisted PBL model was introduced. The N-Gain test showed that the N-Gain experimental class with an N-Gain score of 0.51 belonged to the moderate category, whereas the control class with an N-Gain score of 0.22 belonged to the moderate category. Despite being in the same category, the average value of the N-gain in the experiment class is greater than the average value of the N-gain in the control class. This demonstrates that the PBL model outperforms the 5M strategy in terms of increasing students' critical thinking skills.

The zoom-assisted PBL model utilized in learning has little influence on the motivation of experimental class learning. This is due to the fact that students will continue to be interested in studying, not because of the model (extrinsic factors), but because they already desire to learn and succeed (intrinsic factors).

1. Implementation of PBL Model assisted by Zoom Cloud Meeting.

The PBL model's learning implementation is assisted by Zoom Cloud Meeting, which is monitored using observation sheets filled out by observers invited by researchers through link codes during learning in the Zoom Cloud Meeting virtual environment. The observer in this study is a biology teacher, a colleague who understands the phases (or syntax) of learning with the PBL model through Zoom Cloud Meeting in order to avoid mistakes in delivering evaluations. According to the findings of the observer evaluation, learning implementation received a score of 95% in the category carried out and 5% in the category less carried out.

Table 3
Observer Assessment of Learning Model Implementation

No	Activities	Observation	
		Teacher1	**Teacher2**
1.	Teachers get students to conducive learning situations (Discipline)	**2**	**2**

No	Activities	Observation	
		Teacher1	Teacher2
2.	Teachers together with students begin learning by reading prayers (Religious)	**2**	**2**
3.	Teacher checks student attendance (Discipline)	**1**	**1**
4.	The teacher gives a pretest of critical thinking skills on soil pollution material to students	**2**	**2**
5.	The teacher gives questions that invite students' curiosity (Preplanning/early activities of the learning process)	**2**	**2**
6.	The teacher mentions the topics that will be discussed during this research	**2**	**2**
7.	The teacher mentions KI, KD, and learning objectives	**1**	**2**
8.	The teacher conveys the learning process that must be achieved by students	**2**	**2**
9.	The teacher explains the implementation of PBL assisted by zoom cloud meetings that will be used in the open link learning process, login procedures (creating a positive learning environment)	**2**	**2**
10.	The teacher invites you to listen to the material content, images, and videos according to the learning objectives in zoom cloud meetings (developing lesson plans to create independent learning)	**2**	**2**
11.	The teacher shows the initial video on soil pollution provided in zoom cloud meetings (identifies appropriate learning activities)	**2**	**2**
12.	The teacher invites students to identify topics that are in zoom cloud meetings and organize students into groups (carrying out learning and monitoring activities)	**2**	**2**
13.	The teacher directs students to work on the assignments contained in the student assessments sheet on the Google form (self-study)	**2**	**2**
14.	Teachers and students collaborate in evaluating their learning, broadcasting news about the	**2**	**2**

No	Activities	Observation	
		Teacher1	Teacher2
	dangers of soil pollution and providing assessments		
15.	The teacher confirms the entire topic that has been presented by each group	**1**	**2**
16.	The teacher gives praise to the group whose presentation results are very good and gives enthusiasm and motivation to other students to do better (evaluating individual learning outcomes and external motivation)	**2**	**2**
17.	The teacher straightens and strengthens the material that students have not understood, reminds the dangers of soil pollution (curiosity, applies knowledge and moral values)	**2**	**2**
18.	The teacher and students summarize the conclusions of the lesson and provide feedback on what is produced in the learning process (hard work)	**2**	**2**
19.	The teacher gives homework (increases learning independence)	**2**	**2**
20.	The teacher gave a post-test of critical thinking skills on soil pollution material to students and at the end of each meeting closed the lesson by reciting hamdalah.	**2**	**2**
		37	**39**

Average	**38**
Precentage	**95%**

Missed learning activities occurred when teachers were less effective in regulating student presence and communicating with students about KI, KD, and learning objectives. Overall, the findings revealed that "the researchers' stages of the Zoom Cloud Meeting-assisted PBL model in the experimental class were successfully executed." The implementation of this Zoom Cloud Meeting-assisted PBL paradigm will not be successful unless instructors and students work together effectively. According to Johnson's theory, the researchers' technique for starting the study is to describe the learning model that would be employed to students ahead of time. This is to avoid any confusion among

students and to allow them to prepare all of the essential research tools, such as mobile phones, computers, internet networks, reference books, and other PBL-related facilities.

Furthermore, researchers ensure that the syntax of the PBL model is implemented correctly, despite the virtual aspect of the learning. Starting with the construction of the learning plan, the opening, core activities, analysis, and assessment of the problem-solving process are carried out in line with the syntax and learning plan created by the researchers.

Optimizing the exploitation of premium Zoom media is an additional component that contributes to the effective execution of this Zoom-assisted PBL paradigm. The use of videoconferencing has a significant function in the dissemination of information, particularly when carried out properly (Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye, 2007). During the study, the researchers requested that all students use the camera feature so that students might concentrate more on following the PBL model step by step and so that all students not only listen to explanations but also have direct interaction with researchers, although digitally. (Sandiwarno, 2016) conducted research and found that learning through video conference, in addition to enhancing the presence of direct connection between students and professors, could also enhance the learners' attentiveness when observing the offered materials.

2. Improving Students' Critical Thinking Skills after Implementing a Zoom Cloud Meeting-Assisted PBL Model.

table. 4
Experimental Class and Control Class Pre-test Value Data

Data	***Pre-Test***	
	Experiment	**Control**
N	27	30
Minimum value	44,4	44,4
Maximum value	58,3	61
Range	14,1	15,6
Mean	51,13	51,57
Modus	50	55,56
Median	50	52,8
Deviation Standard	3,87	4,82

Table 5
Experimental Class and Control Class Post-test Value Data

Data	*Post-Test*	
	Experiment	**Control**
N	27	30
Minimum value	61	47,2
Maximum value	94	80,5
Range	33	33,3
Mean	76,44	62,2
Modus	75	63,8
Median	77,77	69,4
Deviation Standard	8,730	9,358

Table 6
Percentage of Achievement of Each Indicator of Critical Thinking Skills Based on Pre-Test Value

Indicator of Critical Thinking Skills	**Percentage of Achievement of Each Indicator of Critical Thinking Skills**	
	Experimental class	**Control Class**
Elementary Clarification	46,91 %	45,56 %
Basic Support	57,20 %	56,67 %
Inferring	46,91 %	51,11%
Advanced Clarification	57,41 %	52,78%
Strategies and Tactics	46,30 %	49,44%
Average	**51,13 %**	**52,22%**

Table 7

Percentage of Achievement of Each Indicator of Critical Thinking Skills Based on Post-Test Value

Data	*Post-Test*	
	Eksperiment	**Kontrol**
N	71,60 %	53,89%
Minimum value	77,78 %	67,04%
Maximum value	79,84 %	64,44%
Range	75,31 %	62,78%
Mean	74,69 %	59,44%
Modus	**76,44 %**	**62,22%**
Median	71,60 %	53,89%
Deviation Standard	77,78 %	67,04%

According to the figure above, information is gathered on the critical thinking skills of each sample class. Students in experimental and control classes scored the lowest percentage on the indicator, achieving a 71.60 percent simple explanation score. Although this metric is very straightforward in comparison to others, pupils score poorly. This is because when students answer questions presented by researchers, specifically questions 9 and 4 (post-test), they provide logical, on-target responses; however, when asked to mention the impact of oil spills on water and the impact of waste on the environment, nearly all students mention only two impacts. Therefore, the range of points (values) provided by researchers is limited to a maximum of 2. This impacts the total percentage average.

In terms of attaining the highest indicators, pupils in the experimental class are on the indicator's conclusion (inferring). Previously, experimental grade children had the lowest percentage of average scores on this indicator, 46.91, based on pre-test findings; however, after learning using the PBL approach, this percentage climbed to 79.84 based on post-test data. The high accomplishment of experimental class students on this inferred indicator is a result of the PBL model's phases in which students become used to understanding the core of the problem and structuring problems so that they are simpler to reason about and find solutions for.

While using the PBL approach, researchers provide a real-world problem to students; in this example, researchers employ student worksheet media that is communicated via the zoom screen. There are instructions in the student worksheet that students must follow in line with the steps of the PBL model. Students then proceed through the processes of the student worksheet, which

researchers monitor and encourage so that students are always involved at each level. The researcher then establishes guidelines to ensure that each student's thought is accommodated and recorded by one of the group members as students speak, with the goal of producing the best ideas. As a consequence, each learner discovers fresh facts that they were previously unaware of. Through this group debate, it is then accepted or established which of the greatest ideas will be supplied as problem-solving solutions by researchers. According to the findings of (Yamin, Permanasari, Redjeki, & Sopandi, 2020), PBL enables students to uncover, identify, and analyze the root causes of an issue in more depth, making the action or solution that students pick simpler to implement.

CONCLUSION

Based on the results of the conducted study, the recommendation given are as follows (1) Learning activities with Problem Based Learning model assisted by Zoom Cloud Meeting on the concept of environmental pollution is carried out well in accordance with the stages (syntax) of PBL model learning. Based on the results of the observer's assessment, a score of 95% with the category carried out. (2) The implementation of PBL model learning assisted by Zoom Cloud Meeting improves students' critical thinking skills, shown by the results of the N-Gain test which is on the medium criteria of 0.51. With the following details: elementary clarification indicator increased from 46.91% to 71.60%, basic support indicator increased from 57.20% to 77.78%, while the inferring indicator increased from 46.91% to 79.84%, advanced clarification indicator increased from 57.41 to 74.31, and strategies and tactics indicator increased from 46.30% to 74.69%. (3) The implementation of PBL model learning assisted by Zoom Cloud Meeting, has no significant effect in improving students' learning motivation, this can be seen from the results obtained from the calculation of learning motivation questionnaires. Where internal factors obtain a percentage of 93.40% and external factors obtain a percentage of 91.86%, which means that experimental class students already have a strong learning motivation from within him so that the PBL model which is an external factor has no effect on students' learning motivation. (4) Students' response to learning with the Zoom Cloud Meeting-assisted PBL model scored 86.11% which is at a very high level. This means that students respond positively and are very fond of learning with the PBL model assisted by Zoom Cloud Meeting on the concept of environmental pollution, because through the PBL model, students can understand the concept of learning through real problems, then actively engage in the problem-solving process. This makes the learning atmosphere more enjoyable and meaningful for students.

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