



Analysis of high school students' critical thinking ability in environmental change material through POE learning

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Article Information	Abstract
Keyword: Learning analysis; POE strategy; Critical thinking; Environmental change material Kata Kunci: Analisis pembelajaran; Strategi POE; Berpikir kritis; Materi perubahan lingkungan History: Received : 13/06/2024 Revised : 17/09/2024 Accepted : 26/12/2024 Published : 06/01/2025	Critical thinking skills are important to master in facing global competition. Biology learning in class must be oriented to improving critical thinking skills. Environmental change material is biology material that requires students to think critically in responding to environmental problems. One way to improve critical thinking skills is to use POE learning strategies that able to train students to be critical of problem. This research aims to provide an overview of students' critical thinking abilities on environmental change material which is improved through the POE learning strategy. This research uses a qualitative descriptive method with the data used in analyzing the data from observations, teacher teaching modules, student responses, student worksheet answers, and interviews. The results of this research provide an overview of several shortcomings in implementing POE learning strategies in environmental change material so that students' critical thinking abilities are still low. These shortcomings include the observation stage which was not carried out optimally, the student worksheet stage did not train critical thinking skills, the environmental problem topic was too big, the learning allocation was not good, and the teacher's involvement in guiding students was still lacking. With this research, a picture of the implementation of POE learning strategies in biology learning can be seen clearly so it is hoped that it can become good initial research for future research. <i>Abstrak. Kemampuan berpikir kritis penting untuk dikuasai dalam menghadapi persaingan global. Pembelajaran biologi di kelas harus berorientasi untuk meningkatkan kemampuan berpikir kritis. Materi perubahan lingkungan merupakan materi biologi yang menuntut siswa untuk berpikir kritis dalam menanggapi permasalahan lingkungan. Salah satu cara meningkatkan kemampuan berpikir kritis adalah dengan menggunakan strategi pembelajaran POE yang mampu melatih siswa kritis terhadap objek permasalahan. Tujuan dari penelitian ini adalah untuk memberikan gambaran kemampuan berpikir kritis siswa pada materi perubahan lingkungan yang ditingkatkan melalui strategi pembelajaran POE. Penelitian ini menggunakan metode deskriptif kualitatif dengan data yang digunakan dalam menganalisis adalah data hasil observasi, modul ajar guru, respon siswa, jawaban lembar kerja siswa, dan wawancara. Hasil penelitian ini memberikan gambaran tentang beberapa kekurangan dalam pelaksanaan strategi pembelajaran POE pada materi perubahan lingkungan sehingga kemampuan berpikir kritis siswa masih rendah. Kekurangan tersebut diantaranya adalah tahapan observe yang dilakukan tidak secara optimal dilakukan, tahapan lembar kerja siswa yang tidak melatih kemampuan berpikir kritis, topik permasalahan lingkungan yang terlalu besar, alokasi pembelajaran yang kurang baik, dan keterlibatan guru dalam membimbing siswa masih kurang. Dengan adanya penelitian ini, gambaran pelaksanaan strategi pembelajaran POE dalam pembelajaran biologi dapat terlihat jelas sehingga diharapkan mampu menjadi penelitian awal yang baik bagi penelitian-penelitian yang akan datang.</i>

A. Introduction

Critical thinking is one of the important skills in life (Mutakinati et al., 2018). Critical thinking is a rational thought and is related to making decisions about what to believe and trust (Ennis, 1991, 2011, 2018). Critical thinking is an essential skill for higher education (Changwong et al., 2018) and required for personal and professional life students (Bezanilla et al., 2019). In the current 21st century global competition requires every individual to have competencies such as creative thinking, independence, cooperation, communication, and critical thinking (Kivunja, 2014; Tang et al., 2020).

Critical thinking needs to be trained because it is a process to generate new knowledge (Akpur, 2020; Ermi, 2015) and solve problems (Nadeak & Naibaho, 2020). The process of problem solving with critical thinking does not use what has been obtained before, but uses a new mind construct (Suwono et al., 2017). The educational institutions have very large roles in improving students' critical thinking skills.

Teaching critical thinking skills is one of the main goals of education (Changwong et al., 2018; Kalelioğlu & Gülbahar, 2013; Syafitri et al., 2021). Improving and practicing critical thinking skills become one of the goals of the curriculum in Indonesia. The Merdeka curriculum currently implemented in Indonesia positions critical thinking skills as an important ability and an output that must be improved (Hastasasi et al., 2022). In the learning process, all subjects must focus learning activities on improving critical thinking skills (Anggraena et al., 2022).

There is a positive relationship between critical thinking skills and other skills such as creative thinking (Fatmawati et al., 2019). This is because critical thinking involves cognitive skills and dispositions (Lai, 2011). The high-level cognitive process of critical thinking improves the learning process. Critical thinking skills are very influential on student learning achievement. Improving critical thinking skills in the future should be the main focus of educators in implementing learning.

Critical thinking skills can be improved by using proper learning strategies, models, or methods. Determination of learning strategies, models, and methods must be carefully prepared because it will have an impact on low critical thinking skills if the strategies, models, and methods used are not optimal (Bustami & Corebima, 2017). The application of innovation in learning is needed to improve student's critical thinking skills (Bustami et al., 2018). The use of a POE (Predict, Observe, Explain) learning strategy can be an option to improve critical thinking skills.

The POE strategy has three main steps, namely predict, observe, and explain (Banawi et al., 2019). The POE has the potential to encourage concept change by constructing knowledge (Hsu et al., 2011; Jasdilla et al., 2019). Students who learn with POE

practice dealing with problems by making predictions and observations before stating explanations. This strategy has a positive effect on learning because it is proven to be able to improve student learning outcomes (Latifah et al., 2019). Thus, POE has the potential to improve students' critical thinking skills.

Efforts to improve student's critical thinking skills in schools is still not optimally done (Anazifa & Djukri, 2017). Low critical thinking skills are caused by learning activities that are not integrated with practicing critical thinking skills (Choy & Oo, 2012). Learning that is done only focuses on conceptual understanding which makes learning passive (Bustami et al., 2018). This is a note on the use of the POE strategy in biology learning because it must be able to integrate critical thinking skills in its stages. The existence of these problems shows that the process of analyzing POE learning must be carried out.

Analysis of the stages of the POE must be carried out to see whether students' thinking skills can be trained by using this strategy. Analysis is useful to see the strengths and weaknesses of POE. Research by Erlin, Rahmat, Redjeki, & Purwianingsih (2021) shows a complete picture of the most effective learning strategies and methods in training metacognition. The results provide an overview of the advantages and disadvantages of each learning strategy and model so as to determine the best strategy or learning model.

Other research conducted on the analysis of the CIRC cooperative strategy was able to provide conclusions on the strategy used (Nasim et al., 2024). The analysis explains the advantages and disadvantages of the strategy used. In addition, research on the needs analysis of Blended Learning Development Integrated with PBLRQA (Problem-Based Learning and Reading, Questioning & Answering) Strategy in Biology Learning can provide conclusions about the next research solution that must be done (Hasmunarti et al., 2019). From the previous research, the data sources used are more using literature and interviews. However, in this research, the data sources used are not only derived from the results of interviews and observations but there are additional other sources, namely student response data and student worksheet answers.

Based on this background, the purpose of this study is to provide an overview of students' critical thinking skills on environmental change topics that are improved through the POE learning strategy. The advantages and disadvantages of the POE strategy in training critical thinking skills will be seen so that further research can be carried out to optimize it. The results are also expected to provide changes to the learning process in the classroom. The learning process that is made as good as possible is felt to be

able to change students' cognitive, attitudes, and skills for the better.

B. Material and method

This is descriptive qualitative research. Descriptive qualitative research methods are used to describe and interpret data obtained to explain the phenomenon. This research was conducted on Tuesday, April 23, 2024 and was conducted at one of the State High Schools in Cianjur. The samples selected in this study were class X students with a total of 34 students. Samples were selected from one class from eleven study group classes. The data taken and used in analyzing learning outcomes include: (1) learning observation data, (2) data on the results of students' answers on the learner worksheet, (3) students' response questionnaire data to learning, (4) data from interviews with subject teachers, and (5) module documents, student worksheet, and student worksheet answers of students on environmental change material.

The research was conducted in one day, but was preceded by pre-observation activities to determine the focus of the analysis of learning activities. The pre-observation activities were conducted at the same school with the same subjects. After the pre observation activities, the research was carried out by observing the learning activities that took place. The observation sheet of learning activities has been prepared in advance in the form of a checklist table of critical thinking skills aspects that are trained in learning. At the end of the lesson, students were given a response questionnaire form to the learning activities carried out by the teacher. After the learning activities were completed, an interview was conducted with the biology teacher regarding the learning process carried out including difficulties, challenges, and recommendations for learning. In order for the research results to be even stronger, the

teaching module and student worksheet answers students on environmental change material were also requested as supporting data for the learning activities that had been observed.

C. Results and discussion

Data from learning observations, teaching modules, student responses, and student worksheet answers in environmental change material are used to analyze the achievement of critical thinking skills training using the POE learning strategy. The stages of the learning process with the POE learning strategy were carried out based on the teaching module made by teacher. Learning stages that are oriented to train critical thinking skills are recorded and matched with one part of the critical thinking skills aspect. The observation results were then compared with students' responses to the learning outcomes so as to strengthen the data. Meanwhile, the interview results were used to analyze the difficulties in improving critical thinking skills.

Analysis of POE learning in guiding students' critical thinking skills in environmental change material

The critical thinking framework is based on Ennis (1991, 2011). The results of observations of learning activities in environmental change material show that learning activities with POE learning strategies carried out by teachers still lack critical thinking skills (see Table 1). Only a few aspects of critical thinking skills can be trained in this learning. Of the 15 aspects of critical thinking skills that exist, only four aspects can be trained in the learning activities carried out. These aspects include focusing on the problem, analyzing arguments, observing, and making hypotheses. These results illustrate that the POE learning strategy is still not optimally implemented.

Table 1 Observation sheet of students' critical thinking skills

No.	Aspects of critical thinking	Description	
		Yes	No
1	Focus	v	
2	Analyze arguments	v	
3	Ask and answer clarification and/or challenge questions		v
4	Judge the credibility of a source		v
5	Observe, and judge observation reports.	v	
6	Deduce, and judge deduction		v
7	Make material inferences		v
8	Make and judge value judgments	v	
9	Define terms and judge definitions, using appropriate criteria		v
10	Attribute unstated assumptions (an ability that belongs under both basic clarification and inference).		v
11	Consider and reason from premises,		v
12	Integrate the dispositions and other abilities in making and defending a decision		v
13	Proceed in an orderly manner		v
14	Be sensitive to the feelings, level of knowledge, and degree of sophistication of others		v
15	Employ appropriate rhetorical strategies in discussion and presentation (oral and written)		v

(Source: Data Observation)

The POE strategy has the potential to improve critical thinking skills in environmental change material. With the POE learning strategy, students can predict, justify pre-conceptions, and build new conclusions (Hsu et al., 2011; Jasdilla et al., 2019). Critical thinking skills involve the ability to draw conclusions, identify relationships, analyze opportunities, and solve problems (Akpur, 2020; Almulla & Al-Rahmi, 2023). POE can facilitate all abilities that are connected to critical thinking.

Table 1 shows some of the critical thinking aspects that are trained in learning. Students are only trained to focus on the given environmental problem, analyze the arguments that have been made, observe, and make value judgments. The environmental change material taught by the teacher using the POE strategy has not been applied optimally. Teachers are the main factor in creating learning activities that are able to integrate POE strategies with critical thinking skills.

The POE stages that were carried out were largely in accordance with the POE stages in general, namely the predict, observe, and explain stages. However, in each of these stages, the learning activities carried out do not present a critical thinking framework as a reference in training students' thinking skills. The POE stages carried out seem to be only general stages that are not too clear for students to do. In fact, teachers should be able to specify what students should do at each stage in order to improve their critical thinking skills. The lack of integrating critical thinking skills in learning is one of the strong reasons for the low critical thinking skills (Choy & Oo, 2012).

Teacher have very important roles in training students' critical thinking skills (Fausan et al., 2021). Unfortunately, the teacher during the lesson focuses more on introducing enviromental problems and orienting students to student worksheet tasks. Students work in groups to complete the tasks. Each student works in their group and the teacher only supervises the group discussion. The core of learning is in the task, but the teacher is less involved in guiding students to construct knowledge through the worksheets provided. Thus, students only focus on answering questions and no other activities.

The observation of learning activities in enviromental change material is supported by the results of the review of the teacher's teaching module. The module only focuses on general activities such as making hypotheses, observing, and drawing conclusions about the general environmental problem. This is unfortunate because the POE strategy has a very large potential role in training other aspects. The POE learning strategy can condition students to have discussions (Nawaz et al., 2020), ease students to analyze information, determine the relevance of information and interpret it as a form of critical thinking process (Mutakinati et al., 2018).

Based on students' responses to learning (see Image 1), most students agree that the learning conducted in class has provided experiences that can acquire all aspects of critical thinking skills. This response contradicts the results of observations and review of teaching modules which show that learning did not guide students in critical thinking skills. Students in responding to the learning process felt that they had been trained by the teacher to master each aspect of critical thinking. This requires proof by analyzing the results of student answers on their worksheets.

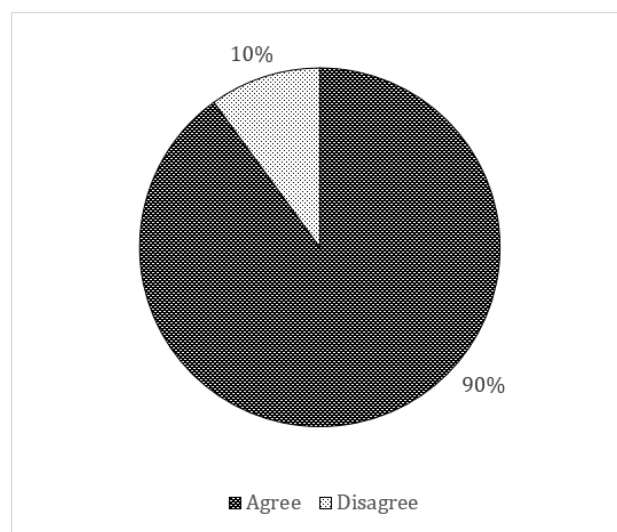


Figure 1
Graph of student responses to classroom learning

Analysis of student worksheet questions and answers in environmental change material

Analysis of the student worksheets showed the questions did not train critical thinking skills in enviromental change material. In the worksheet, three questions represent the three stages of the POE learning strategy. The answers expected from the questions on the worksheet are more conceptual and not guiding to the contextual environmental problem. Students can just look up the answers on the internet without having to think about answering the statement. The questions in the worksheet are shown in Table 2 below.

Table 2 Questions on student worksheets

No	Question
1	What impact has been felt from the issue of environmental change, namely environmental pollution?
2	What causes environmental impacts? How can we solve environmental problems? Look for supporting references in books or on the internet
3	What preventive measures can be taken?

(Source: student worksheet)

The questions on the worksheet may be considered as questions that train critical thinking skills so that students' responses become positive. Students' perception that current learning activities have improved their critical thinking skills are not in line with many research results. Students' critical thinking skills if not trained in learning will be in a low category and need to be improved (Fausan et al., 2021). Through the questions on the worksheet, students who are not trained to think critically in learning environmental change material will certainly not have good critical thinking skills. To think critically, students must be trained in other skills such as analyzing problems, making deductions, arguing, assessing and evaluating, making decisions and communicating effectively (Akpur, 2020; Perry et al., 2014; Wagner, 2015).

Questions in student worksheets that aim to improve students' critical thinking skills in environmental change material must link environmental problems with critical thinking components. Contextualized environmental problems must be raised as a real problem. Students should be directed to answer questions that inspire students to think step by step with the selected critical thinking framework. The stages of thinking contained in the questions on the student worksheet will train their critical thinking skills on environmental change issues.

Questions that do not train critical thinking skills cannot direct students to think critically. Based on the answers to each question on the student worksheet, all the answers that students wrote were conceptual. Students answer the question because the answer expected by the question is a set of concepts. These concepts have not been integrated into new knowledge. The questions in the worksheet should be able to condition students to analyze answers, make arguments, and produce solutions (Fatmawati et al., 2019; Mutakinati et al., 2018).

Based on the student's answers, it also shows that students experience dependence in answering questions by searching on the internet. This is not only because the questions did not train critical thinking skills but also because the environmental topic of the problem is too broad. Topics that are too broad are less stimulating for students to think about because it is not close to their daily lives. (Bustami et al., 2018). This is influential because students' prior knowledge cannot be connected to new conceptions to construct knowledge (Choy & Cheah, 2009).

Analysis of difficulties in improving critical thinking skills in environmental change material

Difficulties in improving critical thinking skills in environmental change material were analyzed based on the results of interviews. The interviews revealed the difficulties experienced by teachers in learning environmental change material, especially in

improving critical thinking skills. Broadly speaking, teachers find it difficult to improve critical thinking skills due to several things, including: (1) students relying too much on the internet to find answers about the environmental solution, (2) students unable to express original personal arguments about the environmental problem, and (3) students having not been able to think systematically in discuss the problem.

These difficulties are inseparable from the teacher's planning for learning which does not anticipate this. First, teachers did not integrate critical thinking skills into the learning process in environmental change material. This is the main cause why students' critical thinking skills in low category (Choy & Oo, 2012). Teachers are still fixated on providing concepts so that other skills are not practiced. Second, the use of the POE strategy was not optimized (Bustami & Corebima, 2017). The POE strategy applied in learning was less detailed and not integrated with critical thinking skills. Third, the questions in the student worksheet did not lead to knowledge construction and did not train critical thinking skills in environmental change material. The POE strategy has good potential to improve critical thinking skills, but its application in student worksheets is still not maximized.

Students' critical thinking skills are ultimately influenced by the teacher and the learning process. A teacher must anticipate and prepare for every possibilities that affects the achievement of learning outcomes. Through this analysis, the description of the learning process that has not been optimal is strongly influenced by the role of the teacher in its implementation. In the future, shortcomings in learning, especially in the use of POE learning strategies, can be anticipated after reviewing the results of this study. Research can be conducted to design POE learning strategies along with student worksheets that can better improve critical thinking skills.

D. Conclusion

The critical thinking skills of high school students in environmental change material cannot be trained by using the POE learning strategy. There are several shortcomings in the implementation of this learning strategy, including the observed stage about environmental problem which is not optimally carried out, the worksheet stage which does not train critical thinking skills in environmental change problem, the topic of the environment problem is too large, the learning allocation is not good, and the teacher's involvement in guiding students to think critically in environmental change material is still lacking. The results of this study can be a reference for other studies in overcoming the problem of improving critical thinking skills in biology learning through improving the POE strategy.

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