Improving Student's Critical Thinking Skills through POE Learning Syntax with the JAS Approach

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Abstract
The critical thinking ability of Indonesian students in various studies is reported to be low. One of the efforts to improve it is through the learning process. Combining the POE (Predict-Observe-Explain) learning model and the JAS approach is believed to improve students' critical thinking skills. This study aims to analyze the POE learning model's effectiveness with the JAS approach in improving critical thinking skills within the excretion system learning in State 2 Senior High School of Ungaran, Central Java. This research is part of the research theme of learning models and the assessment of student learning outcomes. This research using a quasi-experimental design with a non-equivalent control group design. Data on critical thinking skills were obtained using reliable expert assessments. The data were analyzed from the cognitive learning outcomes (pretest and post- test) using a sensitivity index, individual and classical completeness tests, and the average difference test. The results showed that the sensitivity index results were 50.176% with sensitive criteria, complete individually with a significance value of 0.000 <0.05, complete classically with the results obtained, namely 97.2%, and a significant difference in the average critical score. Thinking skills with a significance value obtained is 0.000> 0.005. These findings support the notion that the POE model combined with the JAS technique helps students develop their critical thinking abilities when studying the excretion system. It was recommended to combine the use of the POE model with the JAS approach in teaching similar learning materials with excretion system learning materials.
Keywords: Critical thinking skills, POE (Predict-Observe-Explain) learning model, JAS approach

1. INTRODUCTION

Critical thinking is one of the higher-order thinking skills (HOTS) in the form of a person's ability to analyze an idea using logical reasoning. According to [1] [2], these skills are one of the life skills that need to be developed through the educational process. Critical thinking skills need to be considered in the implementation of the learning process, including biology learning. The critical thinking skills of Indonesian students in several research results [3] [4] [5], including PISA testing [6], were

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reported to be low. One of the efforts to improve it is through the learning process [7]. Therefore, the teacher must be good at determining the suitable model, technique, or learning strategy. The learning process takes place optimally and can develop critical thinking skills.

The POE (Predict-Observe-Explain) learning model -developed by White & Gunstone on 1992- is a strategy that includes ways that a teacher can take to help students improve their understanding of concepts and eliminating misconception [8];

[9] [10] [11], so do learning activity [12], higher order thinking skills [13] this includes critical thinking skills [14] [15] [16]. In POE learning, students are given the freedom to predict, observe, analyze and draw their conclusions so that students' science process skills will also look more optimal [17]. According to Fitriani, Zubaidah, Susilo, & Al Muhdhar (2020), the POE model is applied in learning because it has advantages to improving students' critical thinking, so it can be used to improve students' performance in Biology. However, this model also has weaknesses, such as the need for more thorough preparation, especially concerning the problems presented during the learning that takes place [9]. To cover these weaknesses, it is necessary to have innovations that can support the learning process by utilizing the surrounding natural environment as the object of the problem, namely by applying the POE learning model combined with the JAS approach.

The JAS approach consists of six components carried out in an integrated and comprehensive manner. They become the characteristics of the JAS approach, including exploration, constructivist, scientific processes, learning societies, bioedutainment, and authentic assessment [18] [19]. The novelty of this research is to incorporate the JAS approach into the POE learning model during the learning process. With the hope of bringing students closer to the exploration phase, which is to form character and conservation values that can be explored and developed from students' potential such as being conscientious, curious, critical, creative, religious, disciplined, honest, and caring for the environment.

Based on observations in sample schools, it was found that teachers explained more material using the lecture method (teacher center), and students tended to pay attention to and note things that the teacher conveyed during learning. The learning process carried out by biology teachers to improve critical thinking skills seems to have not been developed optimally. Students are less involved in concept discovery, analyzing problems, and concluding learning. The above problems show that students are not empowering their thinking skills, so that their critical thinking skills are still low. Therefore, it is necessary to study further the effectiveness of the POE (Predict-Observe-Explain) learning model with the JAS approach. This research aims to analyze the effectiveness of the JAS approach to the POE (Predict-Observe-Explain) learning model on improving students' critical thinking skills. The effectiveness in question is to make students active in learning, learning in students to be clearer, easier to understand, fun, and improving students' critical thinking skills in the excretion system learning material.

2. METHODS

This research is part of the learning model's research theme and its assessment of student learning outcomes. This research was conducted at State 2 Senior High School of Ungaran, Central Java. This type of research is a quasi-experimental design with a Non-equivalent Control Group Design. The study sample was taken by classified random sampling from Grade 11 Science. The experimental class treated with the POE learning model with the JAS approach was the Science Class 6 consisting of 36 students and the Science 5 Class consisting of 36 students selected as the control class taught using a lecture model. The data was collected by carrying out a series of learning processes in both the experimental and control classes. Data on critical thinking skills were collected using valid tests following expert decisions.

The pretest and post-test data for the excretion system learning materials were analyzed using a sensitivity index, individual and classical completeness tests, and the average difference test. The success of the items in measuring students' critical thinking abilities is to have the sensitivity to distinguish students who master the material from students who do not. Making items on the excretion system material is guided by indicators of critical thinking by [20] with

cognitive levels of C4, C5, and C6. The results obtained were analyzed using the Item Criterion- Referenced Test or what is commonly referred to as instructional sensitivity. The results of this sensitivity (S) can be expressed in the form of an index called PPDI (Pre-to-post Difference Index) [21]. The item is good if the sensitivity index is between 0 and 1 [22]. The criteria used to state that the item is sensitive to learning if $S \geq 0.30$ [23]. The individual and classical completeness tests were carried out using the SPSS 22 program with the One-Sample Test. It was carried out using post-test data to determine the level of difference in students' average critical thinking ability in the experimental and control classes, then analyzed using the Independent-Sample T-test.

The criteria for the effectiveness of this study are as follows. 1) The results of the sensitivity index in the experimental class meet ≥ 0.30. 2) Classes that are given learning with the POE model with the JAS approach can achieve individual KKM scores of more than 75 and classical learning completeness, which is more than 85%. of an examinee 3) There is a significant difference in the average score of students' critical thinking skills between the experimental class and the control class.

3. RESULTS AND DISCUSSION

3.1 *Result*

3.1.1 *Sensitivity of Items*

The results of the instructional sensitivity analysis are presented in Table 1.

Table 1. Recapitulation of the instructional sensitivity of the item

No	Class	Item Number Category		Average PPDI/S (%)
		Sensitive	Not Sensitive	
1	Experiment	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 25	18, 23	50.18
2	Control	2, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	1, 3, 4, 5, 11, 12, 21, 24, 25	37.72

Based on Table 1, it can be seen that the results of the calculation of instructional sensitivity (PPDI) in the experimental class and control class have reached ≥ 0.30 or 30%, which means that the item can be said to be good or sensitive. However, of the 25 test questions, some of the test questions were categorized as insensitive, the PPDI / S results did not reach 30%. There are two questions in the experimental class, and in the control class there are nine questions. In addition, the number is in the sensitive category. This shows that the item sensitivity in the experimental class is better than the control class.

If the question item is seen from the calculation of critical thinking indicators, the data is obtained in Table 2.

Based on Table 2, it can be seen that in the POE-JAS (experimental) class and the lecture (control) class, all PPDI calculation results on each indicator are between 0 and 1. In the experimental class, all the average PPDI results have reached 30% with category sensitivity. There are four critical thinking indicators in the control class that has not reached 30% are categorized as insensitive. This shows that the sensitivity results seen from critical thinking indicators in the experimental class are more

effective than the control class. Indicator 12 shows the highest PPDI average, which means that the POE-JAS learning model is able to make learners who care about the validity of learning resources. This is because the syntax of the POE learning model combined with the JAS approach teaches these.

Table 2. Instructive sensitivity analysis of experimental class per critical thinking indicator

No	Critical Thinking Indicators	Average PPDI (%)	
		POE-JAS class	Lecture class
1	determine an action	42	28 ^
2	interact with others	56	39
3	ask and answer questions	55	26 ^
4	analyze arguments	53.67	30.67
5	observe and consider the observation report	51	46
6	deduce and consider the results of the deduction	49	25 ^
7	make and determine the results of considerations	49	52
8	define terms and consider a definition	52	51,5
9	identify assumptions	39	42
10	focus question	44.5	44
11	induce and consider the results of the induction	34.5	38.5
12	consider whether the source can be trusted or not	73.7	18 ^

note:

^ = not sensitive

3.1.2 *Completeness of Individual and Classical Learning*

Learning achievement data is processed to test hypotheses regarding student learning completeness after the experimental and control classes get treatment. The

experimental class has a higher average post-test score than the control class. The results of the completeness test of individual and classical learning achievement can be seen in Table 3 below.

Table 3. Instructive sensitivity analysis of experimental class per critical thinking indicator

No	Class	Individual Mastery	Classical Mastery			
		Sig. value	No		Yes	
			Total Student	%	Total Student	%
1	Experiment	0,000	1	2.8	35	97.2
2	Control	0,000	6	16.7	30	83.3

After being tested for individual completeness, the significance value obtained was 0.000<0.05, and it means the average learning achievement in the class controls and experiments achieved more than 75 or completed individually. Based on these data, the experimental class had met the classical learning completeness criteria, namely those who obtained a value of > 75 more than 85%. In contrast, the control class had not met the classical learning completeness criteria.

3.1.3 Test the Difference in the Average Post-test Value

The result of the T value is 5.638 (0.000 <0.05). It can be concluded there is a difference in the average critical thinking ability of students between the experimental class with the control group.

3.2 Discussion

The item sensitivity value in the experimental class has a higher average than the control class because the POE model activities [24] with the JAS approach [19] are used as an appropriate and effective means of achieving critical thinking indicators. At the prediction stage, the teacher provides an understanding of the material to be discussed. This stage is combined with the JAS component in the form of the learning community and the scientific process. Students discuss with groups to analyze the answers to the questions summarized on the Student Prediction Sheet. These questions are related to the teacher's perceptions about the material to be studied in today's learning. At this stage, the teacher is tasked with guiding students in answering questions on the Student Prediction Sheet.

The next step is to observe. At this stage, it is combined with the JAS component in the form of a scientific process, where students prove answers to predictions by exploring and observing through experimental or practicum and demonstration activities based on the problems being studied. By doing

demonstrations and experiments, students will have a direct picture of the object of the problem. According to [25] [9] [17] [26] [27], the learning process by giving problems can have a positive effect on students' reasoning, directing students to think broadly, and becoming trained in problem-solving. Through experimental activities, it will improve students' critical thinking skills during learning. Through demonstrations, activities can encourage students to master the aspects of providing further explanation. This stage is combined with JAS components in the form of a learning and constructivist community. Students are asked to analyze and consider reports of observations that have been carried out together with the group. Therefore, students can conclude the prediction results are following the results of the observations or not. In addition, students can also consider whether the sources used in the observation activities can be trusted or not based on a literature review.

Through the stages of prediction and observation combined with this JAS component, it can increase the ability to think critically on indicators, determine actions, interact with others, define terms and consider definitions, observe and consider observational reports, and consider whether the source is reliable or not. This is in accordance with the opinion of [25] [9] [17] as stated in the introduction. The POE learning model uses the student center strategy, a learning community's existence, and problem-solving. The weakness of POE, which is then strengthened by the JAS approach, adds to how the learners' community solves problems around them.

After the observation is the explanation stage, students are assigned to present the results of their work and group discussions in front of the class. This activity is combined with JAS components in the form of bioedutainment. The teacher asks each group to present their observations in class with games and media to attract students' attention. That is in accordance with [28], the bioedutainment component can be realized with various forms of games and educational media that attract students' attention and make students comfortable. Through this activity, students' critical thinking skills will improve during learning. Then through the constructivism component, students and other groups can exchange opinions using their arguments in comparing observations with previous hypotheses. Therefore, students can identify the conclusions from the results of the discussion. Through the authentic assessment component, student activities during learning are assessed by the teacher.

Learning which requires students to be optimally involved in discussion activities and argumentative activities can improve critical thinking skills. This is also in line according to [29] [30] drawing conclusions made by students will be better able to improve their critical thinking skills. The explaining stage, combined with the JAS component, can improve students' critical thinking skills on indicators of asking and answering questions, analyzing arguments, focusing questions, deducing, and considering the results of deductions.

The success of learning also implies completeness in learning and completeness in the learning process. In this study, the students 'learning achievement completeness test was analyzed individually and classically as a criterion for the learning model's effectiveness in improving students' critical thinking skills applied in the experimental and control classes. Individual and classical learning completeness in the

experimental class has better results than the control class. The cause of students' critical thinking skills in the experimental class is better than the lecture class. Namely, in the experimental class that uses the POE model with the JAS approach, the teacher can create a comfortable and pleasant classroom atmosphere for students in the learning process. The learning process is fun because of the bioedutainment component in the JAS approach. These activities make students active in learning, excited, happy, challenged and learning more effectively so that learning outcomes can be optimal. Besides, according to [28], the existence of JAS components in the form of exploration and constructivism can make learning more meaningful for students.

The learning outcomes are lower in lecture or control class than POE-JAS or experiment class. This may occur because students' limited learning activities are the cause of the low learning outcomes achieved by students due to the lack of active student involvement in learning. Besides, students do not understand the material provided and have not achieved meaningful learning. This results in the learning material being less meaningful and less durable in students' memories. POE with the JAS approach invites students to relate new information to relevant concepts contained in a cognitive structure.

Moreover, the material being studied is potentially meaningful, and student learning is directed towards meaningful learning. Referring to these individual and classical completeness tests, it also shows that the POE model with the JAS approach is more effective in improving students' critical thinking skills at the cognitive level. Then, to prove the average difference in students' critical thinking skills in the control and experimental classes, it was analyzed using the Independent-Sample T-test. Based on the results of these calculations, students' critical thinking skills in the experimental class are not the same as the control class in which the critical thinking abilities of the experimental class are greater than the control class.

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4. CONCLUSION

The POE learning model with the JAS approach effectively improves students' critical thinking skills on the excretion system material in State 2 Senior High School of Ungaran, Central Java. The POE model with the JAS approach is expected to be a combination of effective learning models. Students become active in learning, learning in students becomes clearer, easier to understand, fun, and can improve students' critical thinking skills. Based on the results of this study, it was recommended to combine the use of the POE model with the JAS approach in teaching similar learning materials with excretion system learning materials.

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