

PBL-BASED BIOLOGY MODULE TO IMPROVE STUDENTS CRITICAL THINKING SKILLS

Agasta Kusuma Bintang Pamungkas¹, Joko Waluyo², Nuriman³

¹ Student, Department of Teacher Training and Education, University of Jember, East Java, Indonesia

^{2,3} Lecturer, Department of Teacher Training and Education, University of Jember, East Java, Indonesia

ABSTRACT

Problem Based Learning (PBL) is one of the learning model which based on constructivism theory that most appropriate to be integrated into the module. The integration of PBL into the module can replace the previous teaching materials that can't improve the students' critical thinking skills in analyzing the abstract material like excretion system material in high school. The purpose of this study is to describe PBL-based biology module that are effective for improving critical thinking skills of high school students. The type of study is a research and development. The tested design of this study is Pre-Experimental Design which used one group pretest-posttest design. The sample of study were XI grade students of Muhammadiyah 2 Genteng High School and Genteng 2 Public High School in the odd semester of the 2018/2019 academic year. The Improvement students' critical thinking skills were analyzed by the gain score formula. To get the gain score, the product is tested on the formative evaluation, semi-summative evaluation, and dissemination stage. Based on the data collected on the overall stage obtained the average gain score in the high criteria. It can be conclude that the PBL-based biology module on excretion system material for critical thinking skills effectively able to improve students critical thinking skills.

Keywords: *Problem Based Learning; Biology Module; Students Critical Thinking Skills.*

1. INTRODUCTION

In this 21st century, education becomes very important to improve the students skills like the learn and innovate skills, the used of technology and media information skills, work skills, and survive by using life skills (Binkley, et al. : 2012). To achieve educational goals, the government has implemented improvements in the quality of education at various levels, including updating the curriculum, learning tools and improving facilities and infrastructure. One component of the learning device that plays an important role in the curriculum contents is teaching materials have used to delivering material to students.

The use of teaching materials in the learning process can provide benefits for students. The various of teaching materials make learning activities more interesting. Students will get more opportunities to learn independently and reduce dependence on teacher attendance. In addition, students will also get convenience in learning every competency that must be mastered (Warsono and Hariyanto, 2013). Teaching materials that facilitate the effective and efficient learning goals-achievement possessed by teachers and students are module (Ministry of National Education of Indonesia, 2008).

The development of module is based on constructivism theory which explains psychological and philosophical perspectives which see that each individual forms or constructs most of what they learn and understand (Schunk, 2012). Problem Based Learning (PBL) is one of the learning model that based on constructivism theory that most appropriate to be integrated into the module. PBL provides many benefits for students to develop high other thinking skills such as critical thinking, finding and using learning resources, cooperative work skills, and lifelong learning.

The integration of PBL into the module can replace the previous teaching materials that can't improve the students' critical thinking skills in analyzing the abstract material. One of the abstract biological material that's difficult to observe directly is the excretion system material in high school. According to Santos (2017), critical thinking is an active and organized mental process that aims to understand events and how to talk around through their own thoughts and interactions with others. Thus, critical-minded is an organized mental activity in the information space to find yourself or interact with others. Whereas according to Facione (2013) there are six indicators of critical thinking skills such as interpretation, analysis, evaluation, inference, explanation, and self regulation. Based on that's background, the students critical thinking on on excretion system material can be improved through the used of PBL-based module.

1.1 Statement of the problem

"How is the PBL-based Biology Module Effectively to Improving Critical Thinking Skills of High School Students?"

1.2 Significance of the study

One of the biology learning goals is to develop the inductive and deductive analytical thinking skills in problems solving that related with natural events both qualitatively and quantitatively, and to develop skills and self confidence (Syukrimansyah et al., 2017). Therefore the selection of PBL-based Biology module is more appropriate to provide assistance to students to understand the biology concept.

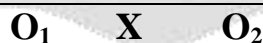
The PBL-based biology module in this study is intended in order students to be able to learn independently and develop their high thinking skills. According with the 21st century learning paradigm, students are required to have learning skills and are able to contribute in the development of the learning quality.

1.3 Purpose of the study

The purpose of this study is to describe PBL-based biology module that are effective for improving critical thinking skills of high school students

2. METHODOLOGY

The type of study is a research and development. The tested design of this study is Pre-Experimental Design. The Pre-Experimental Design results are dependent variables, because there is no control variable, and the sample is not randomly selected (Sugiyono, 2011). The design of test used one group pretest-posttest design by using one group of samples that were deliberately selected and then given a pre-test (initial test) O₁ and followed by given of treatment X, and at the end of the study, the sample was given a post test (final test) O₂. This design is used to determine the effectiveness of PBL-based Biology module to improve the students critical thinking skills.



(Sugiyono, 2011)

Annotation :

- O₁ : pre-test (initial test) before being given treatment.
- X : treatment in the form of testeds by using PBL-based biology module.
- O₂ : post-test (final test) after being given treatment.

2.1 Sample

The samples of study are XI grade students of Muhammadiyah 2 Genteng High School and Genteng 2 Public High School in the odd semester of the 2018/2019 academic year.

2.2 Data Analysis Technique

Critical thinking skills are measured by using instruments in the form of pre-tests and post-tests which contain four critical thinking indicators, such as interpretation, analysis, evaluation, and inference. The Improvement students' critical thinking skills were analyzed by the gain score formula. To get the gain score, the product is tasted on the formative evaluation, semi-summative evaluation, and dissemination stage. According to Hake (1998), the gain score formula as follows.

$$g = \frac{\langle S_f \rangle - \langle S_i \rangle}{\langle S_m \rangle - \langle S_i \rangle}$$

Annotation :

$\langle g \rangle$ = gain score

$\langle S_m \rangle$ = The students highest score

$\langle S_f \rangle$ = Post-test score

$\langle S_i \rangle$ = Pre-test score

with gain score categories:

$[g] < 0.3$: Low

$0.3 \leq [g] < 0.7$: Medium

$[g] \geq 0.7$: Height

The classification level of students' critical thinking skills is formulated as follows.

$$NP = \frac{R}{SM} \times 100$$

Annotation :

NP = Value obtained

R = raw score obtained by students

SM = Maximum score from the specified test

(Purwanto, 2008)

The collected data is processed, then interpreted with the criteria in Table-1:

Table-1 : The criteria of students' critical thinking skills

Value Range	Category
NP > 80	Very Good
60 < NP ≤ 80	Good
40 < NP ≤ 60	Enough
20 < NP ≤ 40	Less
NP ≤ 20	Very Less

3. RESULT AND DISCUSSION

3.1 The Formative Evaluation Results

The formative evaluation stage is a first tested phase. The tested sample consisted of 20 students of Muhammadiyah 2 Genteng High School with different levels of ability. The results of the gain score analysis are described in the following table.

Table-2 : The results of the gain score analysis in the formative evaluation stage

Gain Score	Criteria	Number of Students	Percentage (%)
$[g] < 0,3$	Low	-	-
$0,3 \leq [g] < 0,7$	Medium	14	70
$[g] \geq 0,7$	High	6	30

Based on Table-2 are obtained the critical thinking skills results as many as 70% of students were increased in the medium criteria and 30% of students in the high criteria.

3.2 The Semi-Summative Evaluation Results

The Semi-Summative Evaluation stage is also known as a large group tested stage because the number of samples are greater than the formative evaluation stage, which is as many as 32 students of Muhammadiyah 2 Genteng High School. The results of the gain score analysis in this stage can be described in the following Table.

Table-3 : The results of the gain score analysis in the semi-summative evaluation stage

Gain Score	Criteria	Number of Students	Percentage (%)
$[g] < 0,3$	Low	-	-
$0,3 \leq [g] < 0,7$	Medium	10	31
$[g] \geq 0,7$	High	22	69

The critical thinking skills of 31% of students were increased in the medium criteria and 69% of students in the high criteria. Thus, the average students critical thinking skills in this stage were increased in the high criteria. It can be concluded, The PBL-based biology module are effective for improving students' critical thinking skills.

3.3 The Dissemination Results

The dissemination stage be tested to strengthen the evidence that PBL-based module are effective for improving the critical thinking skills of high school students. This tested stage were treated by a biology teacher with a sample consist of 35 of XI grade students of Genteng 2 Public High School. The dissemination results are described in the following table.

Table-4 : The results of the gain score analysis of the dissemination stage

Gain Score	Criteria	Number of Students	Percentage (%)
$[g] < 0,3$	Low	-	-
$0,3 \leq [g] < 0,7$	Medium	8	22
$[g] \geq 0,7$	High	27	77

Based on Table-4, the results show that critical thinking skills of 22% of students in the medium criteria and 77% of students in the high criteria. On this stage, the critical thinking skills of high school students were increased in the high criteria. It can be concluded that the PBL-based biology module effectively to improve critical thinking skills of high school students.

Based on overall stage, the students' critical thinking skills after using the PBL-based biology module were increased in the high criteria. The critical thinking skills are measured in the development tested of PBL-based biology module consisted of 4 indicators such as interpretation, analysis, evaluation, and inference. The analysis results of each indicator of critical thinking skills are presented in Figure 1.

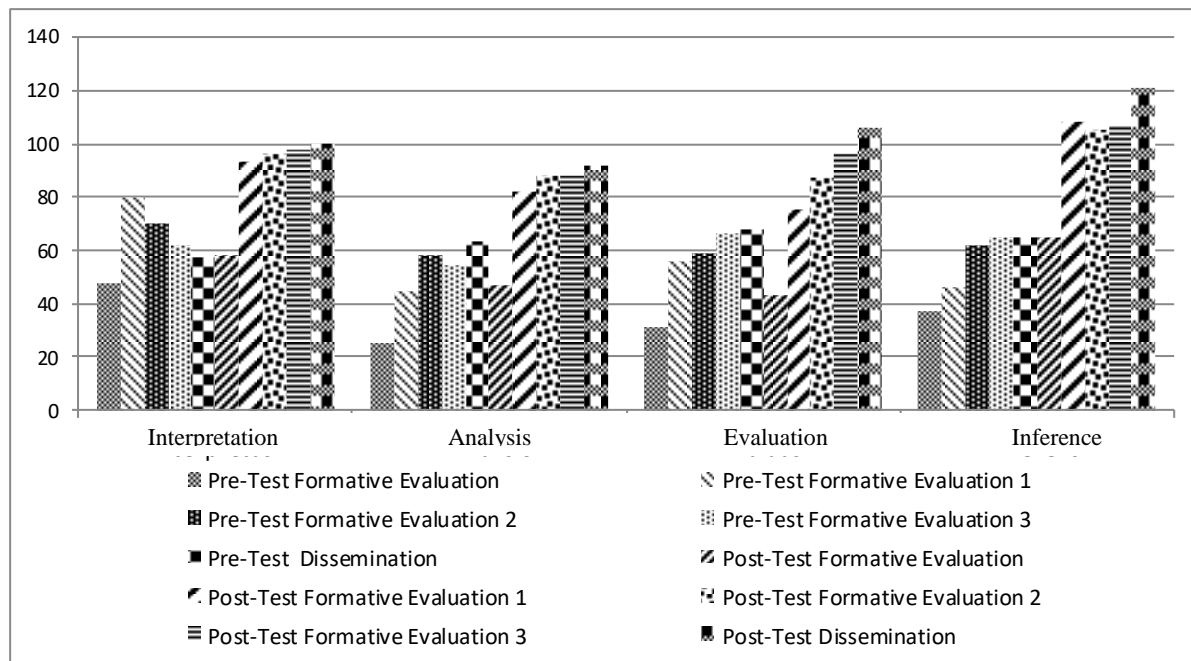


Fig-1 : An increased diagram of each indicator of critical thinking skills

Based on Fig-1, the PBL-based biology module with a fairly complete, broad, and in-depth material; material that is fairly accurate in facts, concepts, principles, and theories; and material that is sufficiently in accordance with the development of science, current, and related to daily life effectively can improve the ability of students' interpretation, analysis, evaluation and inference. It can be conclude that the PBL-based biology module effectively able to improve students' critical thinking skills.

4. CONCLUSIONS

Based on the data collected on the formative evaluation staged that as many as 70% of students have an increased critical thinking skills in the medium criteria and 30% of students in the high criteria. On the semi summative evaluation stage, as many as 31% of students have an increased critical thinking skills in the medium criteria and 69% of students in the high criteria. Furthermore, on the final stage of the tested, 22% of students have an increased critical thinking skills in the medium criteria and 77% of students in the high criteria. It can be conclude that the PBL-based biology module on excretion system material for critical thinking skills effectively able to improve each indicator of critical thinking skills.

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