

# THE EFFECTIVENESS OF PBL-BASED PHYSICS MODULE FOR STUDENTS' CRITICAL THINKING SKILLS

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## ABSTRACT

*Integration of Problem-Based Learning (PBL) into a physics module is an innovation that is felt effective to improve students' critical thinking skills because it gives freedom of critical thinking and skills in solving problems to students through real problem solving applications. This type of study is research and development with the aim of analyzing the effectiveness of PBL-based physics modules in order to improve the critical thinking skills of high school students. The module effectiveness test was carried out at SMAN 1 Probolinggo and SMAN 3 Probolinggo with a pretest-posttest non-equivalent group design as study design. Data on the results of students' critical thinking skills are obtained from the analysis results of students' answers to the module and with indicators of critical thinking that have been developed. Based on the results of data analysis, it can be concluded that PBL-based physics modules are effective to improve students critical thinking skills of SMAN 1 Probolinggo with score of critical thinking skills of 77.0 in the critical category and students of SMAN 3 Probolinggo with a critical thinking skills of 75.3 in the critical category.*

**Keywords:** PBL-Based Physics Module; Effectiveness of PBL-Based Physics Module; Critical Thinking Skills.

## 1. INTRODUCTION

Physics is defined as a branch of sciences that studies natural phenomena or phenomena that are built on a scientific approach. Physics lessons are intended as a vehicle to foster thinking skills that are useful for solving problems in everyday life (Sendi, 2013: 359). Purwo (2016: 67) also added that physics is a subject that learns something concrete and can be proven systematically by using equation formulas that are supported by research. So that in essence learning physics is not just memorizing, but rather emphasizes the process of forming a student's knowledge and mastery of the concept.

At this current, the physics learning often experiences obstacles, including the learning process that has not directed students to the learning process based on inventions, scientific attitudes, and products that are the essence of science. In addition, physics is also often complained of as a difficult field of study (Husniati, 2016: 453). This is because most students have not been able to connect between the material learned and the knowledge have used. According to the Education Assessment Center data, the value of the 2015/2016 national examination at the level of the Senior High School in the city of Probolinggo shows that the average national examination score of physics is 68.1 while the 2016/2017 national examination average scores of physics are 61.3. Based on these data it can be conclude that the physics learning outcomes have decreased.

The reality that occurs in the field is that currently the learning process experienced by students only comes to the provision of knowledge, has not yet arrived at the development of thinking skills that lead to the formation of independent students (Diani, 2015: 24). In learning the teacher uses several textbooks from the publisher, whose

packaging only presents concepts and principles, examples of questions and their solutions and practice questions. Teaching materials are less associated with real problems around student life. So that the packaging of teaching materials is less likely to provide opportunities for students to develop skills in formulating problems, solving problems, reflecting on their learning, and understanding development. So the results of students' critical thinking skills are low (Hendra, 2013: 147). Critical thinking are skills that students must possess as the basic capital of understanding science. Training and developing students' critical thinking skills in learning is very important so that students can better understand what they are learning because students not only acquire knowledge but discover the knowledge itself.

Based on these problems, it is necessary to look for problem solving in determining the right teaching materials, namely constructivist-based independent teaching materials that train students in solving problems, and linking concepts that are relevant with students life around. Based on these reasons, researchers intend to make improvements by applying the use of modules. According to Prastowo (2015: 158) the module is a print media that is intentionally designed systematically and aims to be used by students in learning activities. The module that will be developed in this study is a Problem-Based Learning (PBL) module.

PBL-based module are development by presenting the guidance questions that can direct students' thinking in finding concepts. This module focuses on the process and skills for conducting research which includes exploration, discovering, and understanding activities. This is consistent with the study of Christiyoda (2016: 83) which states that problems solving-based modules are effective to improve students' critical thinking skills because they provide the freedom of students to thinking and solving the problems by using real problems.

PBL-based modules focus on the development of students learning who are required to actively solving problems, so they can encourage students to more understanding in the material being studied and explore knowledge in solving problems that exist in everyday life. Based on the description above, the PBL-based module can be used as an alternative in physics learning so that students can play an active role in learning and understanding the concepts of physics correctly.

## 2. METHODOLOGY

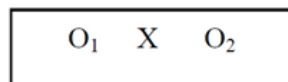
This type of study is research and development (R&D). The purpose of this study was to analyze the effectiveness of PBL-based modules to improve the critical thinking skills of high school students.

### 2.1 Sample

The study was carried out in SMA 1 Probolinggo with samples of X-MIA E class students in the even semester 2018/2019 starting on 2-10 January 2019. The study has also been carried out in SMA 3 Probolinggo with samples of X-MIA 3 class students in the even semester 2018/2019 starting on 14-17 January 2019.

### 2.2 Data analysis technique

The approach used in this study is a qualitative and quantitative approach, with a pretest-posttest non-equivalent group design, namely an experimental study design with a pre-test score as a control. Pre test – post test non equivalent group design can be described as follows;



**Fig-1: Pre test – post test non equivalent group design**

Annotation ;

$O_1$  = pre test results

$O_2$  = test post results

$X$  = treatment

The effectiveness of the module with the PBL approach is analyzed quantitatively based on the results of the students' critical thinking skills analyzed using the following formula:

$$\text{Value} = \frac{\text{Obtained Score}}{\text{Maximum Score}} \times 100\%$$

Terms of description:

Score 0: if not answered

Score 1: if answered incorrectly

Scores varies: if the answer is close and correct.

To find out the effectiveness of students critical thinking, it is done using the Normalized gain (N-gain) formula. Data was obtained by analyzing the value of the pre test and student test post. The gain index is calculated using the unumus gain index according to Meltzer (2002):

$$\text{Gain Index} = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}}$$

Annotation:

$S_{\text{post}}$  = post test score

$S_{\text{pre}}$  = pre test score

$S_{\text{max}}$  = maximum score

Gain index < 0.3 = low

0.3 ≤ Gain index < 0.7 = adequate

Gain index ≥ 0.7 = high

Students' critical thinking skills are obtained from the analysis results of student answers to the module and with indicators of critical thinking that have been developed. The percentage of students' critical thinking can be analyzed using equations:

$$P = \frac{f}{n} \times 100\%$$

Annotation:

P = Percentage of students' critical thinking

f = Number of scores obtained by students

n = Total maximum score of students' critical thinking

**Table-1: Category for students' critical thinking skills**

Range of values	Category
81.25 – 100	Very critical
62.50 – 81.25	Critical
43.75 – 62.50	Less critical
25.00 – 43.75	Very less critical

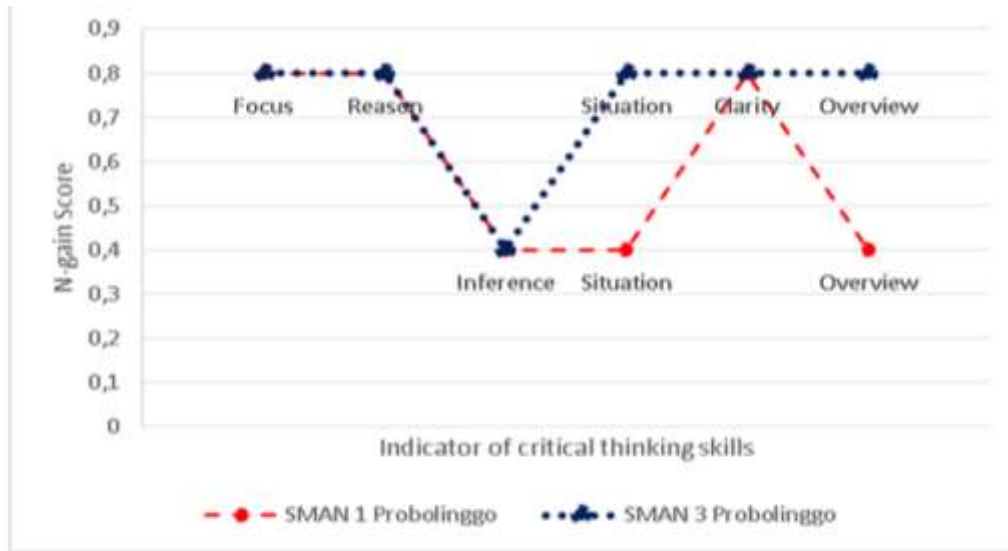
([Probowati, 2016:67](#))

### 3. RESULT AND DISCUSSION

#### 3.1. Data Analysis Results

The effectiveness of critical thinking skills was tested in two schools, that are SMAN 1 Probolinggo and SMAN 3 Probolinggo to prove that PBL-based modules were effectively used in other schools. Students' critical

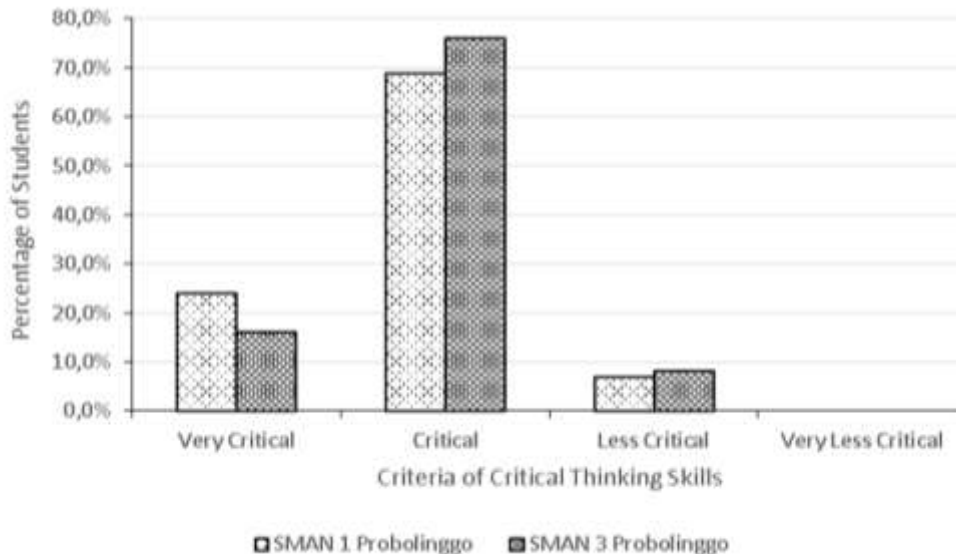
thinking skills are measured through pre-test and posts-test. This test is in the form of a description by measuring six indicators of critical thinking skills, that is focus (answering and asking questions), reason (considering relevant sources), inference (making conclusions), situation (analyzing), clarity (defining), and overview (reviewing). The improvement of students' critical thinking skills can be seen through the N-gain analysis presented by Chart-1.



**Chart-1:** N-gain score of students of SMAN 1 Probolinggo and SMAN 3 Probolinggo

Based on Chart-1, data obtained of critical thinking skills of students of SMAN 1 Probolinggo on the focus indicator score of 0.8; reason of 0.8; inference of 0.4; situation of 0.4; clarity of 0.8; and overview of 0.4. This shows that the critical thinking skills of students of SMAN 1 Probolinggo in adequate category.

Based on Chart-1 too, it can be seen that the results obtained of N-gain test on SMAN 3 Probolinggo for focus indicator score of 0.8; reason of 0.8; inference of 0.4; situation of 0.8; clarity of 0.8; and overview of 0.8. Based on Chart-1, it can be concluded that PBL-based physics modules are effective for training students' critical thinking skills. The results of critical thinking of students in each meeting can be seen on Chart-2.



**Chart-2:** Percentage of students' critical thinking of SMAN 1 Probolinggo and SMAN 3 Probolinggo

Based on Chart-2 can be known that students of SMAN 1 Probolinggo who have critical thinking skills with very less critical of 0%; less critical of 6.89%; critical of 68.9% and very critical category of 24.1%. So the critical thinking skills of students of SMAN 1 Probolinggo are included in the adequate category. While students of SMAN 3 Probolinggo who have critical thinking skills with very less critical of 0%; less critical of 8%; critical of 76% and very critical category of 16%. This shows that students' critical thinking skills are also included in the adequate category. So it can be concluded that the PBL-based physics module can train most of students to develop their critical thinking skills.

### 3.2. Discussion

PBL-based physics modules are useful as one of the supporting teaching materials related to everyday phenomena to help and train students' critical thinking skills in mastering physics concepts. The learning activities developed were supported through pilot activities, discussions, questions and assignments. These questions are based on six indicators of students' critical thinking, that is focus, reason, inference, situation, clarity, and overview (Ennis, 1996: 204). This test is in the form of a description and given to students at the beginning and the end of meeting through pre-test and post-test activities. Based on Chart-1, the average results of students' critical thinking skills were obtained of SMAN 1 Probolinggo of 0.6 in the adequate category and SMAN 3 Probolinggo of 0.73 in the adequate category too, this indicates an improvement of students' critical thinking skills. While based on the results of data analysis which can be seen on Chart-2 are concluded that PBL-based physics modules are effective to improve students' critical thinking skills of SMAN 1 Probolinggo with score of critical thinking skills of 77.0 in the critical category and students of SMAN 3 Probolinggo with a critical thinking skills of 75.3 in the critical category.

Critical thinking skills can be increased because one of the learning activities presented in PBL-based physics modules begins by giving a problem related to events or phenomena that often occur in everyday life. This is in line with the study conducted by Wijayanti (2016: 110) which states that students will have a deep understanding if the learning process emphasizes critical thinking skills. Through critical thinking skills, students are given the opportunity to use higher levels of thinking. To maximize this critical thinking skills, learning should empower their thinking skills.

Based on the aspect of PBL-based physics module content, it strongly supports the training of students' critical thinking skills because this module is compiled based on the earliest PBL stages until the end to form conclusions, so the students' critical thinking skills can be well trained and directed. This is supported by Praba's study (2015: 92) that the critical thinking skills of students who have been trained, can improve the students' reasoning power so that students can pass each stage of learning well and get conclusions correctly at the end of learning. The improvement of students' reasoning power will also improve student learning outcomes.

## 4. CONCLUSION

PBL-based physics modules are declared effective for improving critical thinking skills of students of SMAN 1 Probolinggo with average score of critical thinking skills of 77.0 in the critical category and SMAN 3 Probolinggo with a critical thinking skills of 75.3 in the critical category. Critical thinking skills can be improved because one of the learning activities presented in PBL-based physics modules begins by giving a problem related to events or phenomena that often occur in everyday life. Through critical thinking skills, students are given the opportunity to use higher levels of thinking. So that through critical thinking skills, students can improve their learning outcomes and achieve expected targets. Based on this, PBL-based physics modules are proven effective for improving the critical thinking skills of high school students.

## 5. ACKNOWLEDGMENT

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