

Implementation of Student Worksheets Based on Problem-Based Learning to Improve Critical Thinking Skills

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Abstract: *In general, schools still use publisher-printed worksheets that contain questions that are monotonous, not yet a place for students to hone and empower critical thinking skills. This study aims to determine the effect of applying Problem-Based Learning (PBL) Student Worksheets (LKS) to improve students' critical thinking skills. This type of research is a quasi-experimental non-equivalent control group design involving 2 class X IPA as research samples. Data collection was carried out by providing test instruments for critical thinking skills before (pre-test) and after (post-test) learning. The data obtained were analyzed using prerequisite tests and hypothesis testing. The prerequisite test is the normality test through the Kolmogorov-Smirnov test and the homogeneity test through the Levene test. Furthermore, the data were analyzed by independent t-test. The results showed that the average score for critical thinking skills for the experimental class (X1) was 80, while for the control class (X2) the average score for critical thinking skills was 68.64. Thus it can be concluded that the application of Problem-Based Learning (PBL) based worksheets have an influence on improving students' critical thinking skills compared to classes that apply publisher-printed worksheets. These findings confirm that learning, especially biology learning, requires learning innovations such as teaching materials, so as to facilitate students to be actively involved, collaborative, and critical of problem-solving.*

Keywords: *PBL-based Student Worksheets; critical thinking skills; biology learning*

1. INTRODUCTION

Student worksheets are a collection of sheets containing instructions and task steps to be carried out by students. Worksheets consist of two kinds of forms, namely experimental worksheets and non-experimental worksheets. Worksheets that contain instructions and steps for using tools and materials are called experimental worksheets, while worksheets that contain material text and discussion materials are called non-experimental worksheets (Afifah, 2015). Adha & Refianti (2019) explained that LKS is one of the supporting teaching materials that can support the realization of student learning success.

The use of student worksheets in the learning process is expected to be able to assist teachers in delivering material. With the worksheet, students are able to create more enjoyable learning conditions for students. Students not only understand the concept of the material but through the use of student worksheets, students can gain concrete experience regarding the tasks and problems to be discussed.

We consciously cannot close our eyes to keep up with current advances in science, what students need is worksheets that are able to increase motivation and higher-order thinking skills such as the ability to analyze, solve problems, and others. However, the fact is that so

far the student worksheets that are widely used in schools are worksheets that come from publisher prints which are generally colorless and not yet based on a particular learning model. Another fact is that the use of worksheets is usually carried out independently by students and is not even rarely used as homework material. Students are only asked to work on the questions contained in the worksheet without any feedback given by the teacher. In addition, this pattern of working on worksheets allows students to copy their friends' answers. This is reinforced by a statement [Dezriha Fannie & Rohati \(2014\)](#) in his research which explains that student worksheets are usually used by teachers only as a tool in managing the class when the teacher is unable to attend. The teacher will give assignments to work on student worksheets without further assistance so that students are also not optimal in working on them. In addition, the characteristics of worksheets that are boring both in appearance and material make students lazy and less motivated to work on them. Furthermore [Lestari & Pratiwi, \(2020\)](#) in the research he conducted stated that the teaching materials that were widely used in high schools were worksheets printed by publishers which still emphasized questions and assignments. Student worksheets do not yet contain stages or steps that are able to provide opportunities for students to understand and analyze the origins of the answers to these questions. The use of student worksheets like this is not able to facilitate the improvement of student competence.

Student worksheets are one of the teaching materials that are expected to be able to support learning success. Student worksheets should be able to facilitate the delivery of conceptual material and concrete experiences for students, so there is a need for innovations in them. One of the teaching material innovations that have been carried out by previous researchers is the development of problem-based student worksheets or Problem Based Learning. Several previous studies related to the development of PBL-based student worksheets were research conducted by [Tivani & Paidi \(2016\)](#) who developed problem-based biology worksheets to improve problem-solving abilities and environmental care characters. Other research was conducted by [Arofah \(2017\)](#) who developed

PBL-based student worksheets to improve student learning outcomes.

Student worksheets based on problem-based learning are referred to as activity sheets that require students to solve the problems presented. PBL-based student worksheets can facilitate students to be actively involved in learning, students are allowed to construct their own knowledge and concepts needed in problem solving. Through PBL-based student worksheets it is expected to be able to make students more active, motivated and critical, so that it will affect the improvement of student learning outcomes ([Nata & Manuaba, 2022](#)). PBL-based student worksheets contain a variety of problem solving by students by constructing material and concepts on the worksheet. The problems presented in the student worksheets will lead students to discover material concepts based on the stages of problem solving offered by the PBL model ([Risanti & Darma, 2021](#)). PBL-based student worksheets enable students to be actively involved and construct critical thinking skills through problem solving. Through PBL-based student worksheets that provide opportunities for students to be actively involved in connecting material concepts with problems found in everyday life will be able to train and familiarize students to use critical thinking skills ([Sri Astuty, Muhammad Danial, 2018](#)). [Kuzaimah et al., \(2014\)](#) emphasized that one of the efforts that can be made to activate students' critical thinking skills is through the use of PBL-based Student Worksheets.

Some research results show that the application of PBL-based student worksheets can improve critical thinking, including research conducted by [Paat et al., \(2021\)](#) with results showing that PBL-based student worksheets can improve learning outcomes and higher-order thinking skill abilities. Research result [Ulfah \(2014\)](#) also shows that PBL-based student worksheets can improve students' critical thinking skills.

Based on the results of the initial analysis, observations and interviews that have been conducted by researchers it is known that the use of student worksheets in high schools in Bengkulu City is not much different from the others, namely in the form of worksheets printed by publishers. The results of research conducted by [Syahfitri &](#)

[Muntahanah \(2023\)](#) explain that biology learning in high schools is used to using student worksheets as a supporting learning resource. The use of student worksheets in class is still used as a tool in working on practice questions, where students can find answers to questions in the available material concepts. Student worksheets are rarely used as a tool to help students construct their knowledge. This is also supported by the lack of attention to the improvement of students' critical thinking skills. Therefore, in this study the researchers applied Problem Based Learning (PBL) Student Worksheets to see the effect in improving students' critical thinking skills in biology learning.

2. RESEARCH METHOD

This study applies Quasi-Experimental Design with the Nonequivalent Control Group Design. The design of this study was in the form of a control group pre-test – post-test design, in which each class of the sample group (experimental and control) was given a pre-test (pre-test) before treatment (treatment), and the final test (post-test) was given to end of learning. The research design can be presented in Table 1.

Table 1. Research Design

Class	Pre-test	Treatment	Post-test
A (Experimental)	O1	X1	O2
B (Control)	O3	X2	O4

Information:

O1 and O3 = *Pretest*

X 1 = Implementation of PBL-Based LKS

X 2 = Implementation of conventional LKS

O2 and O4 = *Post-test*

This research was conducted at one of the senior high schools in Bengkulu City involving 2 class X IPA as research samples. Sampling was carried out by random sampling technique obtained by class X IPA 1 which was an experimental class with learning using PBL-based student worksheets, while X IPA 3 was a control class with learning using conventional worksheets (student worksheets printed by publishers)

Data collection was done by giving sheets of critical thinking test instruments to students. After the data is obtained, it will be analyzed using descriptive and inferential statistics. Data analysis

was carried out through prerequisite tests which included homogeneity and normality tests, and then continued with hypothesis testing through independent t-tests with the help of SPSS software.

3. RESULTS AND DISCUSSION

Research data in the form of pretest and post-test values were analyzed through descriptive statistical analysis which can be seen in Table 2.

Table 2. Distribution of Pre-test and Post-test Scores

Value	Pretest		Posttest	
	X1	X2	X1	X2
Min	15	15	65	45
Max	50	50	95	80
Mean	30,47	27,58	80	68.64
SD	9.012	7.718	8.132	8.030

Table 2 explains that the average score in the class that applied PBL-based student worksheets had an average pre-test score of 30.47 with the highest score being 50 and the lowest score being 15. The average post-test score was 80 with the lowest score 65 and the highest score is 95. Whereas in the class that applied the conventional LKS, it has an average pre-test of 27.58 with the highest score of 50 and the lowest score of 15. The average value of the post-test score is 68.64 with the lowest score of 45 and the highest score is 80. Furthermore, to determine the normality and homogeneity of the research data, a prerequisite test is carried out, namely the normality test through the Kolmogorov Smirnov test and the homogeneity test through the Levene test.

Table 3. Prerequisite Test: Normality and Homogeneity

Data	Significance Value	
	Pretest	Posttest
Normality	0.193	0.052
Homogeneity	0.352	0.890

The results of the prerequisite test that have been carried out show that the significance value of the normality test obtained from the pretest and post-test data is 0.193 and 0.052 which is greater than 0.05 (> 0.05). This shows that the research data is normally distributed. Furthermore, the significance of the homogeneity test for pretest

and post-test data showed a value of 0.352 and 0.890 greater than 0.05 (> 0.05), which means that the research data is homogeneous. Based on the results of the normality and homogeneity tests, it can be concluded that the research data can be continued with parametric statistical tests, namely the independent t-test.

Table 4. Results of Independent t-test

		Levene's test for Equality of Variances		t-test for equality of mean		
		F	Sig.	t	Df	Sig. (2-tailed)
Critical thinking skills	Equal variances assumed	0.019	0,890	5.668	63	0,000
	Equal variances not assumed			5.567	62.879	0,000

Based on the results of the independent t-test it can be seen that the significance value obtained is less than 0.05 ($0.000 < 0.05$) which indicates that H_0 is rejected, and H_1 is accepted. This explains that there is an application of PBL-based student worksheets that can improve students' critical thinking skills in learning biology compared to the application of student worksheets printed by publishers. [Ermi \(2017\)](#) explained that printed student worksheets were not suitable for biology learning because printed student worksheets only contained monotonous and boring questions, only emphasizing cognitive learning, rarely involving attitudes and emotions. And sometimes its use is only used as a substitute tool for teachers in teaching in class.

Biology learning generally covers material that is broad, complex and often abstract in nature, so that in the learning process critical thinking skills are needed to avoid misconceptions. Critical thinking cannot immediately appear and be owned by students, it requires innovations in teaching materials or teaching media that are able to develop these skills. [Palennari \(2018\)](#) mentioned that problem-based learning (PBL) is very suitable to be applied in biology learning. Through problem-based learning it will train students in constructing knowledge, independence, and collaboration to solve ill-structured biology material problems.

Problem-based learning can facilitate students in obtaining meaningful learning,

students are given the opportunity to relate and construct their knowledge based on the problems to be solved. This is supported by statements [Masrinah \(2019\)](#) that learning that applies PBL can bridge students in gaining direct experience through problem solving by prioritizing cooperation and communication to formulate ideas and develop reasoning abilities. [Tarmizi et al., \(2017\)](#) explained that the application of PBL-based student worksheets can create effective learning, students will get used to working together in groups. Through group work students can empower, train and develop thinking skills, so as to find solutions to the problems to be solved.

4. CONCLUSION

Based on the findings in this study it can be concluded that the application of problem based learning student worksheets can improve students' critical thinking skills compared to the use of conventional student worksheets. This shows that to increase student learning success innovations are needed in learning that are able to facilitate students to be actively involved and provide concrete experience in solving problems encountered in everyday life. Through problem based learning student worksheets students will be guided to practice analyzing, synthesizing, solving problems, concluding and evaluating. Of course this is a challenge for educators (teachers) to be more creative in providing teaching materials that are relevant to the needs and characteristics of students

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