

Effect of The PBL Model Accompanied by Multi-Representation-Based Science Worksheets on Learning Outcomes

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ABSTRACT

This study aims to examine the significant effect on learning outcomes and the effectiveness of learning by using the PBL learning model accompanied by multi-representation-based science worksheets in grade 8 junior high school students. This research is based on low learning outcomes, students who are less active in learning and students' difficulties in answering questions in image, verbal and graphic formats. The research method used was a quasi-experimental design with a post-test only control group. Data was collected through written tests and response questionnaires. The normality test results for the post-test scores for the experimental and control classes were 0.197 and 0.200, which means these values are normal. The results of applying the PBL learning module accompanied by multi-representation-based Science Worksheets obtained data in the form of post-test scores which were tested using an independent sample t-test. The results of the independent sample t-test obtained a value of 0.00. The results of the questionnaire analysis showed that students responded very positively with an average value of 95%. The results of this test indicate that students more easily understand learning material, are active and interested in learning. Based on the results obtained, it can be concluded that the PBL learning model accompanied by multi-representation-based IPA worksheets has a significant effect on student learning outcomes and is very effectively used in the science learning process in junior high schools. PBL models with a multiple representations can assist students overcoming challenges in problem-solving via the PBL model's processes, also when using different representations.

Keywords : PBL Model, Multi-Representation, Learning Outcomes, Effectiveness of Learning



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I. INTRODUCTION

Qualified human resources influenced by quality education. Capital for the future for a long time as a provision for students to be trained to track changes in time is an important benefit of education [1]. One of the essential objectives around education is learning outcomes because it is closely related to students' absorption of the delivery of knowledge by teachers [2]. Learning outcomes are a measure of students' learning success which can be known through measurement or evaluation [3].

Science or science systematically explains nature [4]. Science is a science that is dubbed as an attitude, a process and a product. Natural Science as a process, namely the activity of obtaining information or knowledge, Natural Science is a meaningful process of knowledge obtained from the process of scientific activity, and Natural Science as an attitude is an effort to train good values in students [5]. Factors that often become

obstacles in the learning process are the learning model chosen is not suitable, rarely uses learning media and teaching and learning activities which are dominated by the role of the teacher [6].

In connection with the results of observations at SMPN 02 Dringu when the teacher taught in class, the authors found the fact that the learning and teaching process of science applied several learning methods including lecture methods, question and answer and discussion in small groups. The integrated methods take reference to the Student Team Achievement Division type's Cooperative Learning paradigm. The science teacher has applied the Cooperative model but the average learning outcomes obtained by 8th grades students at SMPN 02 Dringu are relatively low. The average midterm exam's score for 8th grades students was 55.86, which was still below the school's minimum completeness criteria, which was 70. This was because the implementation of the learning model in class was not fully in accordance with the model's syntax. Learn activity tends to be centered on the teacher where all information about the subject matter is still sourced from the teacher. In addition, from the results of limited interviews with science teachers, it was revealed that students had difficulty working on science problems in the realm of physics given in verbal, graphic and pictorial forms because students' usual learning methods were memorizing material in the form of mathematical formulas without understanding the concept.

The effort to overcome these problems and create meaningful learning is to determine an appropriate learning model which allows students to increase their activeness in learning [7]. A learning model that in its process prioritizes student activities rather than teachers, one example is this PBL model [8]. The PBL learning model is basically presenting a real and relevant event for students to observe clearly and get ideas for solving the problem [9]. The PBL model has difficulties caused by students' habits in working on problems using only mathematical formulas so that students take a long time to solve the problems presented [10]. Therefore, the PBL learning model can be combined with assistive media, namely multi-representation-based IPA worksheets.

Student Worksheets in general are a collection of sheets that are arranged systematically and in them there are assignments arranged by teachers with competencies based on the curriculum [11]. Multirepresentation is a theory that is the same as represented as a different concept, namely verbally, pictures, graphics and mathematics [12]. Multi-representation-based IPA worksheets are worksheets that are made systematically and present Natural Science material with multi-representational aspects [13].

The studies that underlie the use of the PBL learning model with multi-representation-based worksheets assisted media in science subjects, namely research by [14] which revealed that this model influences student learning activities and achievements which are increasing. [15] in their research concluded that the learning model affects student learning outcomes. [16] states that this learning model has a major impact on the learning results of students. Based on information previously explained, the authors considered to do some research about the impact of PBL model accompanied by multi-representation based Science worksheets on the 8th grades students learning outcomes at SMPN 02 Dringu. The purpose of this study is to examine the significant effect on learning outcomes as well as the effectiveness of learning using the PBL model accompanied by multi-representation-based IPA worksheets in grade 8 junior high school students.

II. METHOD

This study applies a quasi-experimental. The research location was determined through a purposive area technique where the location was selected based on certain considerations or purposes. The author chose SMPN 02 Dringu, Probolinggo Regency as the research location. This research was tried out in the even semester of the school year at 2022/2023, from May 20 to June 4. The population taken as research material is students at SMPN 02 Dringu in 8th grades, Probolinggo Regency, in the 2022/2023 academic year. Methods applied to determine the sample was purposive sampling.

Giving post-tests to the experimental and control groups of students allowed for the collection of data on learning outcomes, which were carried out when the learning process was finished, namely at the third face-to-face meeting. The preparation of the questions in the post-test is guided by KD and the main topic of science determined by the author. The post-test in this study contained 20 objective questions and 5 subjective questions. The indicator refers to Bloom's taxonomy which consists of the classification C1 (knowledge), C3 (Application), C4 (Analysis), C5 (Synthesis). The following formulation is used to assess data on learning outcomes in the cognitive domain:

$$Score = \frac{\text{The score of questions answered correctly}}{\text{Max score}} \times 100 \quad (1)$$

The data analysis technique for the post-test was carried out by applying the normality and homogeneity tests then the t-test. The normality, homogeneity and t-test tests are assisted by the SPSS 25 software. After the normality test produces normally distributed data and the homogeneity test shows homogeneous data, then the t-test is then carried out, namely the Independent Sample t-test using the IBM SPSS 25 application. There were two classes in this study which is the experimental and control classes. The experimental class was given treatment using the PBL learning model accompanied by multi-representation-based IPA worksheets. The control class was given the treatment of the learning model that science teachers usually apply at school, namely the STAD type cooperative learning model. Both classes are taught with vibration and wave material, with two meetings for each class. At the last meeting, students in the experimental and control classes were given a post-test. The post-test contains 10 multiple-choice questions and 5 essay questions with vibration and wave material. Then, the researcher gave response sheets to students in the experimental class only. Post-test results and student responses can be used to analyze the effectiveness of learning using the PBL model accompanied by multi-representation-based IPA worksheets.

Hypothesis assessment can be determined by equating the sig. (2-tailed) in the Independent Sample t-test table with decision-making guidelines. The following are guidelines for making decisions on hypothesis testing:

- a) H1: "The learning outcomes of middle school students in 8th grade were not significantly impacted by the PBL approach when used in conjunction with the multi-representational Science worksheets"
- b) H2: "The PBL learning model combined with multi-representation-based Science worksheets has a significant impact on the learning results of eighth-grade middle school students."

Explanation of the decision-making guidelines above, namely:

- 1) Significant value. (2-tailed) is smaller than 0.05, meaning that H1 is denied and H2 is approved, then "there is a significant impact because of the implementation of PBL model accompanied by multi-representation-based IPA worksheets on the outcomes of 8th grades middle school students learning process"
- 2) Significant value. (2-tailed) is greater than 0.05, meaning that H1 is approved and H2 is denied, then "there is no significant impact of the implementation of PBL model accompanied by multi-representation-based IPA worksheets on the outcomes of 8th grades middle school students learning process"

III. RESULTS AND DISCUSSION

A. The PBL Learning Model Accompanied by Multirepresentation-Based IPA Worksheets Against the Learning Outcomes of Class VIII Students in Junior High Schools

The learning outcomes evaluated in this investigation are knowledge only. Data processing of learning outcomes to prove the hypothesis of the effect of the PBL learning model accompanied by multi-representation-based IPA worksheets was analyzed using an independent sample t-test with the help of the IBM SPSS 25 application. Prior to that, the authors conducted the Kolmogorov-Smirnov test and the Lavene test. The results of the normality test can be seen in Table 1 below.

Table 1. Normality Test Results on Learning Outcomes

Test of Normality				
Kolmogorov-Smirnov ^a				
	Class	Statistic	Df	Sig.
Post-Test Learning Outcomes	Experiment	.150	23	.197
	Control	.144	23	.200 [*]

The results of the normality test in the table above show the significance value of the post-test for the experimental class, namely 0.197, and for the control class, namely 0.200, where the values are greater than the assessment criteria, namely 0.05. The results of the normality test show that the overall post-test scores of students from the two classes with different treatments are normally distributed. The results of the independent sample t-test statistics can be seen in Table 2 below.

Table 2. Independent Sample T-Test of Class VIII Student Learning Outcomes

Independent Sample Test						
Lavene's Test for Equality of Variances						
		F	Sig.	T	df	Sig. (2-tailed)
Post-Test Learning Outcomes	Equal variances assumed	.095	.760	7.485	44	.000
	Equal variances not assumed			7.485	43.801	.000

In the statistical test table above, the sig. on the line Lavene's Test for Equality Variances shows a score of 0.760. This value is greater when compared to the determination of the value of 0.05. Referring to these guidelines, it can be argue that the experimental and control class post-test scores variance is uniform. Furthermore, the hypothesis test or independent sample t-test obtained a value of sig. (2-tailed), namely 0.000, which is smaller than the determination criterion, which is 0.05. According to the decision-making guidelines, the data shows that if H1 is rejected and H2 is accepted, then the conclusion is that the PBL learning model accompanied by multi-representation-based IPA worksheets has influence on student learning outcomes at the junior high school level in class VIII significantly.

Based on statistical results, student learning outcomes in the experimental and control classes showed significant differences. This is because the learning process in the experimental class triggers students' curiosity and motivation to understand the subject matter more than learning in the control class. The PBL model accompanied by multi-representation-based IPA worksheets, emphasizes giving real problems to awaken students' process skills. Worksheets based on multiple representations makes science material more concrete by presenting various representations such as pictures, graphs, mathematics, and verbal. That way, activities in the experimental class are more geared toward student-centered learning. Students in the experimental class find it easier to understand and develop knowledge about science than students in the control class, so student learning outcomes in the experimental class are higher than those of students in the control class.

The PBL Learning Model is a teaching model that places great emphasis on solving real-world problems. Students engage in group projects, receive feedback, and participate in discussions as part of this process, which encourages them to be more involved in their studies and improves their critical thinking skills [17]. The questions on the multi-representational worksheets focus students' thinking on processing information from basic knowledge to advanced knowledge so as to train their reasoning abilities. As a result, students tend to easily understand when multi-representation-assisted worksheets is given to them for discussion [18].

According to [19], the application of PBL models with a multiple representations strategy, which can assist students in overcoming challenges in problem-solving via the PBL model's learning processes. The use of numerous representations in learning can also assist students in problem-solving when using different representations, such as visual, physical, and mathematical ones. The students learn not only to recall the learning contents but also to experience the meaningful learning through PBL that is based on numerous representations. All by themselves, the children are gathering and rewriting difficult knowledge, checking for new information, and revising it if it doesn't fit. By giving complete information from the many forms that are offered in order to make a deeper comprehension of the topics, multiple representations can increase students' knowledge. Students' conceptual comprehension of science can be improved by learning with numerous representations [20].

B. The Effectiveness of Learning Using the PBL Learning Model Accompanied by Multirepresentation-Based IPA Worksheets for Grade VIII Middle School Students

The collection of learning effectiveness data is done through the provision of response questionnaires that aim to obtain students' opinions regarding the PBL learning model, accompanied by multi-representation-based IPA worksheets. In addition to student responses, learning effectiveness is also measured by student learning outcomes. The student response indicators studied included interest in the learning model, the benefits of participating in learning activities, and the role of the teacher. The recapitulation of students' responses in the experimental class is listed in the table below.

Table 4. Recapitulation of Experiment Class Student Responses

Indicator	Percentage (%)	Level
Interest in Learning Models	98%	Very Positive
Benefits of Implementing Learning Activities	93%	Very Positive
Teacher Role	93%	Very Positive
Rerata	95%	Very Positive

Referring to table 4, as many as 95% of students responded "very positively" to the application of the PBL model accompanied by multi-representation-based IPA worksheets, and 5% of students responded "positively". The three response indicators show very positive levels. Indicators of interest and interest in learning models are at a "very positive" level with a percentage of 98%. In this regard, it can be said that the application of the PBL learning model accompanied by multi-representation-based IPA worksheets fosters students' interest and curiosity in learning activities. In addition, this learning activity is beneficial for students, so that the percentage of responses is 93% with a "very positive" level.

Likewise, the role of researchers in the learning process is to obtain a "very positive" response level from students with a percentage of 93%. The work of researchers as mentors in teaching and learning activities has a positive impact on student learning. Students also feel a fun and interesting atmosphere when researchers teach using the PBL learning model accompanied by multi-representation-based worksheets. Of the three indicators, it was found that the average percentage of responses from students was 98%, with a "very positive" level.

Learning effectiveness is a criterion of learning success that is measured by the achievement of learning objectives. Learning effectiveness does not only measure learning outcomes but also all efforts that cause students to learn [21]. The PBL learning model accompanied by multi-representation-based IPA worksheets is effective to use or apply. This is evident from the learning outcomes of the experimental class, which are greater than those of the control class, and the "very positive" student responses.

Based on the results of the hypothesis tested through statistical tests, the PBL learning model accompanied by multi-representation-based IPA worksheets effect on student learning outcomes significantly. These good learning outcomes affect the effectiveness of learning because the PBL learning model accompanied by multi-representation-based IPA worksheets is successful in making students active in class during the learning process. In addition, the visualization of multi-representation-based worksheets is able to make students interested so that they are motivated to understand the subject matter more deeply.

Learning in this study was effective because the PBL learning model required students to solve real-world problems presented by the teacher through multi-representational worksheets themselves. Students are encouraged to be active during the learning process so that they can find new experiences and build their knowledge of science. According to [22], the PBL learning model assisted by worksheets, which includes multiple representations, is often used and believed to be effective in improving various student skills. Likewise, research from [23] shows that learning effectiveness increases after applying the problem-based learning (PBL) learning model. The results of research by [24] show that learning using the assistive media developed, namely multi-representation-based worksheets, is categorized as effective in the learning process, as evidenced by the increased students' metacognition abilities.

The implementation of this learning model has several obstacles, including requiring a long and very mature preparation. The reason is that at each meeting, researchers must prepare real problem topics or problem formulations that are listed in the multi-representation-based IPA worksheets. The topic of the problem presented is in the form of real-life events and is in accordance with the material that will be studied by students. In addition, the different characteristics of students make some groups not conducive. This situation certainly disrupts the learning process, which affects the evaluation of the teacher and observer. Therefore, the teacher took action by providing more supervision and guidance, especially during experimental activities and data processing.

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This situation certainly disrupts the learning process, which affects the evaluation of the teacher and observer. Therefore, the teacher took action by providing more supervision and guidance, especially during experimental activities and data processing. Suggestions from the author for other writers who want to research this topic, preferably in preparing the worksheets, can be prepared carefully and thoroughly. This is because the problems in worksheets must be related to the subject matter to be taught. Problems must also be adapted to activities or events in real life that are directly related to students' daily experiences.

For the school, the authors hope that this research can be useful and can be used as inspiration or ideas in preparing scientific and effective learning strategies. Suggestions for teachers, the authors hope that this thesis can be used as material for consideration in implementing the PBL learning model accompanied by multi-representation-based IPA worksheets so that learning is more effective. For other writers, it is hoped that this thesis can be an inspiration for conducting similar research or a useful reference for similar research with different subject matter or topics.

IV. CONCLUSION

The result of hypothesis testing or independent sample t-test obtained sig. (2-tailed) is 0.000 which is smaller than the determination criterion 0.05. According to the decision making guidelines, the data shows that if H1 is rejected and H2 is accepted. This means that the PBL learning model coupled with multi-representation-based science worksheets effect on student learning outcomes at grade VIII junior high school level significantly. Referring to table 4, as many as 95% of students responded "very positively" to the application of

the PBL model accompanied by multi-representation-based IPA worksheets, and 5% of students responded "positively". The results of the hypothesis and student responses indicate that the PBL learning model accompanied by multi-representation-based science worksheets is effective to apply in learning process. The reason is because the PBL model is accompanied by multi-representation-based IPA worksheets makes learning timely and makes students easier to understand a subject matter. Based on the conclusions of the research results, the authors suggest that adopting the PBL learning model with the help of multi-representation-based worksheets media can be used as an alternative to research on other materials and It is intended that teachers would be able to provide students a more diverse learning model for science topic.

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