

Development Of Student Worksheet Problem Based Learning Model To Increase Higher Order Thinking Skills

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Abstrak: Penelitian dan pengembangan lembar kerja siswa berbasis PBL diawali dari rendahnya kemampuan HOTS siswa yang terlihat dari rendahnya hasil belajar siswa. Tujuan penelitian dan pengembangan ini adalah menghasilkan lembar kerja siswa berbasis PBL dan mengetahui efektivitas lembar kerja siswa berbasis PBL untuk meningkatkan kemampuan HOTS siswa kelas IV SD. Jenis penelitian ini adalah penelitian dan pengembangan (R&D) yang merujuk pada teori Borg & Gall. Hasil penelitian menunjukkan bahwa lembar kerja siswayang dikembangkan layak digunakan untuk meningkatkan HOTS siswa, dilihat dari nilai rata-rata siswa yang menggunakan lembar kerja siswa berbasis PBL adalah 77,75 lebih tinggi dibandingkan dengan nilai rata-rata siswa sebelum menggunakan lembar kerja siswayaitu 54,75 dengan nilai Gain ternormalisasi sebesar 0,51.

Kata kunci : lembar kerja siswa, Problem Based Learning, Higher Order Thinking Skill.

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Abstract:The research and development of the Student Worksheet based on PBL starts from the low of HOTS ability of students which is seen from the low of student learning results. The purpose of this research and development is the results of the Student Worksheetbased on PBL and to seek the help of the Student Worksheetbased on PBL to improve HOTS ability of fourth grade students in Elementary School. This type of research is the research and development (R & D) that referred to Borg & Gall's theory. The results of this study indicate that the Student Worksheetdeveloped eligible to be used to improve student HOTS, it seen from the average score of the students that using the Student Worksheetbased on PBL is 77,75 higher than the average score of the students before using the Student Worksheetthat is 54,75 with a normalized Gain value that is 0.51.

Keywords: The Student Worksheet, ProblemBasedLearning, HigherOrderThinking Skill.

I. Introduction

Learning strategy through problem solving approach in learning mathematics in elementary school should be done by many teacher because it will train the learners to develop problem solving ability by finding solution or answer from the problem faced. This is in accordance with the opinion of Riyanto (2012: 56) which states that problem solving requires knowledge to learn to solve the problems so that it will produce the ability to combine several rules into the principle of solving.

The ability to solve problems obtained by learners in learning activities, it is expected to support to develop and improve high-order thinking or better known as Higher Order Thinking Skill (HOTS).

HOTS according to Thomas & Thorne (2009) is a thinking skill that is more than just memorizing facts or concepts. In high-level thinking learners are required to understand facts, analyze each other, categorize, manipulate, create new ways creatively and apply them in finding solutions to problems.

According to Dwi (2017: 87) learning model that can accommodate learners to develop the ability to analyze, evaluate, and create is a model of learning Problem Based Learning (PBL). The same thing is also expressed by Wikanso in Dwi (2017: 132) that the PBL model can maximize the ability of learners to construct the definition of the concept through , ideas, experiences and facts that applied in the search for a solution to overcome the problems faced. Magsino (2014: 8) also argues that the PBL model can develop high-order thinking skills in learners.

HOTS is an important aspect in learning and teaching. Thinking skills is the fundamental in the education process. A person's mind will affect learning ability, speed and effectiveness in a learning process (Heong, 2011: 121)

High-level thinking is basically a process of thinking at a high level in the cognitive process hierarchy. Broadly the arrangement of the hierarchy of thought processes is derived from Bloom's taxonomy, thinking ability begins with the level of knowledge in evaluation to the level of thought for creativity (Ramos, 2013: 2).

Hammond in Ramos (2013: 2) states: critical and creative thinking is a constructive thinking process obtained through direction. There are 3 steps to achieving critical and creative thinking: 1) critically analyzing knowledge, 2) critically analyzing information or conditions, 3) determining steps to draw conclusions, 4) making decisions to create new products or new values.

High-level thinking skills are indispensable for learners to improve their adaptability or adjustment quickly, as the world is tech-oriented today. Instructional thinking skills foster intellectual growth and encourage academic achievement gains (Cotton, 1991: 56).

Mathematical learning should begin with the introduction of problems appropriate to the situation. By posing contextual problems, learners are gradually guided to master mathematical concepts. To improve the effectiveness of learning, teachers should utilize teaching materials that can develop thinking skills in solving problems.

Students' learning outcomes collected in the assessment book found the data of mathematics learning outcomes of learners in the Midterm Exam in the fourth grade is less than 50% which reaches the minimum value of completeness set.

According to Kamarudin (2016: 49) the orientation of the teaching teacher only focuses on knowing and mastering the content of the subject matter, this is because the learners are only prepared for the exam, rather than understanding and applying high-level thinking skills.

The ability of HOTS is a skill that can be trained, That is to create a conducive learning atmosphere will stimulate learners to improve the ability of HOTS learners. Therefore, teachers are expected to look for methods and learning strategies that the impact can boost the ability of HOTS learners.

According to Boud & Felletti in Wood (2016: 17) for the effectiveness of several teaching techniques, it deals with several things about how people learn, based on experience and research, and suggests that PBL is an interesting way to encourage effective learning. The PBL model can train learners to find solutions to the problems presented in the learning activities. By given the stimulus to solve the problem, it is expected that learners can improve HOTS.

To further maximize the use of PBL learning model then the teacher can use the instructional materials in activity sheet of learners. The activity sheet of learners will be able to help learners to better understand the material and optimize the learning process of learners. The activity sheet of learners will also direct students systematically in learning activities to finish or solve problems related to learning materials. The use of the activity sheet of learners can help the learners understand concepts and lead learners to issue scientific attitudes such as preparing, experimenting, observing, analyzing data and concluding.

The Worksheet is a learner's guide that is used to conduct investigation or troubleshooting activities. The worksheet can be a guide for cognitive aspect development exercises as well as guides for the development of all aspects of learning in the form of experimental or demonstration guides. The worksheet contains activity sheets that serve as a guide for learners to solve a problem in learning. The worksheet acts as a teacher assistant in conveying the concept because if only teachers who convey the concept will not be directly understood by learners (Trianto, 2011: 11).

Therefore the alternative that will be used to develop and improve the ability of HOTS of students in fourth grade in Elementary School 03 Argomulyo is by developing the activity sheet of learners Mathematics based on PBL.

The purpose of research and development is to: 1) The realization of the activity of learners based mathematical products based on PBL worthy to improve the ability of HOTS of students in fourth grade in Elementary School, 2) To determine the effectiveness of the activity sheet of learners based mathematics based on PBL on HOTS ability of learners in learning outcomes of learners.

II. Research Methods

This research uses Research and Development (R & D) method of Borg and Gall model. Conceptually, the research and development approach developed by Borg and Gall (2003: 569-575) includes the following 10 steps; 1) Preliminary research and information gathering, 2) Planning, 3) Development of initial product format, 4) Initial test, 5) Product revision, 6) Main field trial, 7) Product revision, 8). Operational field trials, 9). Revised final product, and 10). Dissemination and implementation.

From the 10 steps the researchers set to implement until the seventh step.

The study population is all students in the fourth grade in Core Cluster A. K Gani II Banjit Sub-District of Way Kanan Regency. The sample used in this research is the students in the fourth grade in Elementary School 03 Argomulyo, Banjit Sub-District of Way Kanan Regency.

Instrument used for data collection is questionnaire of teacher requirement, material expert material validation sheet, media expert's validation sheet, user sheet activity sheet of learners, test shaped questions.

The Activity Sheet of The Learners feasibility analysis is obtained from the data validation results calculated using the formula

$$\text{Final score} = \frac{\text{score earned}}{\text{maximum score}} \times 100$$

The final score is converted to the assessment criteria as in Table 1 below:

Table 1. Criteria for the Student Worksheetassessment

Criteria	Score
Very good	76 - 100%
Good	51 - 75%
Less	26 - 50 %
Very Less	≤25%

To determine the effectiveness of the Student Worksheet is using N-gain with the formula:

$$N-G = \frac{\text{posttestscore} - \text{pretestscore}}{\text{maximumpossiblescore} - \text{pretestscore}}$$

Information :

G: gain

The N-gain calculation results are interpreted using the Hake classification (1999: 84) as in Table 2 below:

Table 2 Gain Index Criteria

Index Gain	Criteria
$g > 0.7$	Height
$0.3 < g \leq 0,7$	Medium
$g \leq 0,3$	Low

III. Research Result And Discussion

Research result

The results of research and development that have been implemented are as follows:

Preliminary Information Research and Gathering

In this study, researchers started with a preliminary study, then analyzed the needs of learners and teachers. The technique used is observation with the first step to identify the learning process in the classroom and the questionnaire to the teacher at Elementary School 03 Argomulyo. Data from observations are analyzed and used as a consideration as well as the basis for the Student Worksheetdevelopment.

Based on preliminary research conducted then needed a teaching materials and learning models that can encourage learners to be active and independent in the learning process. Therefore, the researcher chose to develop the Student Worksheetbased math PBL. The activity sheet of the learner is able to minimize the role of teachers so that students are expected to be more active in learning and ultimately can improve the ability of students HOTS.

Planning

The results of the planning stage that has been done by researchers is as follows: a) Preparation of the Student Worksheet framework, b). Systematic determination, c) Planning of evaluation tools, d) Design of assessment instrument design

Development of Initial Product Formats

This activity is done part by part in accordance with the Student Worksheet framework that has been prepared. The preparation of the draft comprises: a) Cover (title page), b) Preface, c) Table of contents, d) KD mapping, e) Learning objectives, f) Guidance on the use of the Student Worksheet, g) Preparation of the Student Worksheet content in accordance with PBL

Initial Test

Initial experiments conducted by experts conducted aims to produce products produced in the form of he activity sheet of the learners can be used by learners. This preliminary test consists of a test of material experts and media experts.

Expert Test of the Student Worksheet Material

Experts test the material aims to get input on the suitability and truth of learning materials that are based on the science on the Student Worksheet developed.

The material expert test was conducted on September 15, 2017, suggestions for improvement of the Student Worksheet products, namely; the conformity of the indicator on the material presentation bill is made per meeting, mathematical sentence made in accordance with scientific rule, presentation of problem about the story made more contextual with environment learners, and product the Student Worksheet given picture which support subject matter.

The second material expert test was conducted on September 29, 2017. In the second material expert test the validator guides and directs on: 1) the conformity aspects of the Student Worksheet with the PBL method, 2) the quality aspect of the the Student Worksheet content.

Furthermore, the presentation aspect of the image used adapted to the level of knowledge, attract students, cover reflects the concept of subject matter presented. In addition, several things that need to be revised are the presentation of activity stages in the Student Worksheet adjusted to the steps of PBL and there is no bibliography.

Based on data analysis of expert material validation results, the Student Worksheet developed can be said to be valid and can be implemented.

Experimental test results on the Student Worksheet product obtained a final score of 85.16 with very good criteria. Judging from the feasibility of the content, each aspect that has been assessed has met the eligibility criteria because the material used is in accordance with the KI and KD, the language aspect is considered to have met the linguistic criteria in accordance with the level of development of learners.

The Student Worksheet Media Expert Test

Expert test media aims to get input on the accuracy of the Student Worksheet design. Expert test media conducted on September 15, 2017. In the first test the validator suggests the following things: the image on the cover adjusted with the material presented, the Student Worksheet given pictures that can make the child interested and in the writing aspect.

On September 22, 2017 the researcher conducted a second media expert test, the validator has stated that the Student Worksheet product is feasible to be implemented. The result of the Student Worksheet product scoring obtained a score of 89.4 with good qualitative criteria. Viewed from the design with the terms of development of the Student Worksheet which consists of three aspects of the assessment that is didactic, construction and technical requirements have been fulfilled.

Field Trial

At this stage, the researcher implements the Student Worksheet product in learning activity which is done in fourth grade in Elementary School 03 Argomulyo. In the field trial phase the results will be analyzed to answer the hypothesis of the effectiveness of the learners worksheet.

Learning activities begins with the pretest and learners carry out learning using the activity sheet of the learners, and at the end of the learning meeting students learn posttest. This is intended to see the improvement of HOTS ability of learners that is reflected in the learning outcomes of students before and after using the Student Worksheet PBL-based mathematics subjects in fourth grade in the first semester.

Learning result of learners before using the Student Worksheet (pretest) and after using the Student Worksheet showed improvement of HOTS reflected from improvement of learning results of learners after learning using the Student Worksheet. The average learning result in the experimental class before using the Student Worksheet was 54.75 increased to 77.75 an increase of 23.00%.

The result of Pretest-Posttest Gain after the calculated 0.50 means that normalized gains are in the medium classification, the effectiveness is effective.

Effectiveness Hypothesis Test

Effectiveness test is done to see the improvement of HOTS ability which is reflected from the learners' learning result before and after learning using the Student Worksheet. The analysis comparing learning result before and after learning using a paired sample t test (Paired t-test).

Before the t-test is analyzed, the test of analysis requirement is test of data normality using Kolmogorov-Smirnov Tests using SPSS 24 program, with test criteria: 1) If value If significance value $> 0,05$, then data is normal distribution. 2) If the significance value < 0.05 then the data is not normally distributed.

The result of normality test of Z-KS pretest value is 0,142 with value of sig 0,200. Next Z-KS value of posttest is 0,180 with value 0,089. The significant value of pretest and posttest $> 0,05$, meaning data is normally distributed.

Thus, the effectiveness test using paired sample-t test can be used. The test criteria are; 1) If the significance value is ≤ 0.05 , then H_0 is rejected and H_1 accepted, 2) If the value of significance > 0.05 , then H_0 is accepted and H_1 is rejected.

T count calculation = -25.064 with sig value. 0,000 $< 0,05$, so H_0 is rejected and H_1 accepted. This demonstrates the enhancement of the HOTS ability of learners as reflected in the acquisition of greater learning result after using the Student Worksheet math based on PBL.

The Final Product Revision

The final product revision is based on hypothesis test results and findings when the product is tested. Hypothesis test results that have been done to obtain learning result of students who increased. Based on the result of consultation to material expert and media expert, it is concluded that the Student Worksheet based on PBL is not revised and feasible to be implemented.

IV. Discussion

Based on the research that has been done shows the increase of pretest and posttest assessments in early trials and field trials. Here are the results of research and discussion of the development of the Student Worksheet-based PBL.

The development of the Student Worksheet based on PBL

The development of the Student Worksheet based on PBL adapts seven R & D steps by Borg & Gall. The first stage of research and initial information gathering, after the researcher knows the low ability of HOTS that is reflected in the low learning result of the learners, the researchers do the planning for the Student Worksheet development so as to increase the HOTS of learners. Furthermore, the researcher prepares the initial product development of the Student Worksheet, in this step the researcher pours the development pattern which will be done in the Student Worksheet based on PBL. The initial test phase is validated with three validators, with the aim of validating the suitability of the product developed under the terms of development. The results of the validation test are described as follows.

Expert material tests include the quality of the Student Worksheet content and compliance with the PBL model. Expert advice of materials such as the suitability of the steps in the Student Worksheet with PBL, and make a bibliography.

Expert test media covering the requirements of making the Student Worksheet are didactic, construction and technical requirements. Expert advice media such as changing the contents to be more contextual and change the display image on the contents of the Student Worksheet to use uniforms of primary school students.

Validation by the classroom teacher includes the content, the conformity of the PBL stages, and the compliance of the Student Worksheet with the terms of development. In the test by the class teacher no revision is done because it is considered feasible to be used to obtain research data.

In field trials the researchers tested the effectiveness of the Student Worksheet through analysis of pretest and posttest learning result data. The results of data analysis indicate an increase in learning result pretest and posttest so it is concluded that the product developed effectively improve the HOTS of learners

Then the researchers made a revision to product improvement. The forms of the Student Worksheet products based on PBL developed can be briefly described, namely: 1) Title page (cover) there are title, researcher name, the Student Worksheet identity, supporting image, user target, the Student Worksheet description, and background 2) Preface, 3) Table of Contents, a list of pages to assist users, 4) KD mapping, description of the material to be learned learners, 5) Learning objectives, contains goals to be achieved by learners, 6) the Student Worksheet usage instructions, contains instructions for users in using the Student Worksheet, 7) The material, containing the material that the learners will learn by PBL steps, consists of six main components of orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses and formulating conclusions, 8) Follow-up, contains about activities for learners, 9) Bibliography, contains references used by researchers.

Learning activities contained in PBL-based the Student Worksheet using six components that are adapted from the opinion Sanjaya (2007: 201) that is orientation, formulate problems, formulate hypotheses, collect data, test the hypothesis and formulate conclusions. The six components are then poured into the learning activities of learners through the development of the Student Worksheet-based PBL which makes learning activities of learners such as discussions to find and solve problems contained in the story becomes more active issues that can improve the ability of HOTS learners.

According to Sukardjo (2013: 54), a theory of learning that emphasizes that individuals gain knowledge from the process of knowledge formation by linking previously possessed knowledge with current and independent knowledge of the individual. the Student Worksheet based on PBL is considered very appropriate because in the learning step learners are directly involved to gain their understanding through systematic PBL steps. This is in accordance with Suhana's opinion (2012: 77) PBL method is a series of

learning activities that involve maximally all the components of learners to seek and investigate the systematic, critical and logical so that they can find their own knowledge, attitude and skills as a form of change .

So it can be concluded that the use of the Student Worksheet-based PBL is very helpful for learners in the learning process, can make learning activities become more active and innovative, learners can find and solve their own problems by linking the material with the knowledge and experience it has in daily life , it will make learners more easily absorb information and process new material, which will impact on improving the ability of HOTS learners.

The enhancement of HOTS ability of learners is seen from some indicators referring to the opinion of Krathworl (2002) in A revision of Bloom's Taxonomy: an overview theory Into Practice, among which are: 1) able to analyze incoming information to find its relation to problem in story, 2) able to make hypotheses and perform testing, 3) Accepting or rejecting a statement based on predetermined criteria.

And the Student Worksheet this can be used as an alternative teaching materials in the learning process in the classroom and as independent learning materials for learners.

The effectiveness of PBL-based the Student Worksheet

the Student Worksheet-based PBL is effective for improving learners' HOTS skills seen in learning result before and after learning using PBL-based the Student Worksheet. The implementation of mathematics learning on FPB and KPK materials begins with the presentation of problems by teachers. Then through the group discussion the students identify the problem and find the solution. The results of the group discussions are presented in front of the class and other groups respond. After the study was finished, the researcher gave a test to measure students' HOTS ability through problem. The result of the analysis using t test shows that the learning outcomes of learners after following the learning using the Student Worksheetbased on PBL is higher than before using the Student Worksheetbased on PBL.

Some of the learning theories that become the reference for the development of the Student Worksheetbased on PBL include constructivism learning theory which according to this theory learn not only related to memorizing lesson subject matter, but also learning is a meaningful experience for learners. Learners find themselves and transform complex information, check new information and revise it if the rules are not appropriate.

The concept of constructivism learning is a learning process that conditions learners to actively engage in building new concepts, new insights, and new knowledge based on data. Therefore, the learning process must be designed and managed in order to encourage learners to organize their own experiences into meaningful knowledge. So in the view of constructivism is very important to have a constructive habit of thinking in need of freedom and learning attitudes.

According to Sanjaya (2007: 208) the advantages of the PBL method are: a). The PBL method is a method that emphasizes the development of cognitive, affective and psychomotor aspects, in a balanced way so that learning will be more meaningful, b). The PBL method provides the space for learners to learn according to their learning style, c). PBL method is a model that is considered in accordance with the development of modern learning psychology that considers learning is the process of behavior change, d). Another advantage is that this learning can serve the needs of learners who have above average ability. That is, learners who have good learning ability will not be delayed by learners who are weak in learning.

The effectiveness of the use of teaching materials the Student Worksheetstrengthened by the opinion Yildirim (2011: 52) which states that the sheets of activity can affect student achievement. Based on these theories, in this study the effectiveness of learning is measured through the learners learn, by looking at the high low learning outcomes obtained before and after using PBL-based the Student Worksheet. The effectiveness of learning can be seen from the increase of the average value before and after using the Student Worksheetbased on PBL, besides the normalized gain value of learning results in learners whose learning using the Student Worksheetbased on PBL fall into the medium category.

The results showed that the the Student Worksheetbased on PBL that was developed including the effective criterion, this can be seen from the average value of learners using the Student Worksheetbased on PBL is 77,75 higher than the average score of learners before using the Student Worksheetbased on PBL that is 54, 75 with a normalized Gain value of 0.51. This can happen because learners use the Student Worksheetusing PBL model steps where in this model pesrta students are required to follow each stage in a systematic way.

V. Conclusion

The product produced in this research is the Student WorksheetPBL on the fourth grade mathematics course through material validation, media design expert, and teacher as user. the Student Worksheetproducts based on PBL effectively improve students' HOTS.

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