

Development of Learning Instrument Based on Problem Based Learning (PBL) for Improving the Mathematical Problem Solving Ability of Class VII Junior High School

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Abstract - Problem solving ability is one of the mathematical ability has an important role in the success of students. But in reality the student's ability to solve the problems of mathematics remains low. For that we need a model of learning characteristics and steps to develop problem-solving abilities, one suitable model is the Problem Based Learning (PBL). Learning in the classroom implementation requires a learning device for its operation, but that happens in the field of devices used have not been tailored to the needs of students and not able to improve students' mathematical problem solving ability. Related to the above description, it is to investigate the device characteristics based math learning Problem Based Learning (PBL). This research is the development of the model of development Plomp, consisting of the preliminary analysis phase, a development phase or loading a prototype, and the assessment phase. In the phase of the preliminary analysis carried out a needs analysis, curriculum analysis, concept analysis, and analysis of the students. In the phase prototype is to design devices based learning PBL form of lesson plan and student worksheet, then conducted a formative evaluation to determine the validity and practicalities. While the assessment phase assessment of the practicalities and effectiveness. The result showed that the device has a valid learning developed with the average index for the lesson plan and student worksheet validity of 82,25% and 78,85%. Learning device has been practically designed with practicality percentage of teachers' questionnaire responses 90,28%, 87,5% student response, and enforceability of the observation sheet lesson plan 92,52%. The results show the effectiveness of data analysis designed device has effectively improve students' mathematical problem solving with an average percentage of 79,43% achievement indicators. Based on these results it can be concluded that the device-based math learning Problem Based Learning (PBL), which has been designed valid, practical, and effective improve students' mathematical problem solving ability grade VII junior high school.

Keywords: *PBL, problem solving ability, development Plomp*

I. INTRODUCTION

Mathematics is a discipline that has its own characteristic than other disciplines. In short, it is said that mathematics deals with systematically arranged abstract concepts or ideas. In addition, mathematics is an comprehending, by studying

mathematics, a person is required to be able to understand a problem faced. Given the importance of the role of mathematics, students are expected to be able to master concepts of mathematical learned, therefore, mathematics is a high mental activity and it is related to hierarchically arranged ideas and concepts. Mathematics not only puts pressure on calculating skills and problem solving skills, but mathematics is an important driver for giving students the ability to solve daily problems.

The ability of mathematical problem solving is the ability to solve a problem in mathematics and applying in daily life. It can be seen in 2015, the results of the Programe test for International Student Assessment (PISA), Indonesia ranked 64 out of 65 countries participating. Besides, the results of the latest PISA test in 2015, Indonesia ranked 69 out of 76 participating countries. This shows that students' mathematical ability in Indonesia is still apprehensive.

This is also seen in SMP Negeri 1 Patamuan. This information was found during a preliminary study. Preliminary study conducted with the provision of mathematical problem solving, teachers interview and questionnaire for students. The results of mathematical problem solving test analysis performed in SMP Negeri 1 Patamuan, students obtained an average score of 13.23 out of 100 maximum score, thus indicating that students' problem solving ability is still low.

Based on the results of interviews with teachers, it is found that students' problem solving ability is still relatively low because students have not been interested in mathematics learning, especially concerns about proof. Teachers also have tried several times to explore the students' problem solving abilities but in reality the students are difficult to understand the problem of mathematical problem solving ability during the learning process. In addition, teachers have not implemented Regulation No. 24 of 2016 Curriculum 2013 that can facilitate students to improve problem solving ability because teachers still rely on textbooks. Furthermore, students questionnaire results obtained information that they have difficulties, include: difficulty in understanding the material, understanding problems and developing ideas in solving problems.

In related with the above phenomena, a mathematics course is needed that allows students to associate mathematical ideas with the environment of everyday life. Lessons that have these characteristics are learning based on Problem Based Learning (PBL). PBL is one of the innovative learning models that can provide the conditions for students active and creative. According to Arends (2008) Problem Based Learning is learning that prioritizes the filing of a problem or question, focusing on the linkages between disciplines, authentic inquiry, collaboration, and produce work or show results. PBL (problem based learning) also help students become independent students. In this PBL, the role of the teacher is to ask a matter of asking questions, facilitating student inquiry, and support student learning.

In the development of this learning device produced products in the form of student worksheet with product quality in terms of validity. Validity in development research includes content validity (relevancy) and construct validity (consistency). According to [4], validity leads to the feasibility of instructional equipments, both in content and construct. A learning device is said to be valid or feasible to use if the contents and constructions are appropriate and interconnected to facilitate users both teachers and students.

The validity of student worksheet developed in this study is assessed on the basis of expert assessment, consisting of mathematics education experts, language experts and educational technology experts. Learning tool is valid if the result of student worksheet validation sheet data analysis in valid category. This development research is conducted to see the validity of student worksheet mathematical based on Problem Based Learning, in order to be used to improve students' mathematical problem solving ability.

II. METHODS

Type of research used is research development. The development model used in this study is the Plomp model. The Plomp model has three development stages: (1) preliminary research phase; (2) prototyping phase; and (3) assessment phase. The steps of the learning device development plan above can be stated in detailed as follows:

1. Preliminary research phase

At this stage, identification or analysis of what is needed for student worksheet development is based on PBL. The purpose of this phase is to establish and define the requirements that is required for the development of student worksheet. At this stage, there are four main steps undertaken by the researcher are: (a) Needs analysis; (b) curriculum analysis; (c) Analysis of concepts; and (d) Analysis of students.

2. Phase prototyping phase

At this phase is done by designing student worksheet based on PBL based on information that has been obtained at the preliminary research stage. At this stage, the main steps undertaken by the researchers are: (a) Self evaluation, is a correction back by researchers to student worksheet after designed. Once revised, the result is called prototype 1; (b) expert review, is a correction of student worksheet conducted by some pre-determined experts. After being revised and declared valid, the result is called prototype 2; (c) One to one evaluation, an evaluation of student worksheet conducted by individuals with different levels of ability. After revision, the

result is called prototype 3. (d) Small group evaluation, an evaluation of student worksheet conducted by 8 (eight) students with different levels of ability. After the revision, the result is called prototype 4.

3. Phase of the assessment phase

The phase of the assessment is to test the effectiveness of the resulting product field test in class VII SMP Negeri 1 Patamuan. It is aimed to see the practicality and effectiveness of product. The data was collected through validation sheet, teacher's and student's response questionnaire, observation sheet of the implementation, and the result of students' problem solving ability test.

Based on the research methods that have been described previously, it can be emphasized that this study only focus on the process of validation stages against student worksheet developed.

III. RESULTS AND DISCUSSION

The process of developing this tool begins from the preliminary research stage, consisting of needs analysis, curriculum analysis, concept analysis and student analysis. This preliminary analysis phase is aimed to determine the basic problems needed in device development.

Based on the results of needs analysis obtained from interviews with teachers, it can be concluded that the available learning equipments have not been fully able to improve students' mathematical problem solving abilities. In addition, the available learning equipments have not fully facilitated students to improve problem solving ability. In addition to teacher interviews, what is done at the needs analysis stage is a test of problem solving ability. Based on the test results given to the students concluded that the ability of problem solving owned by students is low with an average score of 13,23 from 100 maximum score.

In the student analysis, the questionnaires were filled by the students with the result of learning equipments favored by the students in the form of student worksheet which has dancing drawing and has ordered instructions and easy to understand. Furthermore, in the curriculum analysis, the thing done is to analyze Basic Competence (KD). The results of KD analysis are used to formulate indicators of achievement of competence. The last stage of the preliminary analysis is conceptual analysis. Based on the results of concept analysis concluded that the material studied is the material contained in Semester II.

The next development process is to design the learning device (prototyping phase). The student worksheet designed is student worksheet based on PBL. The design of student worksheet starts from the didactic or presentation aspect. There are things to consider in the presentation that is, provide problems in everyday life related to the material being studied. Furthermore, the content aspect, the things that are considered in the contents of student worksheet are presented in accordance with indicators of achievement of competence. In addition, it is viewed from the aspect of the language, the thing that is concerned, the writing and language used in accordance with the general guidelines of Indonesian spelling abbreviated PUEBI. The last step to note is the aspect of the display, it is the overall look of student worksheet designed converted to the character of high school students of Junior High School.

The next stage is self-evaluation (self evaluation). The student worksheet that has been designed is self-corrected. Things to note in the self-evaluation of typing errors and punctuation, clarity of instructions, the accuracy of the stages of PBL and the accuracy of materials, examples and exercises. Furthermore, the validation activities are done in the form of filling validation sheet and discussion. The validation stages in student worksheet are done in two stages: (1) validation of instrument; and (2) student worksheet validation. These stages can be described as follows.

1.1 Instrument Validation

Instrument Validation is an assessment performed by several validators of the instrument. Validation of instruments to be assessed by validators in order to validate learning equipments in the form of student worksheet is student worksheet instrument validation sheet. Assessment of validation of this instrument is done by three validators (experts), they are two lecturers of mathematics education and one lecturer of Indonesian language. Based on the results of the validator assessment, it is stated that the validity of student worksheet instruments based on PBL is categorized as "Valid" with 81.25% validity values.

1.2 Student Worksheet Validation

Validation of learning equipments in the form of student worksheet based on PBL is assessed from several aspects, namely: (1) Didactic Aspects and Content; (2) Language Aspects; and (3) Aspect of graphics or appearance. The assessment was conducted by five experts consisting of three lecturers of Mathematics Education to validate student worksheet based on didactic and content aspects, one lecturer based on language aspect and one lecturer of education technology based on aspect of graphics or appearance. student worksheet validation results can be described as follows.

1. Aspects of Didactic and Content

The result of validator assessment stated that student worksheet based on PBL is seen from didactic aspect and the contents are categorized "Valid" with 81.25% and 80% validity values..

2. Language Aspects

The result of validator assessment stated that student worksheet based on PBL is seen from the aspect of language categorized "Valid" with 79.17% validity values.

3. Aspects of Degradation and Display

The result of the validator assessment stated that student worksheet based on PBL is seen from the aspect of graphics or the display is categorized "Valid" with 75% validity values.

Based on student worksheet validation result based on PBL in all aspect in general validity of didactic aspect, linguistic aspect and aspect of graphics have fulfilled "Valid" criterion with 81.25%, 80%, 79.17% and 75%. Overall student worksheet-based validity of PBL has met the "Valid" criterion with 78.85% validity values. Based on the validity process that has been implemented, it can be concluded that the result of learning equipments in the form of student worksheet-based on PBL class VII Junior High School is valid.

IV. CONCLUSIONS

The discussion shows that in terms of validity of instructional equipments in the form of student worksheet based on PBL class VII Junior High School implemented with Plomp development model produce a valid learning device so that can be used to improve students' problem solving ability.

It is recommended that teachers and students continue to use this student worksheet, in order to help improve students' mathematical problem solving abilities and support from the school is needed to facilitate the use of student worksheet required by teachers.

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