Design Of PBL Mathematics Student Worksheets To Improve Student Learning Creativity For Junior High School

Gendis Ayuwandari, Suparman

Abstract: The purpose of this study was to develop a design of problem based learning student’s worksheet mathematics to improve the creativity of class VII junior high school students. This study uses the ADDIE development model. The development procedure includes five stages: analysis (analysis), design (design), designing the initial form (prototype), development (development) and evaluation (evaluation). The research subjects were seventh-grade students of Muhammadiyah Middle School 1 Minggir, Sleman. The object of this research is the curriculum, material, and characteristics of students. This study resulted in a) the results of the analysis of the needs of the Problem Based Learning student worksheets to improve creativity in accordance with the curriculum, material, student characteristics, and learning objectives. b) the results of the design of Student Worksheets consisting of covers, introductory words, descriptions, competency objectives, concept maps, table of contents, material, steps of action, and practice. This research can be continued to be developed and disseminated.

Index Terms: Learning Creativity, Problem Based Learning, Student’s worksheet

1 INTRODUCTION

THE 21st century needs high-level skills obtained from future global generation based on the advancement of information and technology [1], [2]. These skills will help students to develop, therefore students must be able to apply the knowledge they have learned to face the challenges of today’s life [3]. In the world of education, creativity is very important, especially for students. Creative thinking stands out in response to our rapidly changing world to adapt to ongoing technological and scientific improvements [4], [5]. Creativity plays an important role in mathematics [6]. One of the factors that help facilitate students in understanding mathematical concepts is the teacher as a facilitator who is able to overcome and solve problems in classroom learning [7]. National and international surveys show that student achievement in Indonesia, especially mathematics in secondary schools, is at a lower level compared to more developed countries [8], [9]. Because most students consider mathematical learning difficult and ineffective learning is one of the main factors. As a result, teachers tend to memorize and teach in their own way [10]. Understanding of mathematics itself is a very important basic science in human life with efforts to master science and technology [11]. Students tend to be difficult to solve mathematical problems related to abstract objects. The ability to connect mathematics is the basic ability of students to connect mathematical ideas in real life, this is important for students to overcome mathematical problems, especially in problem-solving [12]. Problem solving tests are alternative solutions that must be given and tested to students, so students become accustomed to solving mathematical problems such as PISA questions [13]. PISA tests are always based on real situations that contain problems that must be resolved because PISA assessment focuses on mastering the process, understanding the concept, and the ability to apply it. [14]. There are several criteria for generating new ideas in mathematics, including clarifying, deep and responsive. Becomes clear, leads to deeper understanding and insight [15], [16]. Creativity in mathematics can be developed in all students because each student has the ability. Creativity in mathematics in school students is evaluated in their previous experiences and taken from the performance of other students [17]. The low student achievement can be caused by the ability and willingness of students to solve inadequate mathematical problems, it can be shown that students to solve mathematical problems always only take steps that are answered, while the steps to understand, plan and look back sometimes the answer is not done [18]. Efforts to increase creativity are done by choosing an appropriate and innovative learning model. One of the right learning models is PBL. PBL is a learning approach that links real-world problems of students to learning about certain learning materials by applying critical thinking processes and problem-solving skills [19]. Research will be carried out by applying five steps of learning, namely: (1) student orientation to the problems, (2) condition students to learn, (3) guiding individual student and group investigations, (4) develop and present work results, and (5) analysis and evaluation of problem-solving process [20]. PBL was chosen because (1) linking problems with real life (2) encouraging students to play an active role in learning activities, (3) encouraging the use of various learning approaches, (4) give students the opportunity to make the choices and effective ways of learning (5) encourage learning with other students, and (6) to achieve quality education. In PBL learning, students work in small groups and can identify given to solve a problem. Based on the description described above, the researcher is interested in conducting research related to developing learning student’s worksheets and combined with a learning model. This research is entitled “Problem Based Learning student’s worksheets Mathematics Learning Design for Middle School Students”.

Gendis Ayuwandari is currently pursuing a master’s degree program in mathematics education at Ahmad Dahlan University, Indonesia, PH+6285726979050. E-mail: dinda.wandari@mail.com

Suparman is an associate professor in mathematics education at Ahmad Dahlan University, Indonesia, PH+6281328201198. E-mail: suparman@pmat.uad.ac.id

www.ijstr.org 3958

IJSTR©2019
2 Research Method

The subjects in this study were seventh-grade students of Muhammadiyah Middle School 1 Minggir Sleman. The type of research used in this study is the research and development method (Research and Development), which uses the Analyze, Design, Develop, Implement, and Evaluate (ADDIE) model [21, 22, 23, 24, 25, 26, 27, 28]. The ADDIE model directs research on process optimization to measure measurable output [29]. Visually the ADDIE stages can be seen in Figure 1.

However, this research is limited to only two stages, namely the analysis and design stages. The analysis phase carried out in this study is divided into 3 namely curriculum analysis, material analysis and analysis of student characteristics. The results of the analysis are used as the basis for developing the product in the form of a mathematics learning worksheet for class VII students. The design phase carried out in this study starts with the preparation of a product framework and designing a product prototype. The third stage is development, the fourth stage is the implementation which is the application of the product that has been made, and the fifth stage is the evaluation based on the results of the module development discussion, the entire product that has been made in Fig. 2.

The technique of analysis was qualitative by previewing and reducing all data to categorize, interpret, and present findings of the data.

3 Discussion

This research was carried out by designing problem-based learning mathematics learning worksheets for VII grade students of Muhammadiyah Middle School 1 Minggir Sleman. The following are the results of the module development design through the analysis and design stages in ADDIE.

3.1 Analysis Phase

3.1.1 Curriculum Analysis

Based on observations, the curriculum used in student worksheets is in accordance with Core Competencies, Basic Competencies, and indicators in the 2013 curriculum. Every material described is in accordance with the indicators of achievement. In the use of the 2013 curriculum, the learning process is centered on students and teachers as facilities so that the student's worksheets developed is able to help students as a center in the learning process.

3.1.2 Curriculum Analysis

Students mention that these students find it difficult to simplify the form of algebra because it is difficult to distinguish between variables one with another variable. Another student problem is that it is difficult to find algebraic solutions in real life. Students are very difficult to find concepts and solve problems in the practice questions given.

3.1.3 Analysis of Student Characteristics

Students tend to memorize when learning mathematics in the classroom, especially when solving mathematical problems. Based on the results of interviews with Grade VII mathematics teachers, it was found that students could not understand mathematics well, in general teachers had difficulty teaching algebraic material. Students need worksheets that can facilitate students in understanding algebraic material. The teacher also explained that the constraints in the mathematics learning process are the limited availability of teaching materials that make the learning process less effective, mastery of concepts and understanding of children is low.

3.2 Design Stage

In the design stage, the student's worksheets will be designed in the form of problem-based learning based mathematics learning worksheets. Based on the results of the analysis above, problem-based learning based mathematics learning modules have been made as follows:

3.2.1 Opening Part

3.2.1.1 Cover

This problem-based learning based student’s worksheets mathematics learning cover is entitled “Problem Based Learning Based Student Activity Sheet for Class VII Middle / MTs Junior High School Students”. So that student’s worksheets is easy to understand, the cover section is equipped with the name of the author, the origin of the university, and the subject matter contained in this student’s worksheets. The following is the design of the student’s worksheets cover that has been made in Fig. 2:
3.2.1.2 Foreword
This preface in problem-based learning based student's worksheets mathematics learning gives thanks to those who have helped in the formation of this student's worksheets and apologies and suggestions for this problem-based learning based mathematics learning module. The following is a preface design that has been made in Fig. 3:

Kata Pengantar
Assalamu'alakum wr. wb


Lembar Kegiatan Siswa (LKS) Matematika berbasis problem based learning materi Aljabar ini disusun dengan harapan mampu mengaktifkan siswa selama proses pembelajaran dan memediasi siswa untuk belajar matematika.

Semoga Lembar Kegiatan Siswa (LKS) ini dapat menjadi salah satu sumber belajar bagi siswa dan membantu guru dalam menyampaikan materi Aljabar. Terimakasih kepada semua pihak yang telah membantu dalam penyusunan LKS ini. Penulis menyadari bahwa LKS ini belum sempurna. Oleh karena itu, penulis mengharapkan kritik serta saran yang bermanfaat dalam pembahasan atau kekeliruan dalam Lembar Kegiatan Siswa (LKS) berbasis problem based learning ini.

Wassalamu'alakum wr. wb

3.2.1.3 Description of Student’s Worksheets
Description of student’s worksheets based on guided mathematics learning problem-based learning contains information in the form of writers, mentors, validators, materials and applications used in making student’s worksheets. The following is the design description of the student’s worksheets that have been made in Fig. 4:

3.2.1.4 List of Competency Goals
List of competency goals in problem-based learning based mathematics learning worksheets contains what knowledge, attitudes, or skills can be mastered after completing learning. The following is a design list of competency objectives that have been made in Fig. 5:

3.2.1.5 Concept Maps
Concept maps in problem-based learning based mathematics learning worksheets contain topics to be studied in the
student’s worksheets and show the interrelationships between topics in the student’s worksheets. Concept maps also help teachers to improve the effectiveness of the learning process in the classroom. The following concept map design has been made in Fig. 6:

![Fig. 6. Concept Map Display](image)

### 3.2.1.6 Table of Contents

The table of contents in this problem-based learning based mathematics learning sheet contains topics discussed. The topic appears based on the sequences in the student’s worksheets. Students can also see the overall topics discussed in the student’s worksheets as well as printed page numbers to make it easier for readers to find the topic. Following is the design of the table of contents that have been made in Fig. 7:

![Fig. 7. Display of Table of Contents](image)

### 3.2.2 Core Part

#### 3.2.2.1 Introduction

Introduction to this problem-based learning based student’s worksheets mathematics learning contains advantages over other student’s worksheets. The advantages of this student’s worksheets can be seen from how to package material combined with problem-based learning based learning approaches. In the introduction it also contains a general description of the content of the student’s worksheets material, convincing students that the material on the student’s worksheets is beneficial to them and provides guidance on how to learn the material to be taught. In this section, there are also core competencies and basic competencies used. Following are the preliminary designs that have been made in Fig. 9:

![Fig. 9. Introduction](image)

#### 3.2.2.2 Material

The material in problem-based learning based student’s worksheets mathematics learning contains detailed explanations of the subjects that are delivered sequentially and systematically so that students are easy to understand the learning material. Here are the design materials that have been made in Fig. 10 and Fig. 11: The material in problem-based learning based student’s worksheets mathematics learning contains detailed explanations of the subjects that are delivered sequentially and systematically so that students are easy to understand the learning material. Here are the design materials that have been made in Fig. 10 and Fig. 11:
3.2.3 CLOSING PART

3.2.3.1 Final Test

The final test in student's worksheets based on problem-based learning based on mathematics learning contains questions related to student's worksheets material which serves to find out how understanding students are after learning algebraic material. The following evaluation design has been made in Fig. 12:

![Fig. 12. Display of Final Tests](image)

3.2.3.2 Summary

This summary in problem-based learning based mathematics learning worksheets examines the main points in algebraic material discussed. The following summary design has been made in Fig. 13:

![Fig. 13. Summary view](image)

3.2.3.3 Glossary

The glossary in this problem-based learning based mathematics learning sheet contains the definition of concepts discussed in the student's worksheets. The definition is summarized so as to make it easier for students to recall concepts that have been studied. The following is a glossary design that has been made in Fig. 14:

![Fig. 14. Glossary view](image)
**Glosarium**

Koeefisien : bilangan yang memuat variabel dari suatu suku pada bentuk aljabar.

Konstanta : suku dari suatu bentuk aljabar yang berupa bilangan dan tidak memuat variabel.

Suku : variabel koeefisien atau konstanta pada bentuk aljabar yang dipisahkan dengan operasi jumlah atau selisih.

Variabel : lambang pengganti suatu bilangan yang belum diidentifikasi nilainya dengan jelas.

**Fig 14. Display Glossary**

### 3.2.3.4 Reference

Reference in problem-based learning based mathematics learning student's worksheets contains sources of information about the contents of the student's worksheets. The following reference design has been made in Fig. 15:

**Daftar Pustaka**


**Fig 15. Reference view**

The validation stage is carried out to determine the validity of the student's worksheets design to be developed. The student's worksheets design that has been approved by the supervisor is then validated by the lecturer validator, the media. Worksheets design validation uses assessment instruments and instruments in the form of questions and questionnaires that have been reviewed by lecturers, Ms. Farida Kurniawati, S.Pd, and Ms. Endah, S, S. Pd. After a valid instrument can be used by media experts to assess the worksheets being developed. Category rating criteria idea by Likert seen from the table 1:

<table>
<thead>
<tr>
<th>Score range</th>
<th>Calculation</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the percentage of total respondents answers has a value &gt; 62.5%</td>
<td>60% &lt; X</td>
<td>GOOD</td>
</tr>
<tr>
<td>If the percentage of total respondent's answers has a value of &lt; 62.5%</td>
<td>X &lt; 60%</td>
<td>NOT GOOD</td>
</tr>
</tbody>
</table>

From the calculations in table 1, it was obtained 60% < X is GOOD but X < 60% is NOT GOOD. The validators provide comments and suggestions to support the perfection in making worksheets designs seen from table 2:

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Score</th>
<th>Calculation</th>
<th>Criteria</th>
<th>To Quantitative Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farida Kurniawati, S. Pd</td>
<td>18</td>
<td>100%</td>
<td>=</td>
<td>GOOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endah S, S. Pd</td>
<td>19</td>
<td>100%</td>
<td>=</td>
<td>GOOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not only comments and suggestions, the results of the questionnaire design validation worksheets assessment given by the validator are calculated and classified like table 1 and get results as in table 3:

<table>
<thead>
<tr>
<th>Comment and Suggestion</th>
<th>Follow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add some picture on page material algebra</td>
<td>In the design of the student’s worksheets is suggested revisions</td>
</tr>
<tr>
<td>Add reference source on the picture</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 3, it can be seen that the average score of media expert assessment is 18 and 19. These results indicate that the design of teaching materials in the form of worksheet that will be developed in the category is very good.

### 4 CONCLUSIONS

The results obtained show that the design of student's worksheets based on problem-based learning mathematics learning has been carried out at the analysis and design stages. At the analysis stage, the researcher grouped into three, namely: curriculum analysis, material analysis and analysis of student characteristics. In curriculum analysis, it was found that the curriculum used was the 2013 curriculum in accordance with the government. In the material analysis, it was found that students experienced difficulties on the subject of algebra. While the analysis of student characteristics is obtained that students are more likely to memorize and need teaching materials that are able to help students in algebra learning. At the design stage, the researcher designs three parts outline namely the opening part which consists of a cover, introduction, module description, list of competency goals, concept maps, table of contents. The core consists of introduction and material. The closing section which consists of the final test, summary, glossary, and references that will be tested by media experts. The developed student’s worksheets have the advantage of increasing the creativity of students' mathematical learning on the subject of algebra because every indicator of learning creativity is incorporated into the questions in the module and integrates a guided discovery-based learning approach. After this research was carried out, the next study was the development of guided discovery-based learning modules until the stages of developing, implement and evaluate ADDIE were carried out.

**ACKNOWLEDGMENT**

The authors wish to thank SMP Muhammadiyah 1 Minggir Sleman because they have given permission to conduct research.
REFERENCES


[29] College Station, “ADDIE Instructional Design Model,” Texas Copyright 2001 ©LOT All rights reserved. 2001.