Student’s Worksheet Design To Improve Problem-Solving Ability For Tenth Grade With PBL

Diyah Istriani, Suparman

Abstract: Solving mathematical problems is a critical ability mastered by students. This study aims to produce worksheets for mathematical learners based on PBL to improve problem-solving skills. This research uses research and development (R&D). This study uses a 4D development model with several stages, including defining, design, development and dissemination. The subjects of this study were tenth-grade high school students in Central Java, Indonesia. Data collection methods using observation, interviews, and questionnaires. The instrument used in this study was a validation sheet. Analysis of needs in worksheets used by students is the first stage in this study. The results of the report are used as a reference for the development of instructional media in the form of student worksheets. The research is a limited study where research is limited to the initial design stage. The results of the initial design validation found that the category is perfect, with an average value of 36. This research can be continued at the development and dissemination stage.

Index Terms: Student’s Worksheet, Problem Solving, Problem Based Learning.

1. INTRODUCTION
MATHEMATICS is essential in the process of developing students ability to think [1]. The mathematical skills that must be possessed by students are problem-solving ability [2]. Every individual needs to have an effort in solving problems in certain situations by involving the thinking process to the maximum [3]. Problem-solving is one part that students must have in the development of 21st century skills [4]. Problem-solving involves a person's skills in analyzing, interpreting, reasoning, predicting, and evaluating [5]. Following one of the essential goals of learning mathematics at various levels is related to the ability of problem-solving [6]. The abilities to solving mathematical problems is the ability to get solutions in solving mathematical problems [3] and is expected to be able to create many ideas [7]. Then the results were obtained that it turns out students in learning mathematics still need more problem-solving skills.

The results of research conducted by the 2015 PISA team generally showing that Indonesian students are still lacking in completing base mathematical concepts [8]. The lack of students in problem solving skills is a familiar phenomenon. Lack of accurate understanding to identify, analyze, recognize meaning, and not use strategies influences failure in problem-solving [6,9]. Minimizing failure in problem-solving can be carried out by various efforts, one of which is by choosing the right, exciting, and innovative learning model [10]. One inspiring, appropriate, and creative learning model is PBL [10]. PBL is an instructional activity of students [11] who have problem-centered problems [12] as the empowerment of abilities, student competence [13] and problem-solving skills of students [14] in related daily life to obtain solutions [15]. Problem-based learning is student-centered, where the teacher is only a facilitator in developing students’ skills to solve problems [12]. Therefore it can be said that errors in making learning models affect problem-solving abilities. The quality of learning can be maximized by the learning model [16], in supporting learning models, innovative learning tools are needed, such as one example is a student worksheet [10]. Student’s worksheets are used to facilitate students in improving problem-solving skills [17,18] mathematics related to everyday life [19]. The sheet contains information on assignments and questions submitted to students. However, based on the results of observations, it was found that the available student worksheets still did not improve students’ problem-solving abilities. Therefore, it is necessary to develop student’s worksheets that use problem-based learning models to improve problem solving skills.

2 METHODS
This type of research is development research. This study produces learning resources in the form of problem-based student learning worksheets to improve problem solving skills for the tenth grade. This research model uses a 4D development model research [20], which consists of define, design, development, and disseminate [10]. In this study only limited to the design stage. The steps of developing a 4D model can be seen from Figure 1 [10].

![Fig 1. 4D Research Model](image)

The research subjects were class tenth grade students of senior high school. Instrument data collection uses observation, interviews, and tests. The observation guide is used to find out data about curriculum and student characteristics. The interview guide is use to find out data about teaching resources. Tests are use to determine student abilities. Data analysis used the analysis of Miles and Huberman’s model [21], which consisted of data reduction, data display, and verification.
3 DISCUSSION AND RESULT

3.1 Define Stage
Student's worksheets development using the 4D development model, several steps are: The first stage is the preliminary analysis. Preliminary analysis to find out which curriculum will be develop in the student's worksheet. The results of curriculum analysis are listed in the mathematics syllabus in the sequence of lessons that refer to the 2013 curriculum. Base competencies that can be derived from indicators of achievement of competencies. Base competencies found can be seen in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Base Competence</th>
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<tbody>
<tr>
<td>3.2</td>
<td>Describe linear programs with two variables and their methods of completion using contextual problems</td>
</tr>
<tr>
<td>4.2</td>
<td>Resolve contextual problems related to linear two-variable programs</td>
</tr>
</tbody>
</table>

Based on Table 1, there are two base competencies that will be used in the construction of student's worksheets. Next is the second stage of the participant analysis. Student analysis was carried out on of tenth grade senior high school students and teachers. Characteristic study to determine the characteristics of students in preparing the worksheet of students. At this stage, the results show that high school students at the age of 15-16 years have mathematical abilities that are still relatively low, in the third stage of the material analysis. The material analysis is used as a reference in the preparation of the material on the student’s worksheet. The fourth stage is task analysis. Task analysis is used as a guide in making assignments according to students' skills. The development of this student's worksheet is expected to be able to improve student problem-solving skills. And the purpose of making this worksheet product is to make it easier for students to solve mathematical problem in everyday life in the form of mathematics.

3.2 Design Stage
The design phase is used to create student worksheets according to the problems found in the study. The student worksheet is compiled to contain the introduction, content, and cover. This student's worksheet product is following the steps of problem-based learning. The initial design results from the protection of the student's worksheet with titled "Mathematics Student's Worksheets Based on the Problem Based Learning of Linear Program Materials" And the cover can be seen in Figure 2.

Fig 2. The cover of worksheet

The next step is the introduction. The introduction contains supporters from the student's worksheet. One of the parts of the presentation is the introductory section. The design of the introduction can be see in Figure 3.

Fig 3. The design of the introduction

The introduction contains an explanation of the student's worksheet that was made. Then proceed with the instructions for using student's worksheets in Figure 4.
Instructions for use contain procedures for using worksheets so that material goals are reached. Next is the table contents of student’s worksheet in Figure 5.

The table of contents shows what is on the student’s worksheet while making it easier for students to find the topic they want to address. Next is the contents section. The contents section contains concept maps, core competencies, competency achievement indicators. The following Figure 6 shows the base competencies, core competencies, and competency indicators that students will achieve.

To facilitate the achievement of learning, a concept map is prepared. The concept map compiled in this student’s worksheet can be seen in Figure 7.

This concept map is intended to map the material that students will learn. From the existing concept, map can create supporting information. Supporting information, in this case, is the base competency of the material being studied. Helping information can be seen in Figure 8.
The act of continuing to understand supporting information. Then the problem is presented about linear programs according to the steps in problem based learning. The steps of the action can be seen in Figure 9.

Figure 9 shows the steps for that students will take in learning the material present. The measures contained in the student's worksheet are following the stages of problem-based learning. The student’s worksheet is also equipped with training. The drawing of the exercise on the student's worksheet can be seen in Figure 10.

The last point in the student’s worksheet contains the practice questions. Problem training is given to training students in understanding subject matter, and practice is also able as a tool for measuring student problem-solving abilities after learning material [10]. The student's worksheets have been validated by two expert validators, namely Titik Handayani, M.Pd., as Mathematics Teachers at Senior High School in Wonosobo, Indonesia and Ageng Triyono, S.Pd., as Al-Azhar Mathematics Teacher Coordinator. The validator, in this case, does not revise the media and learning material. However, the validator only corrects the initial design of the student's worksheet. The following are some inputs and suggestions from the validator summarized in Table 2.

<table>
<thead>
<tr>
<th>Suggestion and Comments</th>
<th>Follow-up</th>
</tr>
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<tbody>
<tr>
<td>Add examples of more interesting questions with the character of students</td>
<td>Giving more interesting examples</td>
</tr>
<tr>
<td>Add goals from the student worksheet</td>
<td>Giving learning objectives on the worksheet of students</td>
</tr>
<tr>
<td>Add an example that shows the problem based learning step</td>
<td>Giving examples that are easy for students to imagine</td>
</tr>
</tbody>
</table>

The suggestions and comments provided by the validators were then revised. On the other hand, the feasibility of the initial design of learning media by the validator is calculated using questionnaire calculation. For the results are shown in Table 3.

<table>
<thead>
<tr>
<th>Accessor</th>
<th>Position</th>
<th>Score</th>
<th>Criteria for Qualitative Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titik Handayani, M.Pd.</td>
<td>Mathematics teacher at SMA</td>
<td>34</td>
<td>Good</td>
</tr>
<tr>
<td>Ageng Triyono, S.Pd.</td>
<td>Teacher Coordinator</td>
<td>38</td>
<td>Very Good</td>
</tr>
</tbody>
</table>
In Table 3, it shows that the average score obtained is 36. These results indicate that the initial design of learning media that will be developed in the category is very good.

4 CONCLUSION
Development of student’s worksheets is carried out in the analysis and design stages. In the initial design phase, it contains covers, introductory words, usage instructions, table of contents, intended competencies, concept maps, supporting information, and individual tasks. The initial design used in making student worksheets using CorelDraw and Microsoft Word 2013. The results of the design validation found that the category was perfect, with an average value of 36.

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REFERENCES