**Abstract:** One of the skills that students need to have in facing the industrial revolution 4.0 era is problem-solving skills. Low problem-solving skills can cause students to be difficult to solve HOTS questions. Student worksheet is needed in learning. Student worksheet that is not integrated with problem-solving skills will have an impact on not achieving national education goals. This study aims to produce a learning resource design according to the learning model to stimulate problem-solving skills. This study uses the ADDIE method (Analysis, Design, Development, Implementation, Evaluation). The research subjects were teachers and students of Muhammadiyah Sewon Middle School, Bantul. The research objects are problem-solving skills, learning models, and learning resources. Data collection instruments use questionnaires, questions, observations, and interview guidelines. Data analysis uses Miles-Huberman that consists of data reduction, data presentation, and concluding. This research has several results. First, students have difficulty learning statistical material. Second, students' problem-solving skills are still relatively low. Third, the Problem-Based Learning (PBL) learning model can be used to improve students' problem-solving skills. Fourth, learning resources that fit the PBL learning model are not yet available. Fifth, learning resources that enable problem-solving skills are not yet available. Sixth, the ADDIE development model can be used to produce student worksheet designs that are compatible with PBL learning models and integrated by problem-solving skills. Seventh, the design of the student worksheet produced is classified as overused. This design can be used to develop student worksheet according to the Problem-Based Learning model in stimulating problem-solving skills.

**Index Terms:** ADDIE, Design, Problem-Based Learning, Problem-solving Skill, Student Worksheet

## 1 INTRODUCTION

Education has an important role in preparing human resources in the face of challenges in the future [1]. The quality of education should direct students to learn actively and teach social values in their life [2]. Problem-solving skills are so important [3]. Mathematical problem-solving skills is one of the skills that students need to have. These skills are needed to live in the industrial revolution 4.0 era [4]. In addition, problem-solving skills are also very important skills in learning mathematics. Problem-solving skills are the heart of mathematics [5]. Problem-solving skills can develop students' mathematical understanding [6]. According to the National Association of Teachers of Mathematics states that one of the goals of mathematics learning is students have problem-solving skills [7]. One method of solving the problem is the method found by Polya [8]. According to Polya, there are four stages to solve the problem, namely (a) understanding the problem (understanding the problem), (b) devising a plan, (c) carrying out the plan that has been prepared (carrying out the plan), and (d) look back at all the processes carried out (looking back) [9]. Problem-solving skills are expected to be owned by students but the facts that exist in Indonesia, students are still having difficulty in solving a problem [10]. This can be seen from the results of the International Student Assessment Program (Program for International Student Assessment or abbreviated as PISA) in 2015, placing Indonesia ranked 63 out of 72 countries with a literacy score of 403. This achievement is still relatively low [11]. PISA uses an innovative literacy approach to find out and analyze students' solving skills [12]. In a learning process, a learning model is needed by a teacher. A learning model that can be used in the learning process and able to improve problem-solving skills is Problem-Based Learning (PBL) model [13]. According to Sudarman PBL is a learning model that uses problems in everyday life as a context of learning [14]. PBL is a learning model that can help students to increase students' high-level skills [15]. PBL involves students' problems solving that occurs in their daily lives. PBL learning models help students to develop the ability in using basic knowledge to solve real-life problems and work together with others. This skill is needed by students in socializing [16]. The learning steps in the PBL model are as follows. (a) Student's orientation towards the problem. (b) Organizing students for learning. (c) Guiding individual and group solutions. (d) Developing and presenting the results of the discussion. (e) Analyzing and evaluating the problem-solving process [17]. According to Putri PBL can improve students’ thinking skills, problem-solving and deeper understanding of mathematical concepts [18].

Learning resources are an important part of implementing education in schools. Learning resources are defined as information that is presented and stored in the form of media, which can help students in learning as an embodiment of the curriculum. Learning resources become meaningful for students and teachers when learning resources are organized through a design that allows someone to use them. According to the Ministry of National Education (2008) one of the teaching materials that can be used is student worksheets [19]. Based on observation at SMP Muhammadiyah Sewon, it can be seen that the student worksheet which used by teachers is not the result of the design or is not made by the teacher herself. The student worksheet consists of learning material, sample questions, and practice questions. Based on observation on student worksheet, some deficiencies exist. These deficiencies include the presentation of incomplete student worksheet material, activities for students are not...
available and the provided questions are not various problems. The student worksheet used also did not contain the steps of the certain learning model. Based on the results of an interview with one of the mathematics teachers at Muhammadiyah Sewon Middle School it is known that the student worksheet used in learning has not encouraged students to solve problems correctly. The problem-solving skills of students are still relatively low. The teacher has not been able to create and design of student worksheet that can truly meet the learning needs, especially to stimulate and develop students’ problem-solving skills. Also, the author has researched on learning resources (student worksheet) used in schools. The value of the validation of the student worksheet is 65 which is classified as not good. As for some of the deficiencies found in the student worksheet are (1) student worksheet does not encourage students to develop problem-solving abilities, (2) the appearance of student worksheet is less attractive, (3) student worksheet does not include the model used, (4) student worksheet has not made it easy for students to be able to understand the material. This study aims to examine what material is still difficult to learn by students, the problem-solving skills level of students, learning models that can improve students’ problem-solving skills, the availability of learning resources by the learning models needed, the availability of learning resources needed to improve problem-solving skills, what development models can produce the learning resources, and the feasibility of learning resources produced for use.

2 RESEARCH METHODS

This research is a research development that will produce a product. The product produced is a student activity sheet design for class VIII. As in [20], [21], [22], and [23], this research method uses the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects of this study consisted of 1 teacher and 3 students of class VIII of Muhammadiyah Sewon Middle School, Bantul. Students in the study subjects were students drawn from the upper group, middle group and lower group. The research objects are problem-solving skills, learning models, and learning resources. The selection of 1 teacher is a teacher in charge of mathematics. Data collection instruments using questionnaires, questions, observation guidelines, and interview guidelines. Questionnaires are used to find out what subjects are still difficult for students to understand and find out what learning resources students are interested in. Interview questions and guidelines are used to determine students’ mathematical problem-solving abilities through teacher helpers. Observation guidelines are used to determine the learning model that can be used to improve problem-solving skills. Interview guidelines and questionnaires are also used to find out the learning tools needed by teachers to improve students’ mathematical problem-solving skills. Data analysis uses Huberman’s Miles consisting of data reduction, data presentation, and conclusion drawing.

3 RESULT AND DISCUSSION

This study uses the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). In the first stage, namely analysis. This analysis is conducted on mathematics teachers and students. This analysis includes the curriculum used, difficulties in understanding the material, things needed in the learning process, problems that often arise in learning, etc. According to Permendikbud No. 21 of 2016 about Basic and Secondary Education Content Standards, the scope of mathematics material for SMP VII-IX consists of 4 scopes, namely (a) numbers, (b) algebra, (c) geometry and measurement, and (d) statistics and opportunities. The researcher will focus on the material contained in class VIII. In this curriculum, there are Basic Competencies that must be achieved by students. One of the basic competencies can be seen in Table 1.

<table>
<thead>
<tr>
<th>Basic Competencies</th>
<th>Basic Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10. Analyzing data based on data distribution, average value, median, and mode of the data distribution to make conclusions, make decisions, and make predictions</td>
<td>4.10. Presenting and solving problems related to data distribution, average values, medians, and the mode of the data distribution to make conclusions, make decisions, and make predictions</td>
</tr>
</tbody>
</table>

A questionnaire was given to 3 students grade VIII of Muhammadiyah Sewon Middle School to find out what material was considered difficult to learn. Based on the questionnaire, the three students gave the opinion that statistical material was considered the most difficult to study. This is because there are various kinds of formulas with data that are difficult to understand. This is also consistent with the results of interviews with mathematics teachers. According to the teacher, the most difficult material to teach is statistics. Statistics material is difficult to teach because the data provided is still considered abstract data by students. The teacher also tells that students find it difficult to solve problems related to statistics especially if the question already requires analysis. According to Polya, there are four stages to solve the problem, namely (a) understanding the problem (understanding the problem), (b) devising a plan, (c) carrying out the plan that has been prepared (carrying out the plan), and (d) look back at all the processes carried out (looking back) [8]. Questions were given to 3 students to find out their problem-solving skills. The results obtained from the work on the questions that are only 1 student who managed to finish correctly. This student is students from the upper group. Whereas 2 other students could not solve the problem correctly. An example of student answers can be seen in Figure 1.
In question number 1, 2 students from the middle and lower groups cannot determine whether to do it 2x. This shows that they do not understand the concept that is related to question no 1. They cannot determine the correct strategy to solve the given problem. They cannot write down what is known and what is asked. They also cannot find the concepts that can be used to solve a given problem. This shows that students cannot fulfill the steps of problem-solving by Polya. Likewise with question number 2. Students are also confused in determining the concepts used to solve existing problems. Students are not able to write what is known and the design of the solution to the problem given. Example of answers to students working on question number 2 is drawn in Figure 2.

![Figure 2. Example Answer Number 2](image)

The student from the upper group can answer the questions well. But not by the stage proposed by Polya. She does not write down what is known and what is asked. Students also do not look back at the problem given to answer the problem correctly. Answers from students from the upper group can be seen in Figure 3.

![Figure 3. Student Answer](image)

Observation and literature are used to find out how to stimulate students' problem-solving skills. One of the goals of PBL is to improve problem-solving skills [27]. Research by Ferreira shows that PBL abilities to improve students' problem-solving skills [28]. Research conducted by Argaw obtained the conclusion that PBL learning is more effective for teaching physics subjects when compared to conventional learning [26]. Amalia's research shows the results that students who are taught using the PBL model have better mathematical problem-solving skills than students who are taught with conventional models [27]. Simamora's research results show that the implementation of PBL learning models can improve learning activities and the ability to solve math problems of class VII B students of SMP Negeri 3 Medan [28]. Interview conducted to mathematics teacher is also used to find out whether the learning resources used by learning model and integrated with problem-solving skills. Based on the interview, the learning resource used by students is a student worksheet. The student worksheet used has not been adapted to the learning model used. Student worksheet also has not encouraged students to have good problem-solving skills. Yet according to the teacher, student worksheet is very helpful for learning in schools. However, the existing LKPD still has shortcomings. This is also supported by the results of interviews given to 3 students. According to them, the problems in the student worksheet are still difficult to solve. The example of settlement in the student worksheet is still confusing. Questionnaires given to students are also used to find out what learning resources they are most interested in. Based on the questionnaire, the three students chose student worksheet as the easiest learning source to learn than modules or books. However, the existing student worksheet did not meet the expectations of the students. Teacher states she can not be able to design student worksheet appropriate learning model that is in accordance with the characteristics of student. The second step in the research model is design. The design of this student activity sheet was developed based on the Problem-Based Learning model. The stages in the Problem-Based Learning model can be seen in Table 2.

<table>
<thead>
<tr>
<th>No.</th>
<th>Steps of Problem-Based Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student orientation towards problems</td>
</tr>
<tr>
<td>2</td>
<td>Organizing students for learning</td>
</tr>
<tr>
<td>3</td>
<td>Guiding completion</td>
</tr>
<tr>
<td>4</td>
<td>Presenting and developing results</td>
</tr>
<tr>
<td>5</td>
<td>Evaluating and analyzing the problem-solving process</td>
</tr>
</tbody>
</table>

The next stage is the development, at this stage of the product being developed in the form of student activity sheets. This student worksheet was developed based on the results of the previous research step.

**3.1 Cover of Student Worksheet**

The following is the initial design of the cover of the student worksheet based on PBL in Figure 4.
3.2 Core Competencies and Basic Competencies

The following are the core competencies and basic competencies that must be achieved by students in Figure 5.

3.4 Learning Activities

The following are learning activities based on the problem-based learning model in Figure 7.

3.3 Instruction for Using Student Worksheet

The following instruction for using student worksheets in Figure 6.

The next step is evaluation. This evaluation is done by validating the product design. Design validation was carried...
out by two people, one material expert and one media expert. The following are data from material expert and media expert in Table 3.

**TABLE 3**

<table>
<thead>
<tr>
<th>Media Expert and Material Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>Amalia Mutia Sayekti, S.Pd</td>
</tr>
<tr>
<td>Farida Kurniawati, S.Pd</td>
</tr>
</tbody>
</table>

Position | SMK Muh 2 Yogyakarta

The following are suggestions from media expert and material expert along with follow-up can be seen in Table 4.

**TABLE 4**

<table>
<thead>
<tr>
<th>Suggestions</th>
<th>Follow Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivational writing, hard to read</td>
<td>The writing on the motivation section has changed both the font and its size.</td>
</tr>
<tr>
<td>Maybe it can be added the description of the semester on the cover</td>
<td>The semester information has been added to the cover.</td>
</tr>
<tr>
<td>There is no glossary to explain unfamiliar words</td>
<td>A glossary was added at the end of the student worksheet design.</td>
</tr>
<tr>
<td>The layout color is interesting, but there are still some pictures that cover the lines of the table</td>
<td>The layout of the image has been improved so it does not cover the table lines.</td>
</tr>
</tbody>
</table>

The following are the results of the follow-up carried by the recommendations of the validators. Motivational writing before being repaired can be seen in Figure 8. Improvements to motivational writing can be seen in Figure 9. Cover before being repaired can be seen in Figure 10. Improvements to the cover can be seen in Figure 11. Glossary addition can be seen in Figure 12. The layout of pictures before being repaired can be seen in Figure 13. Improvements to the image layout is seen in Figure 14.
The results of design validation by material expert and media expert can be seen in Table 6.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material expert</td>
<td>123</td>
<td>Very good</td>
</tr>
<tr>
<td>Media expert</td>
<td>83</td>
<td>Very good</td>
</tr>
</tbody>
</table>

Based on the table above, the design of student worksheet is in the very good category. This shows that the design of student worksheet is feasible to be used and developed as a learning resource for students.

4 CONCLUSION

Based on the research conducted, it can be concluded (a) students are difficult in learning the statistical material, (b) the problem-solving skills of student is still relatively low, (c) learning model Problem-Based Learning (PBL) can be used to improve problem-solving skills students, (d) learning resources that compatible with PBL model are not yet available, (e) learning resources that instill problem-solving skills are not yet available, (f) ADDIE development models can be used to produce design of student worksheet that are appropriate to PBL model and integrate problem-solving skills, and (g) design of student worksheet produced are classified proper to use. Design of student worksheet that is used as learning resources according to the PBL model needs to be well developed. The development of student worksheet is emphasized to stimulate students’ problem-solving skills as well as students. The results of student worksheets developed by PBL model are expected to be one of the solutions for teachers and students to improve problem-solving skills. The results of the field study that have been carried out are expected to have several benefits, namely: (a) as input and advice to the school in improving the learning process and mathematics learning for students; (b) as a basis for developing student worksheet according to the PBL model to improve the problem-solving skills of students in grade VIII.

ACKNOWLEDGMENT

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REFERENCES


