Design of Probability Module Based on PBL Learning Model to Improve Critical Thinking Skills

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Abstract—Critical thinking is an important skill in the 21st century learning in the industrial revolution 4.0 era. The ranking of Indonesia in TIMSS is low. 21st-century student skills in Indonesia such as critical thinking is still relatively low. Teaching materials that do not contain 21st-century skills will have an impact on the effectiveness of achieving core competencies and basic competencies. This research has several objectives. First, analyze the module needs as teaching material. Second, knowing the teacher's response to the 2013 curriculum compatibility module. Third, knowing the problem in students’ critical thinking skills. The design development model used is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This study uses a qualitative method. The research subjects were teachers and students at Sorong Muhammadiyah High School. The object of this research is critical thinking and the Analysis of the Model Problem-Based Learning model. Data collection instruments used observation guidelines and interview guidelines. Data analysis uses descriptive analysis. Research provides several results. First, teachers and schools need electronic modules. Second, the critical thinking skills of class XII students are still relatively low in material opportunities. Third, teachers need modules for curriculum compatibility in 2013. Fourth, modules that integrate critical thinking skills do not yet exist. This research can be developed based on Problem Based Learning modules to improve critical thinking skills. This research can be continued in the Implementation and Evaluation stage.

Index Terms—ADDIE, Critical Thinking, Modules, Design Development, Opportunity Material, Problem-Based Learning.

1 INTRODUCTION

The development of the industrial world is growing rapidly in line with the demands of the world of education, especially in Indonesia to improve the results of professional graduates and prepare superior human resources to products [1]. Mathematics is a subject that must be mastered from an early age because it is a tool or a means of learning other fields of science [2]. With the development of 21st-century education, students are expected to be able to prepare the ability to master a variety of skills, especially creative thinking skills [3]. Critical thinking skills are skills needed in the 21st-century [4]. Critical thinking is one of the skills associated with thinking, evaluating our own and other people's ideas without guessing [5]. The ability to think critically is a form of reason where an individual can increase his thinking potential through a process of analysis and evaluation of problems [6]. Critical thinking requires encouragement from learning that requires students to achieve these abilities [7]. Mathematics has a very important contribution in achieving abilities such as the ability to connect, communication skills, problem-solving, the ability to represent (representation) reasoning and proof of ability [2]. Critical thinking skills are expected to be a part of student learning, and schools will be responsible for developing and refining critical thinking skills into the learning process [8]. Mathematics learning is a subject that can develop critical thinking skills [9]. Evaluation of students' critical thinking skills in mathematics learning uses three components, namely (1) identifying and interpreting information, (2) analyzing information, and (3) evaluating evidence and arguments [10]. Facione 2011 said the most basic definition of critical thinking is evaluation, self-regulation, inference, explanation, interpretation, and analytical skills [8]. Indonesia still focuses on graduating students in national examinations. Teaching practice in schools only focuses on the content of the lesson and ignores students’ thinking skills [10]. Essential thinking skills include several activities such as logical reasoning including analyzing, synthesizing, reducing, and concluding [11]. Preparing for the 21st-century generation, insights into critical thinking must demonstrate significant contributions [12]. Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 22 of 2006 concerning Material Standards for Primary and Secondary Education states that Mathematics learning is provided to promote learners using the ability to think logically, analytically, systematically, critically, and creative thinking as well as the ability to work together. Students can have the ability to obtain, manage, and use the information to survive in a situation that is always changing, uncertain and competitive [13]. Based on PISA research (Program for International Student Assessment) in 2013, Indonesia ranked 62 out of 70 countries participating in PISA [14]. The average value of mathematics achievement in all countries is 490; meanwhile, the average score of mathematics students in Indonesia is 386. Based on that description, Indonesia's ranking is still far below the international average. This means that the mathematical abilities of Indonesian students are still low. The process of learning mathematics in elementary schools needs to be...
to understand the contents of the material.

Based on the description above, researchers intend to make teaching materials in the form of modules in learning. The purpose of this research is to design teaching materials in the form of Modules in learning opportunities by using PBL learning models and producing module designs that are feasible to be developed. This research can be continued in the implementation and evaluation stages.

2 Research Methods

The method used in this study is the ADDIE development model. The ADDIE model is a teaching design process developed by B. Seel and Z. Glasgow, the ADDIE model has five components, namely Analysis, Design, Development, Implementation, and Evaluation [24]. The ADDIE design model is the most popular teaching design model because the stages are adjusted in detail [25]. Another point expressed by experts is that the ADDIE model provides detailed specifications intended to create and measure practical and systematic learning [26] The ADDIE model consists of five stages, namely analysis, design, development, implementation, and evaluation. Each stage has a learning goal so students can achieve good results but there is a key, namely, students must spend time learning independently with a flexible approach to be more effective [24]. The purpose of this study is to design teaching materials in the form of modules to improve critical thinking skills. In the analysis phase, researchers find out about the description of students' needs regarding teaching materials based on PBL learning models to improve critical thinking skills. Furthermore, researchers conducted observations and interviews with students and teachers to find out the learning model used by teachers, student characteristics, material difficulties, and supporting facilities in schools. In the design phase, researchers first make learning objectives to be achieved. The design phase in this study was carried out through the framework of the preparation of teaching materials. The experts will validate the teaching material product design. Design validation is done to determine the assessment of good quality teaching materials. The subjects in this study were class XII of Muhammadiyah Al-Amin Sorong High School. Data collection instruments include guidelines for observation and interviews. The ADDIE model directs research on process optimization to measure measurable results [27]. The ADDIE stages can be seen in Figure 1.
3 RESULT AND DISCUSSION

The analysis, the phase contains the analysis of student needs. The need for teaching materials in the form of modules to improve students' critical thinking skills, analyze the character of students, teaching materials and learning models used by teachers, how to deliver materials and materials that are difficult for students to feel, school facilities and analyze alternative solutions to improve critical thinking skills learners. At this stage, there are several conclusions, namely (1) students need teaching materials that can improve critical thinking skills (2) material that is considered difficult is opportunity material, (3) teachers still use conventional methods (4) Facilities in schools are less supportive (5) alternative solutions to improve critical thinking skills is to design teaching materials with learning models that fit the characteristics of students.

3.2. Design

At the design stage, the design of teaching materials is based on the results of needs analysis. The teaching material used is a module. The module contains cover, preface, table of contents, concept map, KI, KD, indicators, instructions for using the module, goals, core mastery check, material, practice questions, cognitive/evaluation tests, psychomotor/LKS test, summary, glossary, and bibliography. Figure 2 contains the title of the student worksheet that also includes classes and semesters that students will use.
KI and KD contain what students must achieve when learning to use Modules. KI and KD can be seen in Figure 5.

Student activities contain material and sample questions. The material is described so that students can understand the material. Examples of problems are given according to PBL steps. Learning activities can be seen in Figure 6.

Evaluations are presented in the form of essays. The aim is to evaluate the learning outcomes of students in understanding the material that has been learned. Evaluation can be seen in Figure 7.

The summary is presented to make it easier for students to...
understand the learning material discussed today. A summary can be seen in Figure 8.

The glossary is presented to make it easier for students to understand difficult and difficult to understand words that are in the module. The glossary can be seen in Figure 9.

The teaching material in the form of this module has been assessed for eligibility by two mathematics teachers. Some input and suggestions from material and media experts that have been summarized can be seen in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Comments and suggestions</th>
<th>Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do not include alternative solutions to problems so students can think critically</td>
<td>Already repaired</td>
</tr>
<tr>
<td>2</td>
<td>Expand the discussion questions and improve the writing (typo)</td>
<td>Already repaired</td>
</tr>
<tr>
<td>3</td>
<td>Add a Glossary</td>
<td>Already repaired</td>
</tr>
</tbody>
</table>

Input and suggestions from the validators are then corrected according to the revisions given by the validators can be seen in Figures 10, 11 and 12 below.
After being revised and improved the results of the calculation of the teacher questionnaire regarding the developed design can be seen in Table 2.

### TABLE 2
**Design Assessment Results**

<table>
<thead>
<tr>
<th>No</th>
<th>Validator</th>
<th>Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Faturahman, M.Pd</td>
<td>94</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>Sucipto, S.Pd</td>
<td>88</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td><strong>Total Score</strong></td>
<td><strong>182</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Average Score</strong></td>
<td><strong>91</strong></td>
<td>Good</td>
</tr>
</tbody>
</table>

Based on Table 2, the average score for the assessment of media experts is 91. So it can be concluded that the learning media are in a good category. The student module has been validated by a validator and declared to be suitable for use with revisions. The fourth step in the ADDIE stage is implementation. At this stage, designs that have been designed and are categorized as feasibility and effectiveness are given to the school which will be used as a place of research. This stage is done to ensure students achieve their goals in learning outcomes and can improve students' critical thinking skills. The fifth step in the ADDIE stage is evaluation. At this stage, a process to provide value to the learning program that has been developed. Students will be evaluated to the extent to which students can learn the material to improve students' critical thinking skills.

## 4 Conclusion

Based on the explanation above, it was found that; (1) Students have difficulty in learning material opportunities, (2) students’ critical thinking skills are classified as low, (3) PBL learning models can be used to improve students' problem-solving abilities, (4) learning resources that fit the PBL model are not yet available, (5) learning resources that instill critical thinking skills are not yet available, (6) the ADDIE development model is used to produce a module design that is compatible with PBL learning models and integrates students' critical thinking skills. This research will produce a teaching material design in the form of a module based on PBL learning models to improve students' critical thinking skills by the curriculum and characteristics of students. The design of this teaching material consists of a cover, preface, table of contents, concept map, KI, KD, indicators, instructions for use of modules, objectives, core mastery checks, material, practice questions, cognitive / evaluation tests, psychomotor / LKS tests, summaries, glossary, and bibliography. The design of the results of this study has the potential to improve students' critical thinking skills in material opportunities. Based on the results of the validation with an average score of 91, it can be concluded that the design of teaching materials in the form of modules is said to be suitable to be used as guidelines in making teaching materials on material opportunities with PBL-based models.

## 5 Suggestion

Module design in learning material opportunities based on PBL learning models to improve students’ critical thinking skills. This study uses the ADDIE development design model. The stages in the ADDIE model consist of five stages namely Analysis, Design, Development, Implementation and Evaluation.

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## References


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