Design Of Mathematics Module Development Based On Pmri To Improve Critical Thinking Ability Students Of Class Viili Junior High School In Indonesia

Sulis Solihati, Suparman

Abstract: Critical thinking is one component that students must have in the 21st Century. Students who are less critical will be hampered in achieving learning goals. Teaching materials that do not facilitate students to think critically make the learning process less effective. The purpose of this study is to develop teaching materials in the form of modules based on PMRI, to improve students' critical thinking ability. The type of research used is development research using the ADDIE development model. The research subjects included class VIII junior high school students. The instruments used were validation sheets, tests of students' critical thinking ability, observation guidelines and interview guidelines. A validation sheet is given to material experts and media experts. Tests to find out students' 'critical thinking ability are carried out before and after the use of module so that it is known whether there is an increase in students' critical thinking ability. The interview guide is conducted with teacher and students to find out the curriculum and students characteristic in the school. The data analysis technique in this study uses data reduction, presentation, and conclusion. The module design produced is based on PMRI which is in accordance with the characteristics students, curriculum, and assignments of students.

Index Terms: Critical Thinking, Development of Learning, Module, PMRI.

1. INTRODUCTION
At present, education is in the knowledge age with an accelerated increase in extraordinary knowledge. In this 21st century, education is becoming increasingly important to ensure students have the skills to learn and innovate, the skills to use technology and media information, can work, and survive using life skills. In education, it is expected to prepare students who are able to master various kinds of skills to compete in the 21st century. There are four skills needed by education graduates in the 21st century, namely ways of thinking, how to work, tools to work, and skills to live in the world [1]. In this 21st century, one of the skills that must be is the ability to think critically [2]. Mathematics is one of the subjects that can develop critical thinking skills [3]. In creating a well-organized mathematics learning process, effective learning strategies are needed [4]. One solution needed is to develop teaching materials that can facilitate student learning activities so that they will form active interactions between students and teachers [5]. Teaching material used by teachers and students in classroom learning, especially junior high school mathematics learning are one of them using modules. Modules are one form of teaching material that is packaged systematically and attractively to make students easy to learn independently [6]. The module contains material that is equipped with a series of activities, training, and self-assessment to monitor the level of mastery of student learning, and others [7]. Modules based on PMRI approach are designed so that students more easily understand the material, be active in the learning process, and create interesting learning. This can improve students' critical thinking ability. The approach of Indonesian Realistic Mathematics Education (RME) is considered as one of the best approaches to teaching mathematics based on curriculum objectives that focus on teaching high-level thinking skills, including knowledge building, problem solving, students critical thinking, and students creative thinking [8]. Experts say that mathematics in the approach of Indonesian Realistic Mathematics Education (RME) is that human activities must be related to real life situations [9]. There are two core approaches to Realistic Mathematics Education (RME) that believe mathematics must be related to real life situations and mathematics must be seen as human activity [10]. By using this approach, they are given opportunities to learn cooperatively with pleasant learning environment to improve achievement their mathematics. In this approach, the teacher's role is to stimulate learning [11]. The theory of the approach of Realistic Mathematics Education (RME) focuses on guided rediscovery through mathematics and considers problem solving and student interpretation through real-world context-based problems [12]. Implementation with the approach of Indonesian Realistic Mathematics Education (RME) must be able to provide problem-based and interactive mathematics education [13]. Critical thinking skills are a form of reason in which an individual can increase the potential for thinking through the process of problem analysis and evaluation [14]. Then, critical thinking skills are a priority in educational goals [15]. The students need to comprehend that critical approach development is important for the new work situation [16]. In addition, critical thinking skills will encourage students to think independently in solving problem in the school or in the context of everyday life[17].

According to the results of observations and interviews by teacher and students in SMP Negeri 2 Dlingo, that most students have difficulty learning in the material system of linear equations two variables, students are still less active in teaching and learning process, teaching materials used by the school also do not match the characteristics students and teaching materials used have not yet referred to a particular approach. Based on the description described above, the researcher is interested in conducting research related to developing learning modules and combined with a learning
model. This research entitled "Design of Mathematics Module Development Based on PMRI to Improve Critical Thinking Ability Students of Class VII Junior High School in Indonesia".

2 RESEARCH METHOD
The type of research used this study is research and development method which uses the Analysis, Design, Development, Implementation, and Evaluate (ADDIE) model [18]. The ADDIE model directs research on process optimization to measure measurable output LOT [19]. Visually the ADDIE stages can be seen in Figure 1.

![ADDIE Stage](image)

Fig. 1. ADDIE Stage [20]

However, in this study only limited in two stages, namely the analysis and design stages. The stage of analysis (analysis) 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 a basis for developing products in the form of mathematics learning modules for student of class VII Junior High School. The design phase carried out in this study starts from the preparation of the product framework and designing the prototype of the product. The third stage is development, the fourth stage is implementation which is the application of the product that has been made, and the fifth stage is evaluation that is carried out to assess the overall product that has been made and implemented. The instruments used were validation sheets, tests of students critical thinking skills, observation guidelines and interview guidelines. A validation sheet is given to material experts and media experts. Test instruments to find out students critical thinking ability. The interview guide is done to the teacher and students to find out the curriculum and students characteristic at school. The type of data produced is qualitative data in the form of the use of school curriculum, student characteristics, depth of material and input from media experts and material experts while quantitative data in the form of scores from the results of due diligence from material experts and media experts. The subjects in this research were class VII students of SMP Negeri 2 Dlingo. The data analysis technique used is descriptive data analysis techniques.

3 DISCUSSION
This research was conducted by design of mathematics learning module based on PMRI to Improve Critical Thinking Ability of Class VIII Junior High School Students. 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 the modules used by students 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 modules developed are able to help students as a center in the learning process.

3.1.2 Material Analysis
Difficulties experienced such as students do not understand the SPLDV material, students have difficulty in making mathematical models of the given story problems, difficulties in completing mathematical models using graph methods, substitution, and elimination.

3.1.3 Student Characteristic Analysis
Student of class VIII Junior High School have difficulty solving mathematical problems. Based on the results of interviews with Mrs. Tyas as a mathematics teacher of class VIII in SMP Negeri 2 Dlingo, it was found that students could not absorb mathematics well, in general teachers had difficulty teaching SPLDV material to class VIII students. Students need modules that can make it easier for students to inspire material about SPLDV. The teacher also explained that the obstacles in the learning process of mathematics were the limited availability of media that made the learning process ineffective, and mastery of concepts and understanding of children was low.

3.2 Design Phase
At the design stage, the module will be designed in the form of a mathematics learning module Based on PMRI to Improve Critical Thinking Ability Students of Class VIII Junior High School. Based on the results of the analysis above, PMRI based mathematics learning modules have been made as follows:

3.2.1 Opening Section

3.2.1.1 Cover
Cover this PMRI-based mathematics learning module is titled "Design of Mathematics Module Based on PMRI to Improve Critical Thinking Ability Students of Class VIII Junior High School in Indonesia". So that the module 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 module. Figure 2 shows the module cover design that has been made.
3.2.1.2 Preface
This introduction in the PMRI based mathematics learning module expresses gratitude to those who have helped in the formation of this module and apologies and suggestions for this PMRI based mathematics learning module. Figure 3 shows preface design that has been made.

3.2.1.3 Module Description
Description of the PMRI based mathematics learning module contains information on modules in the form of writers, mentors, validations, paper types, many pages and module sizes. Figure 4 shows the module description design that has been made.

3.2.1.4 List of Competency Goals
This list of competency goals in guided discovery based mathematics learning modules contains what knowledge, attitudes, or skills can be mastered after completing learning. Figure 5 shows list of competency goals design that have been made.

3.2.1.5 Concept Map
The concept map in this PMRI based mathematics learning module contains topics to be studied in the module and shows the interrelationships between topics in the module. Concept maps also help teachers to improve the effectiveness of the learning process in the classroom. Figure 6 shows concept map design that have been made.
3.2.1.6 Table of Content
The table of contents in this PMRI based mathematics learning module contains the topics discussed. The topic appears based on the sequences in the module. Students can also see the overall topics discussed in the module as well as printed page numbers to make it easier for readers to find topics. Figure 7 shows the design of the table of contents that has been made.

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

3.2.2 Core Section

3.2.2.1 Introduction
The introduction in the PMRI based mathematics learning module contains the advantages of modules compared to other modules. The advantages of this module can be seen from how to package material combined with the PMRI based learning to approach. The introduction also contains a general description of the contents of the module material, convincing learners that the material in the module is useful for 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. Figure 8 shows the introduction designs that have been made.

![Fig. 8. Introduction](image)

3.2.2.2 Material
The material in this PMRI based mathematics learning module contains detailed explanations of the subjects that are delivered sequentially and systematically, so students are easy to understand the subject matter. In this module there are also a number of Learning Activities that contain material descriptions, assignments and summaries of each sub-chapter discussed. Figure 9 shows the design of Learning Activities that have been made:

![Fig. 9. Display of Learning Activities](image)

Modules are arranged in accordance with the stage of learning discovery, namely to formulate problems, analyze problems, build guesses, make conclusions and apply conclusions. According to [21] interpreting learning which gives freedom to students to investigate mathematical problems through the following steps: (1) formulating problems, (2) formulating hypotheses, (3) testing hypotheses, (4) drawing conclusions. Figure 10 shows material design that have been made.

![Fig. 10. Material Display](image)
3.2.2.3 Assignment
The assignment in this PMRI-based mathematics learning module contains problem exercises that must be completed by students. Assignments in modules need to be approved by the competencies needed by students. The following design assignments have been made:

Fig. 11. Display Assignment

3.2.3 Closing Section

3.2.3.1 Summary
This summary in the PMRI-based mathematics learning module examines the main points in the module discussed. The following summary design has been made:

Fig. 12. Summary View

3.2.3.2 Glossary
The glossary in this PMRI-based mathematics learning module contains concept definitions discussed in the module. The definition is summarized to make it easier for students to recall concepts that have been studied. The following is a glossary design that has been made:

Fig. 13. Glossary View

3.2.3.3 References
This references in the PMRI based mathematics learning module contains sources of information about the contents of the module. The following references design has been made:

Fig. 14. Reference
3.2 Development Phase
The development phase is the realization phase of the module and instrument design used to measure the performance of the product that has been developed. There is expert validation, media validation, and testing. At the expert validation stage, an assessment is carried out to determine the validity of the module design. Modules that have been approved by the supervisor are then validated by the validation, the media expert lecturer and material expert teacher. The module validation uses assessment instruments that have been reviewed by lecturers while the instruments are in the form of questions and questionnaires. After a valid instrument can be used by material experts and media experts to assess the module to be developed.

3.3 Implementation Phase
In the implementation phase, it will be carried out to class VIII students of SMP Negeri 2 Dlingo as users of the mathematics learning module.

3.3 Evaluation Phase
At the evaluation stage, the researcher evaluates media experts and material experts to find out whether the mathematics learning module that has been developed is appropriate for class VIII students. The material experts in this module are Basirah, S. Pd and media experts namely Puguh Wahyu Prasetyo, S.Si., M.Sc. The Following are some inputs and suggestions from material experts summarized in Table 1.

<table>
<thead>
<tr>
<th>TABLE 1 FEEDBACK AND EXPERT ADVICE ON MATERIAL</th>
</tr>
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<tbody>
<tr>
<td>Suggestions and Comments</td>
</tr>
<tr>
<td>There is some uninform content</td>
</tr>
<tr>
<td>Write the name of the compiler</td>
</tr>
<tr>
<td>biography</td>
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</tbody>
</table>

Following are some input and suggestions from media experts summarized in Table 2.

<table>
<thead>
<tr>
<th>TABLE 2 INPUTS AND SUGGESTIONS FROM MEDIA EXPERTS</th>
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</thead>
<tbody>
<tr>
<td>Suggestions and Comments</td>
</tr>
<tr>
<td>There is some uninform content</td>
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<tr>
<td>Write the name of the compiler</td>
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<td>biography</td>
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</tbody>
</table>

The feasibility of designing a mathematics learning module is assessed by media experts and material experts. The following are the results of the questionnaire calculation from the feasibility of the learning module by the media and material experts can be seen in Table 3.

<table>
<thead>
<tr>
<th>TABLE 3 RESULTS OF CALCULATION OF MODULE DESIGN FEASIBILITY QUESTIONNAIRE</th>
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<tbody>
<tr>
<td>Assessors</td>
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<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Puguh Wahyu Prasetyo, S.Si., M.Sc.</td>
</tr>
<tr>
<td>Basirah, S. Pd.</td>
</tr>
</tbody>
</table>

Based on the result of data analysis in the form of module design validation instruments obtained an average score of instrument scores on the feasibility of the learning modules obtained results 19. The criteria for the calculation results based on the results of the trial can be see Table 4.

<table>
<thead>
<tr>
<th>TABLE 4 THE CRITERIA FOR THE CALCULATION RESULTS</th>
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<tbody>
<tr>
<td>Score</td>
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<tr>
<td>-------</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>4</td>
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<tr>
<td>3</td>
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<td>2</td>
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<td>1</td>
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</tbody>
</table>

Based on Table 4 obtained that mathematics learning module on the subject of Two Variable Linear Equation System is included in the good category and the module is feasible to use.

4 CONCLUSION
The results obtained show that the design of PMRI-based mathematics learning modules 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 had difficulties on the subject of SPLDV. While the analysis of student characteristics is obtained that students are more likely to memorize and need media that can help students in SPLDV learning. At the design stage the researcher designs three parts in outline namely the opening part which consists of cover, preface, module description, list of competency goals, concept maps, table of contents, initial tests. The core consists of introduction, material, assignment. The closing section which consists of the final test, summary, glossary and references that will be tested by media experts. The module developed has the advantage of improving students’ critical thinking ability on the SPLDV subject matter because each indicator of critical thinking ability included various questions in the module and integrates the PMRI-based learning approach. After this research was carried out, the next study was the development of PMRI-based learning modules.

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REFERENCES


