Feasibility Test of Physics Textbook Developed Using Multimode Representations to Improve Students' Problem Solving Ability

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ABSTRACT

This study aims to determine the feasibility of physics textbook that has been developed by researcher using multimodal representations to improve students' problem-solving abilities. The instrument used in this study was a questionnaire containing twelve categories of good quality books: the presentation component, the graphic component, the updated component, the suitability of the Competency Standards and Basic Competencies with indicators, clarity and truth of concepts or laws, stages of problem solving carried out, the mode of representation used, the quality of subject description, conceptual hierarchy and organization of writing, main ideas of writing, rules of writing and punctuation, the influence of textbook. The feasibility test was carried out by six experts consisting of three physics lecturers and three physics teachers. From the general assessment, this physics textbook has very good quality.

Keywords: feasibility test; textbook; multimode representation; problem solving ability

1. INTRODUCTION

The National Education Objectives set forth in Law No. 20 of 2003 states that the National Education functions to develop capabilities and shape the dignified character and civilization of the nation in the context of educating the life of the nation, aiming at developing the potential of students to become human beings who have faith and are devoted to God Almighty, of noble character, healthy, knowledgeable, competent, creative, independent, and become democratic and responsible citizens. To achieve this goal the government and institutions engaged in the field of education have made various updates and improvements that are influenced by changes in science and technology on a national and global scale.

To achieve the National Education Goals, various facilities and infrastructure are needed to support education, including the availability of learning materials. Learning materials can be interpreted as a book that contains knowledge and explained systematically and logically [1]. Since long time ago, there have been many experts who paid attention to textbooks, and also expressed their understanding. Textbooks are books that contain material about specific subjects or fields of study, which are arranged systematically and have been selected

based on specific objectives, learning orientation, and student development to be assimilated [2]. The main objectives of the textbook are to facilitate effective teaching, increase students' knowledge, abilities and skills to monitor the level of information assimilation, and to contribute to the overall development of students in education. The fact is that the textbook will facilitate and make learning easy and lively. The essence of textbooks in the teaching and learning process is to make the teacher's effort to impart knowledge easier. Students are also helped to understand knowledge easily, with the view of promoting effective teaching. Therefore, teachers need to choose or improvise in appropriate textbooks to facilitate effective teaching and learning and motivate students [3].

According to Tarigan [4], our world is now a world of books or in other words our world is now a world of reading. We need to realize that all books, textbooks or textbooks are the best and most effective tools or instruments because they have a big influence on the success of learning in the classroom. One important problem that is often faced by teachers in learning activities is choosing the right textbooks in order to help students achieve the desired competencies because textbooks are one means of successful teaching and learning [5]. This is caused by the curriculum or syllabus

and teaching materials are only written in broad outline so to describe them in detail is the task of a teacher. At this stage sometimes the teacher finds it difficult to make or get the right textbook. Textbooks are a unit of learning unit that contains information, discussion and evaluation. Textbooks arranged systematically will facilitate students in the material so that it supports the achievement of learning objectives. Therefore, textbooks must be arranged in a systematic, interesting, high readability aspect, easy to understand, comply with applicable writing rules, and in accordance with the characteristics and needs of students [6].

Permendiknas Article 1 Number 2 of 2008 explains that textbook are compulsory references used at the level of primary and secondary education or higher education. Textbooks contain learning material in the context of improving faith, piety, noble character, and personality, mastering science and technology, enhancing aesthetic sensitivity and ability, enhancing kinesthetic femininity, and health, which are compiled based on national education standards. Lecturers should be able to develop teaching materials as a source of learning [7]. Government Regulation No. 19/2005 article 20, emphasizes that teachers / lecturers are expected to be able to develop the material, while Permendiknas No. 41/2007 concerning process standards governs the planning of the learning process for educators in educational units to develop SAP and teaching materials.

The textbook used must be in accordance with the characteristics of the teaching material [8]. Textbooks must also be able to meet students' needs in understanding concepts [9]. Physics teaching materials, especially temperature and heat materials, are filled with many abstract concepts, so it is necessary to present the material in the form of representations in textbooks. Some forms of representation in physics can be in the form of words, pictures, diagrams, graphics, computer simulations, mathematical equations and so on [10]. The use of various representations is also related to the ability of different students to understand concepts. There are students who are able to understand concepts only with text representations but there are students who are able to understand concepts if they are equipped with image representations. This shows that students need a multimodus of representation in understanding the concept of physics [11]. Multimodus representation is the presentation of concepts in various interrelated representations so that if there are students who have difficulty understanding the concept of one representation it will be helped by other representations.

Multimodus representation is also used in the development of this textbook because concepts that tend to be complex can be simplified by using several representations at once. When students find it difficult to understand text representations, other forms of representation such as graphs, pictures, and tables will

help their understanding [12]. The temperature and heat materials chosen by researchers in the development of this textbook include materials that are considered difficult even though their application is very close to the daily lives of students and teachers. This material is not easy to understand just by memorizing the formula. Students who are accustomed to using mathematical equations only, will find it difficult to master the concepts of temperature and heat and use them to solve problems.

Based on several studies that have been conducted, the use of multimodus representation in textbooks is also able to improve students' conceptual understanding and problem-solving abilities [13]. Therefore, this textbook was developed using a multi-mode representation to improve students' understanding of concepts and problem solving abilities. Textbooks that have been developed using multimodus representation need to be tested for their feasibility before being used by students. The test criteria are adjusted to the use of a multi-mode representation and the purpose of textbook development.

2. RESEARCH METHODS

The purpose of this study was to determine the feasibility of a physics textbook developed using a multimodus representation in improving students' understanding of concepts and problem solving abilities. The developed physics textbook was tested for feasibility based on expert judgment (three physics lecturers and three physics teachers). The data collection instrument used was a questionnaire with scoring guidelines developed by the researcher. The assessment given is adjusted to the quality criteria of Sinaga-based textbooks, namely: (1) presentation components, (2) graphic components, (3) current components, (4) fulfillment of core competencies and basic competencies, (5) clarity and correctness of concepts or law, (6) the stages of problem solving are carried out, (7) the means of representation used, (8) the quality of the description of the subject matter, (9) the conceptual hierarchy and writing organization, (10) main ideas or main ideas of writing, (11) writing rules and the use of punctuation marks, (12) the influence of textbooks [12]. Data on the quality of textbooks is obtained from the results of the assessment through a textbook assessment questionnaire which is then converted into a percentage value. The percentage criteria for the quality of textbooks are presented in Table 1 [14].

Table 1. The percentage criteria for the quality of textbooks

No	Persentage	Criteria
1	0,00 – 0,20	Very Bad
2	0,21 – 0,40	Bad
3	0,41 – 0,60	Medium
4	0,61 – 0,80	Good
5.	0,80 – 1,00	Very Good

3. RESULTS AND DISCUSSIONS

The textbook feasibility test was conducted using a textbook quality assessment instrument adapted from BNSP and the textbook quality assessment instrument contained in Sinaga [8]. The quality assessment instrument was distributed to three high school teachers in Bandung, Medan and Majalengka. In addition to being assessed by the teacher, the textbook quality instrument was also given to three expert lecturers. The assessment conducted by the teacher and expert lecturer consists of several aspects. In addition, teachers and lecturers also provide constructive input in writing physics textbook in the comments column provided. Feasibility test results are shown in Table 2.

Table 2. Recapitulation of Textbook Feasibility test Results

textbooks as a whole, the results of the percentage of assessment can also find out the quality of textbooks in each component of its assessment. Comparison of the percentage of the quality of textbooks based on indicators assessed by the validator of 3 teachers and 3 lecturers are shown in Figure 2.

Figure 2. Percentage Diagram of each Aspects of Book Evaluation

Score	Criteria												Percentage
	1	2	3	4	5	6	7	8	9	10	11	12	
L1	6	3	4	3	10	15	10	10	15	10	3	5	84
L2	5	3	6	3	10	15	15	10	15	15	6	5	98
L3	6	4	6	2	5	15	10	10	15	15	3	5	86
T1	6	4	6	2	10	15	15	10	10	15	3	5	91
T2	6	4	6	3	10	10	15	10	15	15	6	5	95
T3	6	4	6	2	10	10	15	10	10	15	3	5	86
Total	35	22	34	15	55	80	80	60	50	55	24	30	
Maximum Score	36	24	36	18	60	90	90	60	60	60	36	30	
Average	5.8	3.7	5,7	2.5	9.2	13.3	13.3	10	8.3	9.2	4	5	90
Percentage	97	92	94	83	92	89	89	100	83	92	67	100	

A comparison of textbook quality that has been validated by three lecturers and three physics high school teachers who teach in Bandung, Medan and Majalengka are shown in Figure 1.
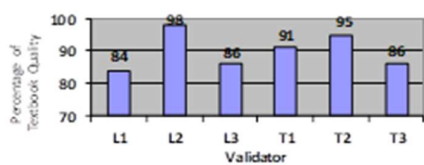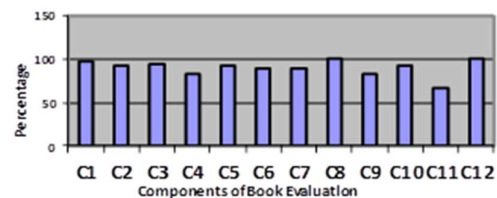

Figure 1. Percentage Diagram of Textbook Quality

Information:

L1: Lecturer 1
L2: Lecturer 2
L3: Lecturer 3
T1: Teacher 1
T2: Teacher 2
T3: Teacher 3

Assessment of the quality of physics textbooks using multimodal representations consists of several components. Based on the results of the average percentage of the quality of textbooks provided by the validator is 90%, which means the textbook is in the very good category. In addition to knowing the quality of

a. Components of Textbook Presentation (C1)

The components of the presentation of the textbook assessed by the validator are: (a) table of contents, (b) learning indicators, (c) concept map, (d) keywords that are the core of the material discussion, (e) questions or practice questions at the end of each sub chapter, mid-chapter, or end of chapter, (f) bibliography. The percentage obtained in the presentation component is 97% with a very good category. From the results given by the validator, almost all validators give maximum values to the components of this presentation. This means that the presentation components in the textbooks have been able to meet the validator's expectations regarding the components of a good presentation in a book and researchers have raised almost all the components expected in the presentation component. The validator also does not provide comments to make improvements or additions to the components of the presentation content.

b. Components of Graphic (C2)

The assessment of the graphic component of the book includes: (a) interesting cover, (b) the concept is displayed visually clearly, (c) contrast, (d) interesting layout based on the choice of font, font size, color and layout. The percentage given by the validator rating is 92% with a very good category. There are some

suggestions regarding the book such as each graphic should be given a box and layout lay out needs to be improved so that the textbook display becomes more attractive.

c. Update Component (C3)

The updated component assessed includes several criteria, namely: presentation of up-to-date material, current features, and relevant references. The percentage of results provided by the validator was 94% with a very good category. Almost all validators agree that the material presented in this book is up to date in accordance with scientific developments. The material descriptions, examples, and exercises provided are also relevant and interesting. The references used are also valid and relevant.

d. Components of Conformity KI, KD, Indicators with Concepts (C4)

The percentage given by the validator of the results of the feasibility test for the suitability component of KI, KD, indicators with physics concepts was 83% with a very good category. Most validators consider that Core Competencies (KI) and Basic Competencies (KD) have been written at the beginning of the chapter but the relationship between IC and KD with Indicators is still incomplete. The validator assesses that there are still some indicators that need to be added to meet the demands of IC and BC such as cognitive indicators to analyse.

e. Components of Clarity and Truth of Concepts or Laws (C5)

The fifth component is the clarity and truth of concepts or laws. From the data provided by the validator, 92% results were obtained for this component in the very good category. The value given by this validator shows that the concepts and legal truths presented in the book are clear. According to the validator's response, some explanation of the concept still needs to be clarified so that it is easily understood by students.

f. Components of Troubleshooting Stages (C6)

The validator gave an assessment result for this component of 89% with a very good category. The validator assesses that the problem-solving stages used in this book are complete, systematic, and make it easy for students to understand the problem solving. The validator also thinks that giving examples and exercises in problem solving stages at the end of each sub-chapter is very good for familiarizing and training students with solving this problem. The improvement suggestion given by the validator is to fix some pictures in the first stage of problem solving so that the images presented represent problems in a more logical and contextual problem.

g. Component Mode of Representation Used (C7)

The percentage given by the validator for this component is 89% with a very good category. The validator considers that the concepts or laws in the textbook of temperature and heat material have been well represented using various modes of verbal and visual representation (text, pictures, graphics, charts, tables, and mathematics) so that the concept description can be more easily understood by students. The modes of representation used are also integrated so that they are interrelated and become a unified whole. The order of use of the representation mode is also appropriate and makes it easy to understand the concept.

h. Components of Quality of subject description (C8)

This quality of subject description gets the highest percentage value from the validator compared to the other components which is 100% with a very good category. All validators, both teachers and expert lecturers agreed that the material presented in this textbook was complete and discussed widely. But despite the extensive discussion, the concepts presented are still relevant and in accordance with the material.

i. Components of Conceptual Hierarchy and Writing Organization (C9)

The percentage obtained by this component is 83% with a very good category. Most validators assume that the description of the teaching material shows that there is a clear conceptual hierarchy, the propositions used to link concepts to one another are quite clear, and the writing organization moves from general to specific or vice versa from specific to general so that it makes it easy to understand the concepts presented.

j. Components of Main Idea or Main Idea of Writing (C10)

The results obtained from the validator for this component amounted to 92% with a very good category. According to the validator, thoughts and concepts have been clearly expressed and relevant to the main idea or story line. The reader can easily understand the main concepts and ideas. However, there are still some important questions in the book that have not been answered. This is a consideration of researchers for further improvement in the textbook.

k. Components for Writing and Using Punctuation (C11) Components

In this component, the validator assesses that the sentence used is well structured, has a strong structure, and is interesting to read but there are still some rules for writing punctuation that are not appropriate. The validator also found that there were some errors in typing words and this became a fix for researchers. For this component, the validator gives a result of 76% in the good category. This component is the component that gets the lowest value from the validator. Therefore, the

rules of writing and punctuation still need to be improved by researchers.

l.   Influence Component (C12)

From the evaluations given by the validator, this component also became the one that achieved the highest percentage of 100% with a very good category. All validators assume that the expository or persuasive writing of teaching material is provocative, lively, and is designed to encourage readers to think. Guide and lead the reader to make satisfying conclusions.

Sinaga [12] states that the resulting textbooks must meet the requirements of a good textbook. The concepts must be described correctly and clearly, the discussion is sequential both inductively and deductively, the depth and breadth of content in accordance with the level of development of students, integrating verbal and visual representations, the sequence of using various modes of representation according to the need to clarify the concepts written, can encourage the reader to want to read more about the information conveyed, and the use of punctuation and sentence structure must be in accordance with the rules of grammar. The results of the quality of this physics textbook provided by the validator is 90% with a very good category. Based on these results it can be stated that the physics textbook using this multimodal representation is suitable to be used as a textbook for high school students grade 10.

4. CONCLUSION

Based on the results of the research and the results of the tests that have been carried out, the conclusions are: Textbook developed using multimodal representation has very good quality categories and each aspect of this textbook has very good category.

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