

# Development Of Textbooks Based On The STEM (Science Technology Engineering And Mathematics) Approach On The Always Energy Saving Theme Energy Source Subtheme For Class IV Elementary School Students

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**Abstract:** This study aims to develop a teaching material in the form of a STEM-based Textbook based on theme 2 Subtheme 1 sources of energy grade IV elementary school. This type of research is development research using the R&D model of Borg and Gall which consists of 10 stages. The quality aspects of textbooks based on the STEM approach studied were validity, practicality, and effectiveness. Data collection methods in this study used observation, questionnaires, tests, and validation. Based on the results of data analysis, it is obtained that the textbook based on the STEM approach is declared valid with a validation percentage of the validator that is 85%. Textbooks were also declared practical based on the results of the questionnaire data analysis which showed student response rates of 87.5%, 88.4%, and 88.97%. The effectiveness of textbooks is known from the percentage of student learning outcomes of, 87%, 85%, and 86%. Based on the results of the analysis of the data it can be concluded that the textbooks have fulfilled all three aspects of the quality of textbooks based on the STEM approach and can become a learning medium in schools.

**Index Terms:** Handbook, STEM Approaches

## 1 INTRODUCTION

Natural Sciences is one of the main subjects in the Indonesian curriculum, including in elementary school levels. Science is part of science or science that comes from English, namely science (Trianto, 2015: 136). According to Iskandar (2010: 52) Natural Science is the study of events that occur in nature. Based on the opinion of some experts, it can be concluded that Natural Science is the study of natural phenomena and everything that happens in nature that is systematically arranged. Learning devices must be prepared by the teacher before carrying out learning. Learning devices are tools or equipment to carry out processes that enable educators and students to carry out learning activities. Learning tools include learning plans that are designed in the form of syllabi and lesson plans. In addition, in the planning of learning also done the preparation of learning media, teaching materials, and assessment tools. There are several presentations of teaching materials developed in elementary schools, one of which is teaching material in the format of print media. Teaching materials in the format of print media that are now being developed in schools such as textbooks, learning modules, handouts, worksheets, and school magazines. The teaching material that the researcher will develop is the STEM Approach Textbook. Textbooks have a variety of forms, it serves to help students find a concept and guide students in learning. The role of textbooks in learning is as a tool to provide knowledge, attitudes, and skills to students. Textbooks as teaching materials have advantages. Strengths Textbook is a media that is easy to learn by students anytime and anywhere without the need for special tools to learn it, makes it easy for teachers to convey learning, Textbooks can get students to learn independently, actively, and creatively. One of the objectives of the textbook is to help students find a concept about a phenomenon that is concrete, simple, and related to the concept that will be learned. The function of textbooks in learning one of them is as a reference material or reference material by students. Based on observations made by researchers in elementary schools that textbooks used in discussing learning themes, especially theme 2, always save energy in sub-theme 1 of energy sources, students only use books published by the government, namely students' thematic books. But in the

student book there is still no problem solving in everyday life that uses a STEM based approach. STEM seeks to foster student imagination such as scientific inquiry and problem solving. The STEM approach refers to the ability of students to apply an understanding of how to do something to solve problems about phenomena that exist in the surrounding environment. One of STEM's understanding of how technology can be developed through an engineering / design process using project-based learning themes by integrating several different (interdisciplinary) subjects. In addition, students will become creative and innovative thinkers who can find forms, and solve problems in ways that lead to innovative and unique applications, which can conceptualize at various levels of abstraction and synthesize all knowledge disciplines and levels of analysis (Plague, et al, 2013). Based on the description of the problems above, the researcher feels it is necessary to develop a teaching material in the form of a textbook based on the STEM approach. Therefore, a development research was carried out with the title "Development of Textbooks Based on the STEM Approach (Science Technology Engineering and Mathematics) on the Theme of Always Saving Energy Subtheme Energy Resources for Class IV Elementary Students". Based on this background, the formulation of the problem in this research are (1) How are the results of the development of textbooks based on the STEM (Science Technology Engineering And Mathematics) approach on the subtheme 1 of energy sources in grade IV SD? (2) How is the effectiveness of textbooks based on the STEM (Science Technology Engineering And Mathematics) approach on the sub-source energy 1 in grade IV elementary school?

## 2 RESEARCH METHOD

This type of research is research and development. The research respondents were grade IV students at SDN Patrang 01 Jember. The R&D research model consists of 10 stages namely; (1) potential and problem stages; (2) data collection stage; (3) product design stage; (4) design validation stage; (5) design revision stage; (6) product trial phase; (7) product revision stage; (8) testing phase of usage; (9) product revision stage; (10) mass production stage (Sugiyono, 2017:

408). The instruments used to obtain data in this study were validation sheets, learning achievement test sheets, and student response questionnaires. Prior to the trial, the STEM approach based textbook went through an expert validation stage. At that stage the level of validity of the textbook based on the STEM approach was assessed by 3 validators, namely 2 expert validators from Jember University PGSD lecturers, and 1 user validator from grade IV elementary school teachers. The scores given by each validator are then averaged to find the percentage of validity using the formula  $V_{ah} = T_{se} / T_{sh} \times 100\%$ . Textbooks based on the STEM approach can be said to be effective if  $\geq 80\%$  of the student competency test scores meet the minimum completeness criteria (KKM). The category of positive learning responses is if  $\geq 50\%$  of all students give positive responses.

### 3 RESEARCH RESULT

#### 3.1 DEVELOPMENT RESULTS

The STEM Approach Textbook developed in this study consists of several sections. The description of the parts in question is as follows.

- a) The cover includes the main identity of teaching materials such as the title of the book, supporting images, writing of energy sources that show the material contained in the textbook based on the STEM approach, the writing for grade IV elementary school shows that this textbook is used for grade IV elementary school.
- b) The introduction contains preface and instructions for using the STEM Approach Textbook.
- c) Table of contents contains the titles and page numbers that function to make it easier for readers to find the desired title quickly and precisely without having to search one by one from the whole page.
- d) The teaching material contains a description of the theme 2 always saving energy sub-themes learning energy sources 1 to learning 3.
- e) Products for developing STEM Approach Textbooks are STEM Creativity. STEM Creativity contains experimental activities that must be carried out by students in each learning to increase students' understanding of the learning material namely, STEM Creativity makes simple solar panels, STEM Creativity makes simple watermills (PLTA), STEM Creativity makes simple windmills (PLTB).
- f) Competency test contains questions that aim to find out the level of students' understanding of the material discussed in the Book based on the STEM approach.

#### 3.2 VALIDATION RESULT

The scoring results provided by the four validators are processed by the expert validation formula ( $V_{ah}$ ) and poured into the validation results table. The percentage of validation values obtained are then referred to at intervals to determine the level of validity of the cartoon-based worksheet based on the subject and its nature.

#### 3.3 TRIAL DATA RESULTS

The response of this trial is the fourth grade students of SDN Patrang 1 Jember, amounting to 31 students, consisting of 8 male students and 23 female students, SD-IT Harapan Umat Jember totaling 21 students, consisting of 11 male students and 10 students women, and also SDN Kepatihan 3 Jember totaling 29 students, consisting of 19 male students and 10 female students. The Effectiveness of Textbooks Based on the STEM Approach. Indicators of effectiveness Textbooks based on the STEM approach are post-test

results that meet the minimum completeness criteria (KKM) values. Textbooks based on the STEM approach can be said to be effective if  $\geq 80\%$  of the number of students get the learning outcomes  $\geq$ KKM that is used by schools is 75. Field trials are conducted as many as 4 meetings using textbooks based on the STEM approach. At the end of the study a post test was conducted to determine the effectiveness of the textbook based on the STEM approach. The effectiveness of textbooks based on the STEM approach is measured through learning achievement test activities in the cognitive domain carried out at the end of learning. Data on the value of student learning outcomes can be seen in appendix C. The data generated 85% of students get the value of learning outcomes  $\geq$ KKM, while 15% get the value of learning outcomes  $\leq$ KKM. Based on the data generated it can be seen that the effectiveness of textbooks based on the STEM approach reaches 85% with a very effective effectiveness level. Student response indicators are student responses regarding the developed textbooks that are STEM-based textbooks measured through student questionnaire responses. Student response data were obtained through the results of the questionnaire responses that were distributed to fourth grade students. Questionnaire responses were given to all students after the learning process ended. The data generated in the form of student responses to the use of textbooks based on the STEM approach. Student responses can be stated positive if the percentage of agreement  $\geq 50\%$  (Trianto, 2010: 243).

### 4 RESULT AND DISCUSSION

This research develops Textbook Based on STEM Approach. The manufacturing process uses the R&D development research model (potential and problem stage; data collection stage; product design stage; design validation stage; design revision stage; product trial stage; product revision stage; product trial phase; product revision stage; mass production stage) developed by Sugiyono. Before being used for development trials, the STEM Approach Based Textbook goes through the validation stage first. Validation is done by experts and users or practitioners. Expert validation was carried out by giving validation sheets to 2 validators namely, two lecturers from FKIP PGSD University of Jember. User or practitioner validation is done by giving a validation sheet to grade IV elementary school teachers. This validation aims to get the value from the validator. The value of the validator will be used as a reference whether or not the product is worth trying out. In addition, the purpose of validity is to get opinions, suggestions, and comments from the validator. The opinions, suggestions, and comments given by the validator are used as a reference for the revision or improvement of the product before the trial. The aspects assessed in the validation process include four aspects, namely the appropriateness of the content, linguistics, presentation, and graphics. The values of the four aspects are then averaged to get the final validity of the STEM Approach Textbook. The results of the validity of Textbook Based on STEM Approach are 85%. According to Akbar (2016: 82) the results of validity that are in the range of  $80 \leq V \leq 100$  have a very valid level of validity. The results of the validity of the STEM Approach Based Textbooks are in the range of  $80 \leq V \leq 100$ , then the STEM Approved Textbooks have a very valid category so that the product is eligible to be tested. After the STEM Approach Textbook is declared valid, a trial is carried out on the product. The trial aims to determine the effectiveness and response of students to textbooks based on STEM approach. The effectiveness of textbooks based on the STEM Approach is done by giving a description item through a test of learning outcomes given to students at the end of learning. The grades obtained by students illustrate the effectiveness of textbooks based on the STEM approach. Textbooks based on the STEM approach can be declared effective if the KKM completed learning

outcomes value  $\geq 80\%$  of the total number of students. Research data at SDN Patrang 1 Jember shows that 87% of students get the learning outcomes  $\geq$  KKM, while 13% students get the learning outcomes  $\leq$  KKM. Data of research results at SDN-IT Harapan Umat Jember shows 85% of students get the learning outcomes  $\geq$  KKM, while 15% of students get the learning outcomes  $\leq$  KKM. Data from research results at SDN Kepatihan 3 Jember shows 86% of students get the belajarKKM learning outcomes, while 14% of students get the nilaiKKM learning outcomes. According to Akbar (2016: 82) the effectiveness results which are in the range of  $80 \leq V \leq 100$  have a very effective effectiveness level. Effectiveness of Textbooks based on the STEM approach are in the range of  $80 \leq V \leq 100$ , so textbooks based on the STEM approach can be categorized as very effective and feasible to use. Based on the results of the questionnaire, at SDN Patrang 1 Jember obtained an average of total students answering "yes" to the questionnaire option or giving a positive response to the media in all aspects reaching 87.5% or in the excellent category, at SD-IT Harapan Umat Jember response positive students toward textbooks in all aspects reached 88.4%, and in SDN Kepatihan 3 Jember students' positive responses to textbooks in all aspects reached 88.97% or in the very good category. Positive responses were shown by students to the design and presentation of textbooks based on the STEM approach, namely, as many as 87.5% of students at SDN Patrang 1 Jember, 88.4% of students at SD-IT Harapan Umat Jember, and 88.97% of students at SDN Kepatihan 3 Jember stated that he wants to use textbooks based on the STEM approach again, because the design of textbooks based on the STEM approach is interesting for students and the atmosphere when learning to use textbooks based on the STEM approach is fun. Students become enthusiastic when learning because, in textbooks based on the STEM approach there are activities that must be carried out by students that make students active while learning. Trianto (2010: 243) states that positive learning responses if positive student responses  $\geq 50\%$  of all students. Based on the results of the questionnaire that was distributed to students, the results showed that the response of students to the use of textbooks based on the STEM approach was positive..

## 5. CONCLUSION

Based on the analysis of the data that has been done, it can be concluded the results of the development as follows.

### a) Development Results

The results of this development are in the form of STEM Approach Textbooks for grade IV elementary school students who have passed the validation stage. Validation of Textbooks Based on STEM Approaches is included in the category of very valid with a validity percentage of 85%.

### b) Effectiveness

The effectiveness of textbooks based on the STEM Approach is known from the cognitive learning outcomes of students at SDN Patrang 01 Jember by 85%, SD-IT Harapan Umat Jember by 90%, and SDN Patrang 01 Jember by 86.2% with a very effective category. The effectiveness of textbooks based on the STEM approach is also seen from student responses. STEM-Based Textbooks get positive responses from students of SDN Patrang 01 with a positive response presentation obtained reached 87.5%, SD-IT Harapan Umat Jember reached 88.4%, and SDN Kepatihan 03 Jember reached 88.97% or very response categories well. Therefore, the STEM Approach Textbook for fourth grade elementary school students is effective to be developed. Based on the results of research on the development of a textbook based on the STEM approach that

has been implemented, the following suggestions can be made.

- a) For teachers, it should be more creative in making textbooks so that students can be interested in learning. The teacher can add learning media according to student characteristics. The teacher should be more creative in creating a pleasant learning atmosphere so that students do not feel bored.
- b) For other researchers, this research development is expected to be used as a reference for further research with different research variables and learning material.

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