

STEM Analysis on the Environmental Care Materials in Elementary Schools Thematic Book

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ABSTRACT

This research is motivated by the importance of combining Science, Technology, Engineering and Mathematics (STEM). One of which is in science learning, including science, technology, and mathematics. This study aims to analyze STEM contained in the theme 3 in thematic book 3 of the fourth grade in elementary school. Data collection techniques in the form of the latest edition of the teacher and student thematic book documentation in accordance with Minister of Education and Culture of the Republic of Indonesia Number 37 of 2018. Based on the results of STEM analysis on theme 3 with sub theme 3 titled Let's Love the Environment, it can be found out that there are components of science, technology and mathematics. On sub-theme 1 about Animals dan Plants in My Environment, it is found out that there is components of science only. On sub-theme 2 about Diversity of Living Things in My Environment, it is found out that there is components of science and mathematics only, meanwhile on sub-theme 3 Let's Love the Environment, it is found out that there are components of science, technology and mathematics. The concluded this research is needed to combine the four components of STEM so that they can be well integrated.

Keywords: *STEM, Books, Environmental, Care.*

1. INTRODUCTION

The development of Indonesian education in the era of globalization will demand to prepare a qualified generation in all aspects of life because it will be a challenge to changes in human life that are different from the previous era. This is also a challenge for each educational facility, namely schools, both formal and informal, to prepare innovative education from all aspect, for example teaching materials, learning resources, human resources (teachers), methods and so on that will improve the ability of students in acting and thinking.

Education in Indonesia, which now emphasizes the ability to act and think through the implementation of the 2013 curriculum, is expected to be a means to improve service quality and develop learning innovations. One of them is the application of various learning in one interrelated theme and can be a means of solving problems seen from various disciplines. One of them is the problem in learning science such as environmental problems where the solution can be from four disciplines such as Science, Technology, Engineering and Mathematics (STEM). As it is known, science learning is meant to equip students with various skills that is needed to continue education and to

develop themselves. The goals achieved through science learning are scientific skills [1]. Therefore, a strategy is needed in the implementation of science learning so that this goal can be achieved. Wilujeng, et al [2] state that science learning at the high school level should be equipped with critical thinking and creative activities so that it is not limited to learning that emphasizes memorization. In addition, Wilujeng, et al [2] also added that the science learning process must make students acquire knowledge, complete skills and develop scientific attitudes and noble values in an integrated way. This is supported by Rosana, et al [3] that integration in science learning is intended so that the learning process can be more meaningful, effective and efficient.

The example of integration in science learning is in the application of the STEM approach. The components contained in the STEM approach enable teachers to carry out meaningful, effective and efficient science learning. In addition, the integrated application of STEM also allows students to combine several concepts at once. Science, Technology, Engineering and Mathematics or abbreviated as STEM is a learning approach that is popular at the world level that is effective in implementing Integrative Thematic Learning because it combines four main areas in

education, namely science, technology, mathematics, and engineering [4].

STEM education in the 2013 curriculum which is applied in good schools which is summarized in textbooks and school curricula which are now being implemented in schools both at the elementary school level to high school is a learning approach that is a solution to facing challenges globalization era where the STEM approach is a learning designed to deal with real-world situations through problem-solving based learning in everyday life [5].

Elementary school becomes the first milestone and basis for habituation and training because at this time the ability of the intellectual level has begun to develop. Elementary school students are at the concrete operation stage. Several countries such as Malaysia and the United States have collaborated in the development of STEM fields for students aged 13-14 years so that they can compete in the economic progress of the 21st century. According to education expert Charismiadi in Beritasatu.com 2016 several countries have implemented STEM education since 10 years ago, among them are Finland, America, China, Australia, Vietnam, Malaysia and the Philippines. STEM education has been developed in several countries in the last 3 decades and has experienced a very significant increase in the quality of education. This can be seen from several private elementary schools that have integrated STEM-based education in their learning process. However, state-based primary schools are still lacking in implementation. Even though some of the benefits in STEM education are to make students become problem solvers, inventors, innovators, have independence, are literate towards technology, think logically, and are able to connect learning with everyday life.

Based on those facts, it can be concluded that STEM education has been widely applied in various countries. Based on this, it is necessary to carry out further studies regarding the STEM study on the 2013 curriculum learning resources (especially books) to see how much STEM is contained in elementary school books that have been taught by teachers in schools through methods, models, approaches and so on. Is it true that it has been completely or only partially used in the learning process, one of which is the theme of environmental care which makes it possible to see various kinds of problem solutions that can be raised by studying STEM in various disciplines.

1.1. Theoretical Framework

STEM education is an approach to education in which Science, Technology, Engineering, and

Mathematics are integrated within the educational process. This approach focuses on solving problems in everyday life as well as in professional life. STEM education shows students how science concepts and principles, technology, engineering and mathematics (STEM) are used in an integrated manner to develop products, processes and systems that benefit for human life.

STEM is an acronym for Science Technology Engineering Mathematics. Moore et al [6] state that STEM is an approach and effort in combining several or four STEM subjects into one lesson based on relationships between subjects and real-world problems. Kelley & Knowles [7] defines STEM as an approach to teach two or more STEM subjects related to authentic practice so as to increase students' interest in learning. Sanders [8] also explains that STEM is an approach that explores two or more STEM subjects as well as one or more subjects in schools.

1.1.1. Scientific Inquiry

The instruction-based science inquiry approach requires educators to encourage and provide examples of scientific inquiry abilities and build students' curiosity, openness to new ideas. In this case, students are required not only to work based on existing procedures, but are expected to be able to design their own procedures for what and how these procedures should be carried out in order to obtain maximum results from learning.

1.1.2 Technology

Technology is directly related to human needs as well as economic, social, cultural or environmental aspects obtained from the process of problem solving and the development of new products [9]. The STEM approach must provide opportunities for students to view technology as a vehicle for good and positive change.

1.1.3 Engineering

The nature of engineering design provides opportunities for students with a systematic approach to solving problems that occur naturally in all STEM subjects [7]. Engineering design also provides students the opportunities to find common ground and build connections between STEM subjects that have been identified as the key to the integration of each subject [10]. This engineering design approach allows students to build on their own experiences and provides an opportunity to build science skills and mathematical knowledge through design analysis and scientific inquiry [7].

1.1.4 Mathematical Thinking

Mathematics is commonly perceived to be a difficult subject for students to learn [11]. So, it has been

proposed that instead of instructing the content and practices of mathematics, the main focus of study should be on students' experience of the discipline and providing mathematical sense-making [12]. In the implementation of STEM in the learning process, the mathematical aspect is very necessary, especially in terms of evaluation.

1.1.5 Study of Elementary Schools Thematic Books

The thematic book that is used in elementary school was based on the regulation of the Minister of Education and Culture of the Republic of Indonesia Number 37 of 2018 concerning Amendments to the Regulation of the Minister (Education and Culture Number 24 of 2016) concerning Core Competencies and Basic Competencies of Lessons in the 2013 Curriculum on Elementary and Secondary Education which leads to informatics learning.

This research is a qualitative descriptive study. A data collection technique is in the form of documentation. The instrument used in this research is an analysis sheet in the elementary school thematic book on the theme of 3 Grade IV Caring for the Environment which includes 3 sub-themes about Animals and Plants in My Home Environment, the Diversity of Living Things in My Neighborhood, and Let's Love the Environment. The analysis was carried out on the material covered in thematic book, especially in learning 1 and 3 in sub-theme 1, learning 1 and 3 in sub-theme two, and learning 1 and 3 in sub-theme 3. Observation sheets were prepared by defining the nature of each component in STEM then matched with the material in the book. The observers in this study were the researchers.

There are three basic science competencies to be analyzed in this theme, including analyzing the relationship between the form and function of body parts in animals and plants, explaining the importance of balancing and preserving natural resources in the environment and conducting joint natural resource conservation efforts. the people in his neighbourhood. Meanwhile the definition of STEM components that will be used as guidelines in analysis activities is shown in Table 1.

2. METHOD

Table 1. Definition of STEM Components

No.	STEM Components	Definition
1.	Science	Science is a study related to natural events that involves investigation, research and measurement to explain the cause and effect of a natural phenomenon. Scientific research and research can be used to identify the evidence needed to answer scientific questions and answer problems in human life.
2.	Technology	Human innovation or invention which can be in the form of software and hardware as a means to fulfill human wants and needs, so that it can facilitate human work for a more advanced life.
3.	Engineering	Knowledge and skills to design, apply, replicate and engineer a work in the form of equipment, systems and machines that can be used by humans to speed up and simplify the production process of goods and services
4.	Mathematics	Science that deals with numeration, patterns of change and relationships, space and form. How to think rationally, logically and reasonable, and how to use it in a systematic and structured manner.

3. RESULTS AND DISCUSSION

Based on the results of the analysis on theme 3 (sub themes 1, 2 and 3) in learning 1 and 3 regarding STEM with basic science competencies: 3.1 Analyzing the relationship between the shape and function of body parts in animals and plants, 3.8 Explaining the importance of balancing and preserving resources in the environment and 4.8 Conducting natural resource conservation efforts with the people in the environment there is a Science, Technology and Engineering component, sub-theme 2 about discovery and its benefits has a Science and Engineering component, and sub-theme 3 about Let's Become an Inventor has a Science and Mathematics component. Based on this, the science thematic book in elementary school for Environmental Care material for the fourth grade does

not completely combine Science, Technology, Engineering and Mathematics (STEM) components in one theme.

3.1 Sub-theme 1 Animals dan Plants in My Environment

Sub-theme 1 in the fourth grade thematic book entitled animals and plants in my environment. In this sub-theme, the results of the analysis show that there is only science component in it. The science component in this sub-theme includes information on the stages of plant growth and development, bodyparts of plants and animals, and the impact of wise attitudes on the environment. Meanwhile, the other three STEM components are not found in this sub-theme.

Table 2. Results of STEM Component Analysis in Sub-Theme 1

No.	Theme 3	Basic Competencies	STEM Components			
			Science	Technology	Engineering	Mathematics
1	Sub-theme 1	3.8 Explain the importance of balancing and preserving natural resources in the environment 4.8 Carry out activities to conserve natural resources together with the people in the environment	Students are given information about the stages of rice growth	-	-	-
			Rice growth process	-	-	-
			Students are asked to analyze the impact of being care on the environment (caring for the environment)	-	-	-
			Students are able to recognize plant parts through pictures	-	-	-
			Students are able to differentiate the places where the plants live according to the growing conditions.	-	-	-

3.2 Sub-theme 2 Diversity of Living Things in My Environment

Sub-theme 2 in the fourth grade thematic book entitled the diversity of living things in my environment. In this sub-theme, the analysis results show that there are only science and mathematics components in it.

The science component in this sub-theme includes the life cycle of plants, recognizing animal body parts and distinguishing animal limbs through pictures. The mathematics component appears from the activity of writing down the differences and similarities of animal limbs on the Venn diagram. Meanwhile, the other three STEM components are not found in this sub-theme.

Table 3. Results of STEM Component Analysis in Sub-Theme 2

technology and mathematics components in it. The science component in this sub-theme includes the life

No	Theme 3	Basic Competencies	STEM Components			
			Sains	Technology	Engineering	Mathematics
2	Sub-theme 2	3.1 Analyze the relationship between the form and function of body parts in animals and plants	Students are asked to identify Indonesian natural resources and their conservation efforts			Students are asked to write the differences and similarities of different animal limbs in the Venn diagram
		3.8 Explain the importance of balancing and preserving natural resources in the environment	Students learn the life cycle of a pea plant by experimenting with growing mung beans and observing their growth			
		4.8 Carry out activities to conserve natural resources together with the people in the environment	Students observe body parts of animals (birds) through pictures, and write down their functions			
			Students observe spiders and insects, and find differences between their limbs and write them down in the table.			
			students are asked to observe the environment and write down the characteristics of the animals around the environment			
			students observe the animals in the environment (chickens and ducks) and write down the characteristics of the place to live			
			students classify the places where animals live based on natural conditions and characteristics			

cycle of plants, recognizing animal body parts and distinguishing animal limbs through pictures. The component of mathematics can be seen from the activity of writing down the differences and similarities of animal limbs in a pie chart. Meanwhile, engineering components are not found in this Sub-theme.

3.3 Sub-theme 3 Lets Love Our Environment

Sub-theme 3 in the fourth grade thematic book entitled Lets Love Our Environment. In this Sub-theme, the analysis results show that there are only science,

Table 4. Results of STEM Component Analysis in Sub-Theme 3

No.	Theme 3	Basic Competencies	STEM Components			
			Science	Technology	Engineering	Mathematics
3	Sub-theme 3	3.8 Explain the importance of balancing and preserving natural resources in the environment	Students are asked to write down how to protect the environment	students are taught about making compost based on the story/narrative presented		Students read the estimated density of garbage at the trash shelter which is shown in a pie chart
		4.8 Carry out activities to conserve natural	Students are asked to distinguish between types of medicinal plants that are easily found around the house			

No.	Theme 3	Basic Competencies	STEM Components			
			Science	Technology	Engineering	Mathematics
		resources together with the people in the environment	(turmeric, galangal, ginger).			
			Students are asked to write down how to maintain balance and environmental sustainability			

4. CONCLUSION

Based on the results of the STEM analysis on theme 3, sub-theme 1 about Animals and Plants in My Home Environment, there is only Science component, sub-theme 2 about the Diversity of Living Things in My Neighborhood has Science and Mathematics component, and in Sub-theme 3 about Let's Love the Environment there is Science, Technology and Mathematics components. Based on this, the science thematic book on the theme of environmental care for the fourth grade in each sub-theme is not complete in combining Science, Technology, Engineering and Mathematics (STEM) components in one theme. The results of the analysis that have been carried out also show that in science learning, there should be a teaching material or learning media that can integrate all STEM components so that students can learn science comprehensively and thoroughly so that the knowledge possessed by students is intact.

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