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HOW LOW-CARBON ISSUES ARE ADDRESSED IN PRIMARY SCHOOL TEXTBOOKS

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ABSTRACT

This study aims to examine the existence of learning material related to educational issues regarding low-carbon levels. Through the content analysis, 26 primary school science textbooks from ten publishers in Indonesia were reviewed, focusing on the study covering the selection, presentation, provision of supporting materials, and low-carbon issues. The research method used is the qualitative content analysis process method with research steps: (1) data collection; (2) data analysis textbook; and (3) ethical considerations. The results showed that sixty one point six percent of teachers said the book was under the curriculum's coverage. The sixty point six percent of the relevance of content to student experiences was appropriate, so is the fifty three point five percent of the relevance of examples and exercises with learning objectives and the material presented. It is also found that fifty five point six percent of various questions and discussions were adequate for testing students, the other fifty one point five percent had included supporting questions and exercises, and sixty point six percent of teachers said there was a teacher's guide. Then fifty point five percent, according to the teacher, students' awareness of low carbon is still relatively low, and forty six point six percent of the content coverage regarding low carbon is still considered sufficient by the teacher. This study concludes that there was too little coverage of low-carbon issues and a lack of additional material related to the low-carbon content in primary science textbooks. The topic of low carbon is still implicit in the environmental literacy found in textbooks. The follow-up that can be done is providing a low-carbon concept to science textbooks in primary schools so that our students and society will have low-carbon awareness and increased environmental literacy.

Keywords: content analysis; primary science textbook; low-carbon education

INTRODUCTION

Low carbon is one of the concepts that students need to know. This concept aims to create awareness of low-carbon community behavior (Hudha et al., 2020). This behavior has an essential role in reducing carbon emissions and improving the quality of the environment around us (Chen & Li, 2019). However, so far, the application of this concept in primary schools is still lacking. Students do not show low-carbon behavior in everyday life (Du et al., 2020) when their behavior can be changed using textbooks (Noyes & Garland, 2006; Kissinger, 2013). Science teachers and researchers often use school textbooks as useful teaching resources to support the planning and implementation of science lessons (Abd-El-Khalick et al., 2008; Schubatzky et al., 2019). However, textbooks in primary schools have not fulfilled a much more critical role in science education. Simultaneously, science teachers in schools rely heavily on textbooks to organize and deliver instruction and provide homework to students (Lipson et al., 1993; Weiss et al., 2001; Niaz & Maza, 2011).

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Textbooks are tools for interpreting curriculum content and methods efficiently. It is used to carry out educational goals under the curriculum and is the essential element in science lessons (Kim et al., 2011). It cannot be denied that school science textbooks constitute a significant component in the learning process and instructing students (Lipson et al., 1993; Lin & Wu, 2007). Science textbooks are created based on interpretations of the curriculum, and it turns them into intermediate media for learning by teachers and students. Therefore, science textbooks can be described as mediators between the curriculum developed by the Indonesian government. Textbooks can also be seen as curriculum compilers and are often referred to as curriculum materials from which they are developed (van den Ham & Heinze, 2018). One of the most useful analyzes for primary school curriculum planning is content analysis in science textbooks (Shahmohammadi, 2013).

In recent years, science education researchers at the primary level have identified many problems in science textbooks. The problems include the use of inappropriate vocabulary or readability (Skorecova et al., 2016), misinformation (King, 2010), too shallow concept (Chaisri & Thathong, 2014), creativity (Klieger & Sherman, 2015), and the lack of emphasis on students' scientific thinking (Chiappetta et al., 1993). Science teachers also tend only to use textbooks that can be found in bookstores or provided by schools. They are less innovative in developing student worksheets (Leasa et al., 2016) so that analytical content related to science textbooks is needed to develop better science textbooks. Many have conducted a content analysis on science textbooks, such as textbook content analysis on the topic of scientific literacy (Ardianto & Pursitasari, 2017) (Zakiya et al., 2017), textbook content analysis on high order thinking skills (HOTS) (Pratama & Retnawati, 2018), content analysis on textbook related to nutrition (Grommet & Tkachenko, 2019), teacher's book content analysis (Güven, 2010), mathematics textbook content analysis (Vicente et al., 2020; Zhang et al., 2020), physics textbook analysis (Bancong & Song, 2018), content analysis on assignments in elementary science textbooks (Andersen, 2020), and many more. However, the content analysis of primary school science textbooks in Indonesia related to the low-carbon topic of the prior studies has not been analyzed. An examination of the low-carbon theme on developing primary school science textbooks in Indonesia will provide essential insights into students' knowledge of low-carbon awareness.

The theme highlighted in this study is related to a low carbon, which is a perfect topic for us to study. It is usually implied in green education discussions or green energy (Amin et al., 2019), although these topics differ significantly. Low carbon is a concept of low-carbon behavior that prioritizes energy wisely and is environmentally friendly. Students need this concept to gain knowledge for the use of environmentally friendly energy and create awareness of low-carbon community behavior (Phang et al., 2016; Dai et al., 2019). In the education field, this topic is called low-carbon education. This study aims to report our direct observations about what differentiates science textbooks, whether they contain topics related to low-carbon education. If we want our students and society to be aware of low-carbon content, it is essential to embed the low-carbon concept starting at the primary school level. This research is limited to primary school science textbooks in Indonesia published from 2017 to 2020. Our discussion focuses on the content aspects of the textbooks, particularly on the topic of low carbon based on the latest information in the textbooks we analyzed.

METHODS

The research method used was the qualitative content analysis process with three main stages: data collection, data analysis textbook, and ethical considerations (Wiklund Gustin et al., 2020). The data was collected using the Focus Group Discussions (FGD) method (Ho et al., 2019). The FGD serves as an ideal method for obtaining in-depth discussions to measure public opinion (teachers) because it is very similar to people's daily conversations. The group of FGD consists of seven primary school teachers in East Java Province, Indonesia. The selection of FGD participants was carried out randomly by involving senior teachers, teachers currently taking Professional Teacher Education (PTE), and fresh graduate teachers. Besides, the researchers distributed questionnaires related to science textbooks in primary schools to collect data. Two hundred questionnaires were given to teachers taking PTE, and 99 questionnaires were returned. The questionnaire criteria were adapted from the analysis of textbook research abroad (Table 1).

Content analysis was conducted to examine 26 science textbooks in Indonesian primary schools. The textbooks are limited to those published from 2017 to 2020 and from 10 publishers. This step is taken to identify common problems in the textbook. The steps of textbook data analysis are in Figure 1 (Lin & Wu, 2007).

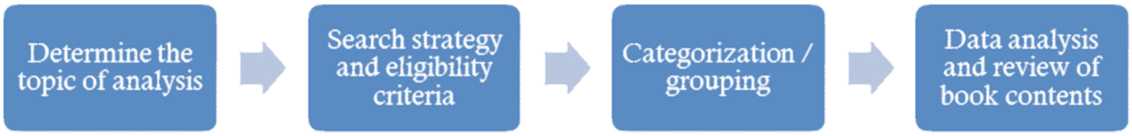

Figure 1. Steps of the Textbook Data Analysis

The first step of analysis is to determine the keywords or topic of analysis. Data collection was carried out in primary school textbooks in Indonesia. The books were randomly selected, which is the most frequently used, easy to find, and is considered sufficient to represent books of its kind. The second step is to adjust the textbook with its eligibility criteria according to the specific indicators. Furthermore, each item was examined and categorized according to the science textbook review criteria. This study identifies problems in the content aspect only in primary science books, so we get the main items shown in Table 1 (Lin & Wu, 2007).

Table 1. Research Analysis of Textbooks Abroad (Lin & Wu, 2007)

Criteria	Detailed Items
Content selection	Adequate coverage of all topics as described in the curriculum
	The relevance of content to the student experience
Content presentation	The relevance of examples and exercises to the learning objectives and material presented
	Sufficient variety of questions and discussions to test students
Provision of supporting materials	Supporting questions and exercises
	Teacher's guide
Low-carbon content	Student awareness about low carbon
	Coverage of low-carbon content

The item criteria are the modification of previous research and adjusted to the needs and objectives of the study. To maintain confidentiality, we decided to disguise the list of book titles, publishers and not leave positive comments on any textbooks. It was done to prevent the publisher from quoting the research results for commercial purposes. It should be noted that these dozens of books are among the most used books, and there is no definite proof that they are the most popular.

In the final step, the sample books were reviewed with the disclosed names of publishers and authors to prevent any unwanted occurrences. A set of criteria used is shown in Table 1. The books reviewed regarding low-carbon content are in grade 4 theme 2, grade 5 theme 8, and grade 6 theme 4. It should be noted that the material regarding low carbon in primary schools includes saving energy (energy sources), conserving water (water cycle), and globalization (electrical energy) (Phang et al., 2016).

This study upholds research ethics. The participants were informed about the research objectives. Their participation in the study was voluntary, and that they could withdraw from the study at any time without providing any explanation. Confidentiality throughout the research process is vital when dealing with small-connected communities (Damianakis & Woodford, 2012).

RESULTS AND DISCUSSION

The analyzed science textbooks were compulsory and supplementary books in Indonesia. For compulsory books in Indonesia, the Indonesian government requires textbooks from the Ministry of Education to be studied in schools. Complementary or companion books in schools can be obtained from private publishers. The lists of books and publishers are disguised to maintain confidentiality. The primary education curriculum in Indonesia applies a thematic approach and scientific learning so that textbooks in

Indonesia at the primary school level are mostly packaged in a thematic form. Books with a thematic approach can integrate knowledge, skills, learning values, and creative thinking using themes (Wuryani & Yamtinah, 2018).

Seven out of ten publishers publish thematic books, and three other publishers call their books a companion book. As shown in Table 2, it can be seen that the private sector dominates the publication of primary science textbooks. However, private publishers still go through government screening in publishing their books. The example is the last two books where the publisher only markets books for grades 1 and 4. According to the publisher, the government only passes books in that particular classes, while other books have not been assessed. Some publishers publish a series of assignments and questions and complementary books, and some provide teacher's companion books in hardcopy and softcopy forms. Lecturers and teachers dominate the author's reputation in this textbook. The following list of books that we analyzed can be seen in Table 2, while the results of distributing questionnaires to teachers are under Table 3.

Table 2. List of Analyzed Books

Publisher	Grade	Publication Year	Number of Pages	Number of References
Book 1	4	2017	162	31
	5	2017	170	25
	6	2015	130	56
Book 2	4	2017	210	10
	5	2019	226	8
	6	2019	242	8
Book 3	4	2018	125	11
	5	2018	135	8
	6	2018	120	9
Book 4	4	2017	132	7
	5	2018	174	10
	6	2019	168	24
Book 5	4	2017	122	27
	5	2018	126	16
	6	2018	126	19
Book 6	4	2017	162	18
	5	2018	162	13
	6	2018	162	17
Book 7	4	2019	164	18
	5	2019	132	14
	6	2019	172	20
Book 8	4	2019	178	18
	5	2019	178	18
	6	2020	178	22
Book 9 (Grade 1 and 4 only)	4	2019	132	16
Book 10 (Grade 1 and 4 only)	4	2019	107	9

Although the curriculum guidelines define the range of topics to be included in the textbook, the books vary widely in presenting the content and depth of each topic. In the following, we discuss eight common problems that we have identified. They are presented in four subsections: content selection, content presentation, provision of supporting materials, and low-carbon content.

In terms of content selection, there are two explanations, including general problems related to the coverage of the selected content, whether it is under the curriculum and relevant to student experiences. The content coverage of each book is actually under the current curriculum. The reason is that both the government and private publishers had passed the selection process from the Ministry of Education in Indonesia before publishing. Publishers that have not passed the review will not publish their books. For example, some publishers only publish books for grades 1 to 4, while grades 5 and 6 cannot be published because they have not passed the review by the Ministry of Education in Indonesia. This process is carried out to control the content.

Table 3. Teacher Questionnaire Results

No	Indicators	Criteria (On Percentage)				
		Very Low	Low	Average	Good	Very good
1	Adequate coverage of all topics as described in the curriculum guidelines	0	2	25.3	61.6	11.1
2	The relevance of content to the student experience	0	1	32.3	60.6	6.1
3	The relevance of examples and exercises to the learning objectives and material presented	0	5.1	29.3	53.5	12.1
4	Sufficient variety of questions and discussions to test students	0	8.1	27.3	55.6	9.1
5	Supporting questions and exercises	0	7.1	33.3	51.5	8.1
6	Teacher's guide	0	1	14.1	60.6	24.2
7	Student awareness about low carbon	5.1	21.2	50.5	22.2	1
8	Coverage of low-carbon content	3	21.2	46.5	28.3	1

From the questionnaire data distributed, 61.6% of teachers rated the coverage of all topics in the curriculum guidelines as good. Meanwhile, the relevance of the content to current student experiences can be considered good. However, in this case, the student experience is casual. The experiences of students who have limitations and are geographically different are still not very visible, so we need books that can cover all universal student experiences. The relevance of content can help empower students to learn and encourage student learning behavior in a better direction (Schrodt, 2013). Books in school already have student activities, and it can be seen from the composition of the material presented. In the book, there are assignment activities, practicum, and individual questions, whether guided by the teacher or practiced independently. Assessment with teacher guidance can improve student mastery of concepts and quality in learning (Jufriadi & Ayu, 2019; Martínez-Jiménez & Ruiz-Jiménez, 2020). In addition to providing insights for students and teachers, assessment can also provide student learning progress and information about student learning objectives and learning processes (Gerritsen-van Leeuwenkamp et al., 2019).

The presentation of the content in each book has different characteristics. Some books present an attractive display of content and are packaged according to the age of primary school children, which is undoubtedly very helpful in improving student learning. In some books, the relevance of the content to the exercises and material is good. Some even published the book series specifically for questions and exercises as additional to material books. All publishers can follow this to increase student knowledge and practice. Book publishers can also include more authentic examples and questions for students. Besides, to measure scientific reasoning, reasoned multiple-choice questions could be used with various types, for example, reasoned multiple-choice with details or essay questions (Prastiwi et al., 2018). The intention is to understand scientific concepts and reasoning more clearly and deeply, not only by providing varied questions but also by providing appropriate action in the student learning process. One example is learning in the laboratory. Moreover, project-based learning can also have a more positive impact on student academic achievement than direct instruction (Guo et al., 2020). Thus, students will gain real experience in questions and exercises apart from project activities. Questions and exercises can strengthen students' understanding of the book's concepts to stimulate and form students' thinking patterns in solving problems. However, some publishers rarely include questions that can train students to think at higher levels, even though these abilities can be trained to primary school students in an appropriate proportion. According to our analysis, the book's questions are limited to C1-C4 of bloom taxonomy and mostly multiple choice. It takes several analyzing and problem-solving questions to improve students' high-level cognitive abilities any further. Practical concepts are not simple content-based, multiple-choice questions that rely on students' activities in rereading notes or memorizing facts and definitions.

In contrast, good concept questions are those designed to assess student understanding through analysis. Also, the learning strategies used must be appropriate to enhance the students' basic concepts. The strategy in question is that students can build concepts through modeling a phenomenon and then apply the model to other situations (Rahmatina et al., 2018). Building concepts through modeling can strengthen students' understanding of basic concepts developed to be applied to different situations, which should be existed in primary science textbooks. Furthermore, student projects related to science content are also required. From the results of our analysis, some publishers are submitting project content to students. Project-based learning is a way for students to learn independently and increase their collaboration skills through scientific work. It is excellent so that students' scientific work skills can begin to be trained. Examples of these skills are decision making, problem-solving, conflict management, teamwork, and an essential learning element (Musa et al., 2012). Besides, a question related to the formation of student behavior is also needed. Character behavior has been widely discussed in this textbook, but behavior about awareness of low carbon's importance has not yet been discussed in question. This behavior has a vital role in reducing carbon emissions in the future (Chen & Li, 2019).

Questions and exercises must be provided at the end of each chapter in a textbook. Also, textbooks must be accompanied by teacher's guides that provide teaching instructions, additional teaching materials, and answers to exercises. According to a questionnaire given to teachers, 51.5% of books were good. However, students should have good practice material that must be completed after studying the book's contents. The exercises listed in the book do not have an answer key because it is only available in the teacher's handbook. The teacher's handbook should also have an assessment rubric for essay questions that require problem-solving. Supporting exercises outside of the book are still have not occurred from the books we analyzed. The practice questions are always at the end of the chapter.

Two out of ten publishers book we analyzed had their question books apart from the student's companion and main books. It is beneficial for schools and teachers who need question material in evaluating students. However, it becomes very ironic if all the questions and answers have been provided in the book. The teacher will not develop in making questions and will only focus on the book's questions. Simultaneously, teachers must have competency in content knowledge, pedagogy, self-efficacy, and enthusiasm for teaching in creating a challenging learning environment for students (Fauth et al., 2019). Supporting electronic form materials is also very good if they are found in student's and teacher's books. The examples are reference sources from the internet, the use of augmented reality (AR) applications, and other applications because the use of digital applications has been proven to increase student interest and learning outcomes (Sulistyowati et al., 2018, 2019).

We did not get all the teacher's guides that we analyzed because these books were rarely sold in the market. The publisher usually provides it if the school or teacher orders it. According to the survey (Table 3), 60.6% of teachers have manuals from publishers. We only got 3 out of 10 publishers that included teacher's guides. This guidebook is also prepared based on the curriculum used in Indonesia. The teacher's guides we got were pretty much the same as the student handbooks. The only difference is that the teacher's guide provides instructions for teaching, learning activities, and the general learning model used in Indonesia. It resulted in deficiencies in the instructional instructions and suggested learning activities. The teacher's guide should have a design of learning models and learning activities that are more interesting and effective according to each book's topic. Books will be better equipped with learning aids, simulation, or visualization tools.

The content provided in the teacher's guide should be planned far ahead and not the same as the students. The concepts in the teacher's guide must be more critical or more complex and must be accompanied by additional material to assist teachers in elaboration. The teacher's guide should also include a reference list of online sources related to material content. This reference can be in the form of books and journals that are recommended for further reading. It was not yet in the teacher's guide that we analyzed. Providing answer keys for exercises is suggested to have a detailed explanation, and there should be answer keys for more complex questions. The teacher's guide should provide a plan or learning process (method), student workbooks, and evaluation. It is crucial to notify teachers who have a monotonous understanding and teaching habits that need change. It can have a positive effect on learning outcomes and can make it easier for teachers to learn new learning methods (Piper et al., 2018). A useful teacher's guide can show the entire instructional process from planning to evaluation. Evaluation in the teacher's guide can also use an android application or another (Hudha et al., 2018). Teacher's guides should be designed so that teachers can read easily (Hosseini & Gursel, 2012).

The low-carbon content in primary school books in Indonesia does not highlight the low-carbon aspect and is still implied by environmental literacy content. There is no separate content that specifically discusses low carbon, even though this content is crucial in today's era to be taught to primary school students. From our analysis results, primary school books in Indonesia have not fully provided awareness and understanding of the low-carbon concept. Awareness of the low-carbon concept much helps their behavior. If low-carbon behavior has been taught since primary school, it will create good habits in students. Students will start to save energy, reduce carbon emissions, and love the environment. The low carbon concept in primary school books is implicitly explained in grades 4, 5, and 6. Each class is distinguished by the theme discussed. For example, in grade 4, there is theme 2, "always save energy," this chapter discusses energy sources, the benefits of energy, and alternative energy. One example used in primary school textbooks is "turning off the lights while sleeping and turning on electronics only when we need them. These are simple things we can do to save electrical energy. Saving electrical energy means that we have implemented our rights and obligations in a balanced manner". This content is good enough in educating students always to save energy, but it is still implied in low-carbon content.

In grade 5, theme 8, with the title "our friend's environment," discusses environmental changes, environmental conservation efforts, as well as the water cycle. There are text readings related to the water cycle in the book, and then students are asked with their groups to draw a simple chart that explains the water cycle and add sentences to explain the process. Next, students present the results of their group discussions. In grade 6, theme 4, with the theme "globalization," the discussion is about changes in electrical energy and the role of electricity in the globalization era. The coverage of each class is still in the form of concepts regarding energy saving, water cycle, and electricity saving.

There is still no concept regarding low carbon itself. Simple ways that have been found in primary science textbooks are the behavior of saving electricity by turning off the lights and TV when they are not in use. Currently, perhaps the most crucial thing to anticipate is the use of gadgets in the student environment. By teaching this concept, primary school students will understand that playing with cellphones too much and frequently charging them will harm the carbon on earth. Besides, it is necessary to add ways to save the efficient use of lamps. A simple count is the use of lights of different types. A simple picture with an explanation of renewable energy using solar cells can also be used. Many people have widely recommended using solar energy, but solar energy sustainability has never been discussed (Arora et al., 2016). It can be done because we have already mentioned a little about solar energy use in primary science textbooks. Environmental education can produce direct benefits for the environment and concretely tackle conservation problems (Ardoin et al., 2020), so low-carbon learning is critical to teach in schools. The concept of low carbon should be introduced to primary school students to understand the dangers of carbon on earth. With this learning, it is hoped that it can increase children's awareness of the environment based on knowledge of simple low-carbon applications.

CONCLUSION

This study analyzes general problems related to the content of science textbooks in primary school. The books analyzed were 26 primary science textbooks from 10 publishers. We identified each problem to explain what went wrong in the book, provided examples, and suggested better ways to handle the content. Unfortunately, the implicit content of low carbon in primary science textbooks does not give enough information to the students. There is no comprehensive and structured material about the low-carbon concept since it is only found implicitly in the environmental literacy text. Therefore, to build awareness of low-carbon content for our students and society, it is essential to embed the low-carbon concept starting from the primary school level by including low-carbon content in their textbooks.

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