Advisability of integrated science teaching material on the topic of environmental pollution to increase environmental literacy and critical thinking of junior high school students

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Abstract. This research aims to produce integrated science teaching material on the topic of environmental pollution and to obtain empiric factors about the advisability of integrated science teaching material to increase environmental literacy and critical thinking. The research method used the Research and Development (R&D). The object of this research was the integrated science teaching material on the topic of environmental and the implementation in Junior High School Student. While the subjects of this research were Junior High School Students grade VII in Bandung. The text books development method used the model for the process of writing instructional materials. This research used instrument assessment of textbook quality and the readability for of their main ideas instrument. Draft I of teaching material was tested in limited field of Junior High School using the readability for of their main ideas instrument, this draft was also validated by 3 lecturers and 10 Junior High School teachers using assessment of textbook quality. Sampling technique used in this research was qualitative. The results of teaching material development showed high quality percentage of 80.24% with excellent criteria, even though, the readability for of their main ideas test showed percentage of 89.1% with high criteria (independent category).

1. Introduction
The increase of critical thinking skill and environmental literacy is one of the efforts to reach the 21st century students' skills. The ability of critical thinking and environmental literacy is one of the aspects that exist in educational goals that refers to 21st century education according to [1] which consists of information media, technology skill and learning and innovation skills. The Critical thinking skills and environmental literacy have been listed in Ministry of education and culture regulation Number 54 of 2013 on Graduate Competency Standards which require students to have the skills of thinking and acting effectively and creatively in the abstract and concrete field as a development that was studied in the school independently. One of the important thinking skills developed in students is critical thinking skills, where students are required to have the ability of knowledge (cognitive) to analyze, understand problems, and find solutions on environmental issues. In addition, the environmental literacy/school literacy movement (GLS) is also listed in The Regulation of Minister of Education and Culture no. 23 of 2015. School Literacy Movement aims to cultivate the activity of reading and writing so that the citizen of school become literate [2]. Literacy competence is an integration of listening, speaking, reading, writing, and critical thinking skills.
The result of the research showed that the students' environmental literacy is still low because of several factors, one of them is the intention to know and study the environmental problems [3]. The result of Pisa in 2006, Indonesia ranked in 52nd (bottom 6th) for both environmental science and geoscience from 57 countries participating in the event. The percentage of Indonesian students' skill level for environmental science shows that 35.8% are below D level, 16.8% at C level, 8.9% at B level, and only 4% are at A level [4]. The analysis of PISA in 2006 conducted by OECD showed that students' awareness of environmental issues was in line with their level of knowledge and literacy skills of environmental science. Students who were more familiar with complex environmental phenomena have a high ability in the environmental literacy. The results were not different in the students' critical thinking skills in junior high school, the research have been done by [5] showed that the students' critical thinking ability was very low with an average of 43.41%, it could be noticed from the students' skills in asking and answering question, giving reasons, making hypothesis, and determining the solution of the problem that was still very low. This indicated that students' critical thinking skills were still low.

Furthermore, in Indonesia, environmental education program has been developed in which the implementation was based on the decision between the Minister of Environment and the Minister of National Education in 2010. The implementation of the program in the curriculum of secondary school was done in two ways; integrated in other subjects such as science, biology, and geography or stand alone as the subject of environmental education (PLH) which is generally included in local content subjects. Based on this, it can be concluded that the environmental literacy and critical thinking skills of students have not implemented by the teacher specifically to students in junior high school. This is in accordance with the results of interviews with one of the teachers in junior high school in Bandung where teacher was more focused to train the students to understand the concept rather than the ability to think critically and environmental literacy. Whereas, clearly seen in the curriculum of 2013, students are required to have the ability to think and act effectively and creatively in the field of abstract and concrete as a development that was studied in the school independently which are the ability of critical thinking and environmental literacy.

From several previous studies, there were still few researches report about the increase of critical thinking skills by using textbooks. Besides that, combining critical thinking and environmental literacy in textbooks was still very rare. Based on the target of educators and educators in curriculum of 2013 which was realized in UU No. 14 of 2005, there were four competencies to be achieved, among them is pedagogic competence. Students learn primarily through interaction with teachers and teaching materials, learning interactions between students and teachers framed by instructional materials chosen by teachers and provided by the school. Interactions in learning include interactions with people (teachers, peers) and teaching materials (textbooks, workbooks, instructional software, web-based content, homework, projects, quizzes, and tests) [6]. The use of teaching materials has a direct effect on learning compared to the learning method used by the teachers and teacher’s action in selecting all the teaching materials is more important. Textbooks that are shared now have not yet accommodated a whole environmental literacy and critical thinking into junior high school learning. Moreover, the textbook have not integrated materials as a whole into integrated science learning, so researchers are interested in conducting research by developing science books to increase the ability of critical thinking and environmental literacy of junior high school students. This research aims to produce integrated science teaching material on the topic of environmental pollution which can increase environmental literacy and critical thinking and obtain empiric factors about the advisability of integrated science teaching material to increase environmental literacy and critical thinking. The research questions were how the quality of integrated science textbook according to experts and teachers and how the understanding of basic ideas for students was.

2. Method
Research methods used was the development research [7]. The subject matter of this research was the integrated science teaching material on the topic of environmental and the implementation in Junior High School Student. While the subjects of this research were Junior High School Students grade VII in Bandung. Participation in this research consisted of 30 student. The textbooks development method used the model for the process of writing instructional materials. This research used instrument assessment
of textbook quality and the readability for of their main ideas instrument. The draft I teaching material was conducted by a limited field test at the school using a teaching readability for of their main ideas instrument, and validated by three lecturers and ten junior high school teachers using assessment of textbook quality instrument. Assessment of textbook quality instrument used according to [8] which consists of 33 aspects of assessment by using Likert scale with 4 choices. Qualitative sampling technique was used. Data obtained in this research was the result of textbook validation.

3. Result and Discussion

3.1 Assessment of textbook quality

The draft I teaching material was conducted by a limited field test at the school using a teaching readability for of their main ideas instrument, and validated by three lecturers and ten junior high school teachers using assessment of textbook quality instrument. Assessment of textbook quality instrument used according to [8] which consists of 33 aspects of assessment by using Likert scale with 4 choices. The results of the assessment were interpreted to be very less with the score of 0-25, the category was less with the score of 26-50, the category is good with the score of 51-75, and the category is very good with the score of 76-100. Table 1 showed that the result of assessment of textbook where the textbook quality aspect has a percentage of 80.24% and is very well categorized.

| Table 1. Assessment of textbook quality |
|----------------------------------------|
| Teachers                               | Experts             |
| R.1 | R.2 | R.3 | R.4 | R.5 | R.6 | R.7 | R.8 | R.9 | R.10 | E.1 | E.2 | E.3 |
| Percent | | | | | | | | | | | | | |
| 71.2 | 71.9 | 72.73 | 87.12 | 90.15 | 86.36 | 85.61 | 93.94 | 70.4 | 84.0 | 72.7 | 68.0 | 87.8 |
| age | 7% | 7% | % | % | % | % | % | 5% | 9% | 3% | 94% | % |

Note: R= Respondent, E= Expert

It is proved that the textbook developed by using the model for the process of writing instructional materials adapted from [8] and adjusted to the guideline characteristics form of environmental textbooks to develop environmental literacy issued [9] with 4 aspects of ecological knowledge, environmental influences, cognitive ability, and behaviour is advisable to use. The advisability of this textbook is due to the development method used a process model to create documents that have multiple sections. In addition, the model used to present what was written and coupled with images, graphics and tables, makes the prints more clear and comprehensive.

The stages of writing should begin by analysing the competencies standards of graduates, core competencies and basic competencies. This was done so that the contents of the book are in accordance with core competence and basic competence. The second stage formulates the indicators of learning by adapting to the aspects of critical thinking skills and environmental literacy. This adjustment was done so that the textbooks can increase critical thinking skills and environmental literacy.

The third stage was determining the scope of the material and determining the integrated science by selecting and sorting the material or content so that the breadth and depth were accordance with the curriculum demands. Besides, the determination of integrated science was done so this textbook contains science material in an integrated manner where there are physics, chemistry and biology concept in it. The discussed content is related to its relevance in everyday life. The phenomena presented are adapted to the concepts discussed in the subject matter. In addition, learning activities were designed to encourage students to learn by looking at real situations. The result of this stage was a list of topics and subtopics that will be explained and developed in new science textbooks.

The fourth stage was creating a concept map. The concepts covered in the topic outline were mapped in concept maps. The use of concept maps on textbook writing were supported by [10] which states that the concept mapping was an effective tool for teaching scientific concepts in science subjects. Stages of concept mapping is in accordance with the article [11], concept maps provide the hierarchy of the topics.
to be written. The fifth stage was drafting an outline. Drafting an outline has function to sort the material from general to specific or specific to the general. Therefore, the draft outline was made as a reference for writing integrated science textbooks. The purpose of using multiple representations of concepts in science books is in order that students can understand easily the reading contained in textbooks. The science book should accommodate students' abilities where students possess different intelligence capabilities. One of the way to accommodate was defining a concept represented by at least two representational models. Students have difficulty in understanding the concepts represented by one of representational model can be helped using different representational models. The final product in this stage was a list of some representations of each concept covered in each subtopic. The representation mode is shown in Figure 1.

Some representation modes were combined into multimode representations. The next stage is creating a multimode representation that explains the topic or subtopic by integrating verbal representation modes (text/narrative) with the visual mode, so that written explanation will be more cohesive. This stage was an attempt to ensure that science textbooks have appropriate criteria in terms of coherence and cohesion, which were the characteristic of quality textbooks and made science textbooks easily to read by students. Furthermore, researchers then designed activities to trill the ability of critical thinking and environmental literacy shown in Figure 2.
Draft I teaching materials was conducted by a limited field test in schools using an instrument of readability of the main ideas in teaching materials. The assessment of textbook quality instrument was used according to [8]; assessment rubric consisting of the aspect of the assessment of the main idea and the aspect of the assessment of the supporting sentences of the main idea. The instrument used was adapted from [8] with a maximum score of 4 if the student response was complete, specific and correct, score 3 if the student response was correct but not complete, score 2 if the student response only gives details but not the main idea, score 1 if student response not true but he already tried, score 0 if the students did not try to respond to what was ordered. Furthermore the percentage of average scores was interpreted to be low (difficult category), medium (instructional category), and high (independent category). The main idea test was divided into 4 sections done by 30 students. The first part was sub-chapter of the environmental consisting of 6 discourses, the second part was sub-chapter of air pollution consisting of 5 discourses, the third part was water pollution consisting of 5 discourses and the fourth is the soil pollution consisting of 4 discourses. Each student's discourse must define the main idea and supporting sentences, besides the students were asked to encircle the words in discourse that do not understand the meaning and underline the sentences in the elusive discourse. The results of the assessment Table 2 shows that the results of the textbook assessment where the textbook quality aspect has an average percentage of 80.24% and is categorized very well.

| Table 2. Assessment the readability for of their main ideas |
|-----------------------------------------------------------|
| Sub Chapter Environmental | Sub Chapter Air Pollution | Sub Chapter Water Pollution | Sub Chapter Soil Pollution |
| Average percentage of readability for of their main ideas | 96,7% | 77% | 93% | 100% |
| Average percentage of sentences supporting the main idea | 85,8% | 68% | 96% | 96,25% |

In the sub chapter air pollution has the lowest percentage due to air pollution material was difficult to understand and there were many new vocabularies and not yet understood by the students. The average height of the percentage of the readability of the main ideas indicates that the science textbook developed
in this study can be read by the students. These results indicate that students can easily process and understand the content or information in textbooks because the described concepts use multiple representations. This was in line with research conducted by [12] that the use of multiple representations of concepts in writing science textbooks can help students better understand scientific concepts and enable them to ask questions/problems.

4. Conclusion
The textbook developed using the method of model for the process of writing instructional materials is advisable to use, it was showed that the results of the assessment of textbook quality has a percentage of 80.24% and very well categorized, as well as demonstrated from the comprehension test, the main idea of the textbook has percentage 89.1% and high category (self-categorized).

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