

# Development of Context-Based Teaching Book on Environmental Pollution Materials to Improve Critical Thinking Skills

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**Abstract**—This study aims to develop a teaching book based on context to improve students' critical thinking skills on environmental pollution materials. The research method used in this study was Research and Development (R & D) with ADDIE design (Analysis, Design, Development, Implementation, and Evaluation). The instruments used in this study consisted of expert validation sheets which were used to validate teaching materials by experts, questions about readability of teaching books, questionnaires to determine students' and teachers' responses to teaching book, and instruments of critical thinking skills. The results showed that teaching books had a good level of validation in aspects of content, presentation, and language, students' responses to teaching books were very good, the teaching book assisted teachers in the learning process, and improve students' critical thinking skills on environmental pollutions after using teaching book with N-gain of 0.33 (moderate). This indicates that context-based teaching book is useful for developing students' critical thinking skills on environmental pollution material.

**Keywords**—*context-based teaching book; critical thinking skills; environmental pollution*

## I. INTRODUCTION

Government has made various efforts to improve the quality of human resources through improving the quality of national education. Improvements which have been made include the development of the 2013 curriculum [1]. The 2013 curriculum requires a paradigm shift in education and learning, where learning is not only learning about concepts, theories and facts, but also applications in everyday life [2].

One of important factors in the learning process is learning resources, such as teaching books. Teaching books are learning resources which have been the main source of teachers and students in obtaining information. However, in reality, the existing teaching books are still general and not well structured. In addition, teaching books also cannot accommodate learning that can support daily life. The current condition of teaching books tends to be more oriented to the transfer of knowledge with the context of material that is not relevant to everyday life [3]. Context-based learning is the starting point for developing scientific thinking. The main

purpose of a context-based approach is to present scientific concepts to students through activities in daily life, so as to increase their motivation to be interested in learning science [4].

The science learning process emphasizes giving direct experience to develop competencies so that students are able to explore and understand the natural environment scientifically, they are able to foster the ability to think, work scientifically, and communicate which are important aspects of life skills [5]. In order to realize the learning objectives of science, then fostering students' thinking skills, especially critical thinking skills is very necessary.

Critical thinking skills are active, persistent thinking skills, and involve careful consideration of the beliefs or knowledge that supports them [6]. A critical individual will actively find out the truth of an information, be able to evaluate the accuracy and reliability of various arguments [7]. At present, students should be able to solve existing problems by providing solutions and expressing their opinions on environmental issues, both conveying orally or in writing. Thus, students must have good critical thinking skills, because critical thinking is a mental process to analyze or evaluate information, where information can be obtained from observations, experiences, induction and deduction processes, or communication [8].

Based on the results of preliminary observations made in one of Bogor's private junior high schools, students' critical thinking skills in the school are still in the poor category. Based on the results of the trial test, students' critical thinking skills in three classes are 65.60%; 66.57%; 67% respectively. This low ability indicates that students' critical thinking skills need to be improved. But the ability to think critically is not an ability that can develop by itself. This ability must be trained through a stimulus that requires someone to think critically. One way is through teaching books.

Junior high school science curriculum has several teaching materials that can be used to train critical thinking skills, one of the materials is the impacts of pollution in life, where students must be able to describe pollution and its effects on living things. The material is about pollution and the negative impacts that arise, so that in this material can be found some problems

in everyday life. Therefore, with the existence of teaching books based on the context of environmental pollution, students are expected to be able to develop their critical thinking skills, especially in responding to environmental problems and proposing solutions to these problems.

## II. METHOD

This research was a development research with ADDIE design consisting of five stages: 1) Analysis: analysis of potential problems that occur in science learning related to the science curriculum, critical thinking skills, and teaching books; 2) Design: the design of context-based teaching book based on the formulation of indicators and learning objectives, learning materials, and the macro structure of teaching book; 3) Development: validation of teaching materials by two experts and school teachers on the content, presentation, and language of teaching book; 4) Implementation: the application of teaching book in science learning activities in one of junior high school in Bogor City with One Group Pretest-Posttest research design [9]; and 5) Evaluation: evaluating the results of the implementation of teaching books on students' critical thinking skills, gathering students' responses to teaching books, and reflecting on the process and results of the implementation of developed teaching book.

The research subjects who involved in the implementation phase were 33 students of class VII junior high school in Bogor City. The instruments used in this study include expert validation sheets, book readability tests, critical thinking skills tests, and student and teacher response questionnaires on the developed teaching book.

## III. RESULTS AND DISCUSSION

The initial stage has been carried out in the development of context-based teaching book includes the strengths and weaknesses analysis of teaching books commonly used in learning, materials analysis in accordance with curriculum and student characteristics, characteristics analysis of existing teaching books, and design module layout analysis to build student interest in teaching books.

The results of the analysis showed that the components of the content and materials of teaching books which were commonly used are not in accordance with the demands of 2013 curriculum graduates. The existing books also did not accommodate students' character and critical thinking skills. Books' presentments have not been structured and has not fulfilled the components needed in teaching books.

Based on the results of the needs analysis, curriculum analysis, and material analysis, the draft of the teaching book was then designed with regard to curriculum, student characteristics, indicators of learning outcomes, and critical thinking skills.

### A. Design of Context-Based Teaching Book

Design of the book began with the structuring phase of teaching materials by creating a macro structure (Fig. 1). This teaching book was developed in accordance with the 2013 curriculum of class VII semester 2 by developing core

competencies and basic competencies. The teaching book prototype developed in this study contains the components presented as follows: 1) Book cover; 2) Preface; 3) Presentation of the contents of the book; 4) Table of contents; 5) Concept map of environmental pollution materials; 6) Introduction, which contains the structure of core competency, basic competency, indicators and learning objectives; 7) Material Description; 8) Competency Test; 9) Student Activities; 10) Evaluation; 11) Bibliography; and 12) Glossary.

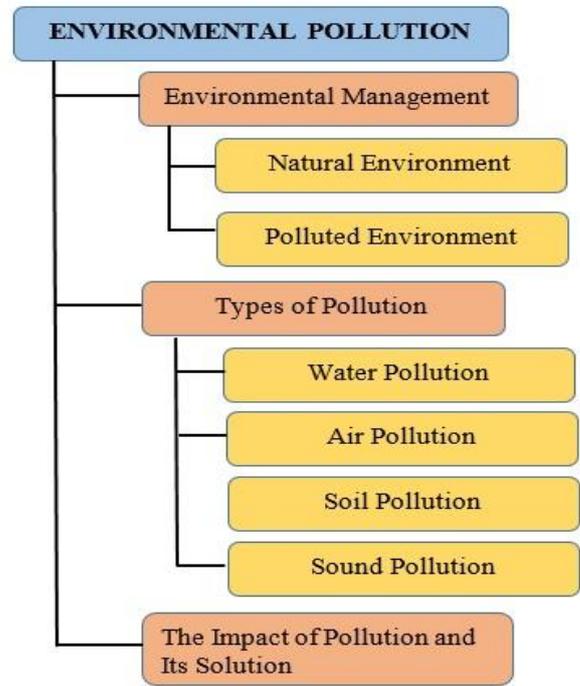


Fig. 1. Macro structure of environmental pollution context-based teaching book.

### B. The indicator of Critical Thinking Skills in the Context-based Teaching Book

Ennis reveals 12 indicators of critical thinking skills which are summarized in five thinking skill groups, namely 1) carry out elementary clarification of the problem; 2) gather basic information; 3) inference; 4) carry out advance clarification; 5) come to the best conclusion [7]. The five groups of critical thinking skills were inserted in each section of a teaching book based on the context of environmental pollution. The description of indicators of critical thinking with the context of teaching books is outlined in table 1.

After teaching book were arranged in accordance with the components and characters of teaching books, the next step was teaching book validation. Validation was very important, so that teaching book in this research was suitable for used. The results of validation by three experts on the content feasibility component obtained an average value of 85% and had a very good category.

**TABLE I. DESCRIPTION OF CRITICAL THINKING INDICATORS ON CONTEXT-BASED TEACHING BOOK**

No.	Critical Thinking Indicator	Context on Teaching book
1.	Focusing question	Ciliwung River Pollution in Competency Test 1.
2.	Analyzing arguments	Water Hyacinth Attack in Pening swamp in Competency Test 2; Waste burning in Competency Test 6.
3.	Observing and considering observation reports	Waste foam at KBT Marunda in Competency Test 3; Identify the types of pollutants in the school environment.
4.	Inducing and considering the results of induction	Water pollution and air pollution.
5.	Determine an action	Pollution in Ciliwung river in Competency Test 1; greenhouse effect in Competency Test 5; efforts to prevent soil pollution in Competency Test 7; solution to the problems of noise pollution in urban areas in Competency Test 8; and decomposition of packaging materials.

**C. Characteristics of Context-based Teaching Book**

The developed context-based teaching books have the following characteristics: (1) in accordance with pedagogical aspects, (2) can be used to improve students' critical thinking skills, and (3) equipped with images of pollution problems that can attract students' attention to reading and questions that can improve students' critical thinking skills.

To find out the level of ease in the use of context-based teaching book by students, the readability test of teaching books was carried out. The results showed that the material of environmental pollution was easy to understand (63.7%) and so was for the impact of pollution materials (62.5%). These indicated that students were easy to learn materials through the context-based teaching book.

**D. Implementation of Context-based Teaching Book**

After validating instructional materials by experts and testing the level of readability, the next step was testing the teaching book to students' critical thinking skills. The implementation of teaching book was carried out for 33 students of grade VII. Pretest was given to students before using teaching book, and posttest was given to students after they used teaching book. During the process of implementation, students used the book independently. The results of students' critical thinking skills were presented in table 2.

**TABLE II. STUDENTS' CRITICAL THINKING SKILLS**

No.	Data	Pretest	Posttest
1.	Number of students	33	33
2.	The highest score	75	90
3.	The lowest score	30	55
4.	N-gain	0.33	
5.	% N-gain	33 %	

The analysis results of students' critical thinking skills (N-gain = 33%) showed that students' critical thinking was in the medium category. It means that the context-based teaching

book has a quite impact on students' critical thinking skills. Based on each indicator, students critical thinking skills were presented in table 3.

**TABLE III. STUDENTS' CRITICAL THINKING SKILLS FOR EACH INDICATORS**

No.	Indicator of Critical Thinking Skills	Pre-test	Post-test	Max. Score	N-Gain	Category
1.	Focusing question	90	115	165	0.33	Medium
2.	Analyzing argument	97	100	165	0.04	Low
3.	Observing and considering observation reports	76	92	132	0.29	Low
4.	Inducing and considering the results of induction	59	71	99	0.30	Medium
5.	Determine an action	47	65	99	0.35	Medium
Average					0.32	
Category						Medium

Based on the data on table 3, students were low in analyzing argument. They were not accustomed to deal with problems and expressing their opinions, so it is necessary to habituate students in argumentative activity. This was due to the ability to reason and exposing evidence can be trained through learning activity [10]. Students were also low in observing and considering observation reports. This was because students have not been able to dig deeper into the level of observation in teaching books. But, for focusing questions, inducing, and determine an action, students' skills were medium. Critical thinking is a process which based on steps to analyze, examine, and evaluate arguments so that it matches the indicators that exist in critical thinking [11].

Students' and teacher's responses as users of teaching book need to be considered in this study. Based on the result of questionnaire, student's responses were in very good category with the average of 90%. The results of responses are considered very good and feasible to use if the percentage is above 80% [12]. This showed that using context-based teaching book was worthy for students in the learning process. Students were excited to the context-based teaching book for every part of reading which stimulates the context of daily life. Science learning which used enjoyable teaching book could improve students' learning motivation, educate students' critical thinking skills for individual or group, and enhance learning outcomes [13].

Teachers have positive responses regarding environmental pollution context-based teaching book. Based on teachers' questionnaire, all of the teachers agreed that context-based teaching book has interactive layout and most of them realize the benefits of teaching book. The teaching book has helped teacher in the process of learning, including materials, learning activities, until formative test as an evaluation instrument.

Process and results of learning can be affected by external and internal condition of students [14]. The application of new methods in learning will provide optimal results if the internal conditions of students were in good condition and have good readiness to carry out learning activities.

#### *E. Evaluation of Context-based Teaching Book*

The development of context-based teaching book involved evaluation and revision several times. The final evaluation was in the concept map of teaching book, glossaries, and time allocation must be taken into account because the activities of students who were so densely engaged in observation. Students' argued that they need for additional animation in teaching book to attract student learning attention.

#### IV. CONCLUSION

Context-based teaching book on environmental pollution materials was able to improve students' critical thinking skills. This teaching book has in accordance with pedagogical aspects, integrated materials with the daily context, and easily used for students in science learning activities. Context-based teaching book can be used by science teachers to prepare students' high order thinking skills especially critical thinking. So, the development of context-based teaching book should be enlarged not only for environmental pollution materials but also another topics of science.

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