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Research Article

Textbook on additives and addictive substances with a scientific-based approach, a research and development

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Abstract: Improving learning activities requires teaching materials that can accommodate students' scientific skills. This study aims to produce textbooks for additives and addictive substances with a scientific approach and analyze their validity and effectiveness. This research and development used the Borg & Gall model which consists of 10 steps. Products are validated by media experts and material experts. The product trial used a limited test with 15 students of seventh grade in junior high school. The validation results show that the product is valid and very good. Meanwhile, the results of the trial of student responses to the use of the average value of 89.13% and learning outcomes increased by 87%. Thus, the textbooks developed are very suitable for use in the learning process.

Keywords: addictive substance; Borg and Gall step; scientific textbook

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1. Introduction

Teaching materials have a role in the learning process. Teaching materials are all materials (both information, tools, or text) used in the learning process that arranges systematically and covers all competencies that will be mastered by students (Islam et al., 2014; Sharma & Pooja, 2016; Suarman et al., 2018; Weldi, 2020). The existence of teaching materials allows students to learn a competency coherently and systematically (Asrizal et al., 2018). Usually, teaching materials are independent. Students can learn by themselves because it is systematic and complete (Bahri et al., 2016; Ikram et al., 2015).

Appropriate teaching materials can generate positive interest in readers. However, developing teaching materials without a proper approach will be meaningless. A well-defined approach in the development of teaching materials is needed. One of the learning approaches that have been considered suitable for learning abstract materials is the scientific approach. Suarman et al. (2018) states that learning using a scientific approach can emphasize providing direct experience using observation, experiment, or other methods, so the information or data obtained being valid can also be considered.

The scientific approach focuses on the use of scientific methods in learning activities. It's an actual scientific process carried out by students and teachers (Hernawati et al., 2018). This approach expects students to think scientifically, logically, critically, and objectively according to the facts. These thinking skills are needed for students to face challenges in the 21-st century. The 21st-century education requires continuous mastery of science and knowledge as well as mastering various skills to enter society. The 21st-century thinking pattern emphasizes students to think more critically, integrate all knowledge with real-life, understand technology and information and be skilled in communicating and collaborating (Darling-hammond, 2014; Glaze, 2018; Osborne, 2013).

However, there are still many difficulties faced by teachers in Indonesia to apply a scientific approach to learning, including in its development of teaching materials.

Interviews were conducted with science teachers of eighth grade at SMP Negeri 1 Kokop, Bangkalan Regency, East Java, Indonesia. As a result, they only use science textbooks published by the Ministry of Education and Culture as a learning reference in the teaching process. However, the number of package books is limited, so they are used interchangeably. To support the learning process, students only have a student worksheet. Therefore, it is necessary to develop teaching materials, especially based on a scientific approach to support student learning in science classes.

Teaching materials with a scientific approach equipped with laboratory activities will empower students. Laboratory activities are needed to increase students' knowledge and skills in science or science learning activities (Bergman et al., 2013; Gardner & Gasper, 2013; Kapici et al., 2019). The laboratory is a place to prove a hypothesis through an experiment. Students can conduct experiments to prove the scientific theories they have learned in learning. Activities in the laboratory make it easy for students to understand what they are learning the material through a scientific work approach (Boltax et al., 2015; Gezer, 2015).

One of the science materials that need laboratory activities is additives and addictive substances. The observation results showed that the material for additives and addictive substances was incomplete and not comprehensive. For example, the material for artificial sweeteners only mentions four types of artificial sweeteners, while according to the Minister of Health there are six kinds of artificial sweeteners. In the identification of various additives in food and beverages, students find out by reading the composition on food and beverage packaging without being implemented directly. In addition, there are still many students who have difficulty in determining the essential material in the textbook. So that teaching materials are needed that can help improve student competencies and skills. This study aims to produce teaching material for additives and addictive substances with a scientific approach and analyze their validity and effectiveness.

2. Materials and Methods

This research and development used the Borg and Gall model that consists of 10 steps. The Borg and Gall step consist of 1) research and collection preliminary, 2) research planning, 3) early product development, 4) expert validation, 5) product revision, 6) early test, 7) product revision, 8) field test, 9) final product revision, and 10) dissemination (Figure 1). However, this study only carried out up to seven steps, until product revision. The early test was conducted on eighth grade students of SMP Negeri 1 Kokop, Bangkalan Regency, East Java, Indonesia.

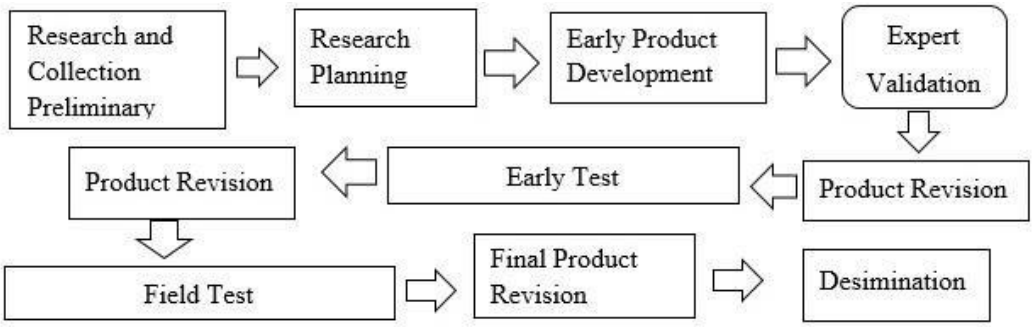

Figure 1. The steps of Borg and Gall model

The instruments used are validation questionnaires, student response questionnaires, and the implementation of textbook products. A validation questionnaire uses to assess the feasibility of the developed biology textbook draft. Eligibility criteria include eligibility criteria for material content, presentation of material, language, and graphics. The expert validation questionnaire was measured using a Likert scale scoring with the score categories as Table 1. Student response questionnaires are distributed to test subjects consisting of 15 eighth-grade students at SMP Negeri 1 Kokop Bangkalan. Student

response questionnaires were measured using the Guttman scale scoring criteria "1" for "yes" answer and "0" for "no" answer.

Table 1. The Likert scale category used for the validator questionnaire.

Scale	Category
5	Excellent
4	Very good
3	Good
2	Fair
1	Poor

The result of validation and questionnaires were analyzed quantitatively descriptively with the percentage technique. The percentage value is interpreted in terms of the criteria described in Table 2 and Table 3.

Table 2. Criteria for the validity of the results of the media and material expert assessment

Criteria	Percentage (%)	Category
A	80 – 100	Valid
B	60 – 79	Fair
C	50 – 59	Not valid
D	0 – 49	Invalid

Table 3. The category of students' response questionnaire

Scale	Category
$85 \leq \mathbf{X}$	Excellent
$70 \leq \mathbf{X} < 85$	Good
$50 \leq \mathbf{X} < 70$	Fair
$\mathbf{X} < 50$	Poor

3. Results

The results of each stage of research and development from the Borg and Gall model which are limited to stage 7 are described as follows.

3.1. Preliminary research and data collection

Preliminary research was conducted using observation and interview techniques. Observations and interviews were conducted at SMP Negeri 1 Kokop on April 17, 2018. The results show that the textbooks used in science learning in the classroom are still limited. As a result, students are more passive in learning in class. The books used for learning additives and addictive substances are good, but the presentation of the material is not comprehensive. For example, the material for artificial sweeteners only describes four types of artificial sweeteners, which should have six types. In addition, in the identification of various additives in food and beverages, it is only explained how to read the composition on the packaging without being implemented directly. The observation results also showed that students had difficulty in determining the essential material in the textbook. Textbooks owned by students have not directed students to accommodate their scientific process skills

3.2. Research planning

The research planning is adjusted to the results of the previous step and is strengthened by the analysis of the teacher's lesson plans. The analysis result of the teacher's lesson plans resulted in the existence of specific learning objectives that were developed for textbooks of additives and addictive substances. Concepts related to that substance consist of sub-chapters of dyes, sweeteners, preservatives, flavorings, flavoring agents, types of addictive substances, and the impact of using addictive substances on health. The

development of textbooks is directed at facilitating laboratory activities to hone students' scientific process skills. Therefore, a scientific approach was chosen to be the basis for its development. A textbook based on a scientific approach equipped with laboratory activities will empower students. Laboratory activities are needed to increase students' knowledge and skills in science or science learning activities

3.3. Early product development

The early stage of product design for textbooks on additives and addictive substances consists of three main parts, namely introduction, content, and closing. The introduction part of the textbook consists of five part, namely: 1) the cover (contains the title, curriculum, book user, author, study program, name of the university, year of manufacture and is accompanied by an image that corresponds to the title of the textbook); 2) the front page (contains the title, user of the book, author, validator, and the publisher); 3) a preface (contains a series of sentences from the author about the background of making the book, the activities, and the advantages of the developed textbooks); 4) a table of contents to make it easier for readers to find pages that match the desired material; 5) a user manual that contains a guide to the use of textbooks for both teachers and students.

The content section contains the main material developed following the basic competencies, indicators and learning objectives. At the beginning of the content section, a concept map is presented as a general description of the material that serves to facilitate the flow of students' thinking in studying textbooks. The material is divided into two subchapters, namely the first sub-chapter on additives and the second sub-chapter on addictive substances. The presentation of the material is equipped with an activity rubric in which there are student activities following the scientific approach, which consists of, "Let's Observe", "Reasoning", "Let's Gather Information", "Identify" "Let's Do It". At the end, a summary and evaluation questions are presented. The last part of the textbook is the cover which contains a glossary and a list of references.

3.4. Expert validation

Expert validation is carried out to assess the developed textbooks so that a valid final product is produced. Material expert and media expert validated the developed textbook. Material expert is Dr. Rr Eko Susetyarini M.Si. The material expert validates three aspects, namely: 1) the suitability of the material description with basic competencies; 2) the accuracy and correctness of the material; and 3) and learning support materials. The results of the material expert assessment can be seen in Table 4. Feedback from material experts stated that the material is appropriate and following the needs, but the author must explain the results of plagiarism and mention the source of the images in the textbook.

Table 4. The validation result of material expert

No.	Aspect	Percentage (%)	Category
1.	The suitability of the material description with basic competencies	80	Valid
2.	The accuracy and correctness of the material	100	Valid
3.	Learning support materials	80	Valid

Media expert is Dr. Atok Miftachul Hudha, M.Pd. Media experts assess three aspects of the developed textbooks, namely: 1) presentation feasibility; 2) graphic feasibility, 3) and content design. The results of the full assessment by media experts can be seen in Table 5. Feedbacks from media experts stated that there must be: 1) improvements to the images presented in the textbook; 2) improvement in the citation and must be included in the reference list; 3) improvement separation between paragraphs and paragraph spacing; and 4) improvement of illustrations that are more appropriate.

Table 5. The validation result of media expert

No.	Aspect	Percentage (%)	Category
1.	Presentation feasibility	90	Valid
2.	Graphic feasibility	100	Valid
3.	Content design	90	Valid

3.5. Product revision I

The first product revision stage is to improve the textbook according to the input of material experts and media experts. Revisions are made to the contents of the textbook. There is a revision of the existing image improvements in the textbook to make it more in line with the material of additives and addictive substances. Then, fix the illustrations used. There are also revisions of the table's addressing, writing the citation, improving paragraph spacing, and fixing font formats (bold, italic, underline).

3.6. Early test

The textbook trial phase involved 15 eighth-grade students of SMP Negeri 1 Kokop Bangkalan that reflected the heterogeneous characteristics of the academic level. The product trial was carried out with 10 questions consisting of five multiple-choice questions and five essays. Students answer the questions that are already in the textbook for 40 minutes and fill out a student response questionnaire to the developed textbook. The results of product trial (early test) data can be seen in Table 6.

Table 6. The early test results

No.	Student	Pretest	Category	Posttest	Category
1.	R.T.	85	Complete	93	Complete
2.	U.H	77	Complete	85	Complete
3.	I.S.	75	Complete	81	Complete
4.	S.Y.F.	80	Complete	91	Complete
5.	B.V.	73	Complete	89	Complete
6.	H.O.	72	Complete	94	Complete
7.	S.Y.	60	Incomplete	68	Incomplete
8.	T.A	76	Complete	78	Complete
9.	N.H	65	Incomplete	74	Complete
10.	R.T.	74	Complete	80	Complete
11.	I.N.	66	Incomplete	78	Complete
12.	I.D.	82	Complete	96	Complete
13.	R.O.	62	Incomplete	84	Complete
14.	A.B.	60	Incomplete	70	Incomplete
15.	R.L.	65	Incomplete	77	Complete
Completeness percentage (%)		**60**		**87**	

Table 6 shows an increase in the completeness percentage, which previously increased from 60% to 87%. Furthermore, student responses were also measured after using the developed textbook. The results of the student response questionnaire get an average percentage of 89.13% which is included in the excellent category.

3.7. Product revision II

The second product revision stage is to make revisions based on the results of the responses from the early test to students. Based on the product trial (early test) data, it shows a very significant difference, from 60% to 87%. So that, the developed textbook can be re-tested in a wider class (field test). The developed textbooks need improvement to reach the perfect stage, after being revised, the production of textbooks can be increased for use in other institutions.

4. Discussion

The validation results show that the textbooks developed based on the scientific approach are valid, both from material and media experts. It can be seen that textbooks can be used without revision because according to material experts, the overall content of the material, illustrations, and questions is appropriate and meets competency standards. However, some revisions were made to adjust the images and some writing formats in the textbook. The textbook which was developed based on this scientific approach is following the demands of the education curriculum in Indonesia. Like several previous studies which state that the scientific approach can fulfill the competence of the realm of knowledge and skills and is presented by the demands of the curriculum (Asrizal et al., 2018; Fajarianingtyas et al., 2019; Ibrohim, 2015; Novianto & Mustadi, 2015; Setiyadi et al., 2017). In addition, textbooks related to additives and addictive substances are supported by presentations that are coherent with the thought process through a scientific approach. This makes it easier for students in the learning process to direct their scientific thinking process skills. The existence of practice questions also provides benefits for measuring the achievement of student competencies. As some researchers mentioned that textbooks need to include an evaluation of students' thinking processes as a reflection of their learning (Anista et al., 2016).

The results of the early test showed an increase in the completeness percentage of students from 60% to 87%. This shows that there is a positive change due to the use of the developed textbook. This is because the laboratory-based scientific approach to material additives and addictive substances that have been developed is very good for use as teaching materials in science learning. Some research prove that learning science is not only focused on cognitive outcomes, but by learning science students will be able to develop scientific skills and attitudes (Awalliyah et al., 2015; Listiani et al., 2016; van Aalderen-Smeets et al., 2017; Zubaidah et al., 2018). The results of the early test were also strengthened by student responses which stated that the textbook material on additives and addictive substances was in the excellent category (89.13%). This is in line with Setiyadi et al. (2017) with research results that textbook developed based on a scientific approach are good for use in learning. According to Wahyuni (2018) learning using a scientific approach is learning that emphasizes providing direct experience using either observation, experimentation or other means, so that the reality that will speak as information or data obtained besides being valid can also be accounted for.

5. Conclusions

The conclusion that can be drawn from research and development shows that textbooks on additives and addictive substances developed based on the scientific approach are declared valid by material experts and media experts. Meanwhile, the student responses result is 89.13% (categories as excellence) and the percentage of student learning completeness increased from 60% to 87% (early test). Thus, the developed textbooks are suitable for use in the learning process, but still need to be continued in the next R&D stage, namely field trials, final product revision, and dissemination. Furthermore, textbooks can be used to support student learning processes.

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