The feasibility and readability test of stem-based integrated science teaching book model themed “blood as transportation system on our body”

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Abstract. This study aims to examine the feasibility and the readability tests of STEM-Based Integrated Science Teaching Book Model Themed “Blood as Transportation System on Our Body”. The research was done on using quantitative descriptive methods. The subjects were 60 8th Junior High School Students and 8 Science Junior High School Teachers. The feasibility tests were done based on BSNP assessment guidelines. The research showed that the qualities of science teaching book are feasible to use as resources and guidance for students. It was also found that the ease of understanding and reading makes this book acceptable and liked by students.

1. Introduction

Innovations on the development 21st century learning are needed to bridge the gap between educational system and the current global crisis. The 21st century learning teaches students to improve skills and competencies so they can overcome global challenges [1]. Students are taught to think critically, communicate effectively, innovate and solve problems through collaboration.

In science learning, one of the learning innovations that can accommodate the demands of 21st century learning is STEM education. STEM education has the main goal of building STEM literacy and 21st century competency [2]. STEM education is a learning activity that integrated science, technology, engineering, and mathematics. In its implementation, STEM education can be included in conventional subjects such as science and mathematics which are combined with engineering and technology [3].

The implementation of STEM education in schools requires contributions from the science education community (colleges, teachers, and lecturers). According to [4], science education community can be contributed on innovative models of STEM education-based learning units and teaching materials that are proven by scientific research. The science teaching book model is one kind of teaching materials. The urgency regarding the need for science teaching books that support STEM education must be immediately fulfilled by developing a science teaching book. The researcher has developed a STEM-Based integrated science teaching book model that have integrated themes. Before it can be used for learning, science teaching books must be evaluated in advance to meet the eligibility criteria and the quality of science teaching books [5]. This study aims to describe the feasibility criteria of science teaching books based on BSNP assessment guidelines and the readability of science teaching book.
2. Methods
The research method used was quantitative descriptive method [6]. This research method explain research result using descriptions based on quantitative data obtained.

The feasibility test was using feasibility instrument. The feasibility instrument was used to review the feasibility of science teaching books from four aspects such as content, linguistics, presentation, and graphics. The indicators were adapted from the BSNP assessment guidelines [7]. This instrument was given to 8 Science Junior High School Teachers. The analysis of the feasibility of the textbook are from average scores of each indicator on each aspect. The average scores of each aspect then compared with the criteria for the feasibility categories as found in the following table 1.

| Average Score | Criteria   |
|---------------|------------|
| 1.00 – 1.49   | Poor       |
| 1.50 – 2.49   | Fair       |
| 2.50 – 3.49   | Good       |
| 3.50 – 4.00   | Excelent   |

The readability test was using readability test rubric. Readability test rubric contains the key of main ideas and statements of each paragraph on science teaching books. Readability tests were given to 60 8th Junior High School Students. This instrument was used to collect information about rough sentences such as abstract, complex, and difficult. The rough sentences then modify and corrected using didactic reduction methods. After didactic reduction methods was done, the readability test was re-performed. The analysis begins with scoring of each paragraph then the score was categorized using readability categories by [8] as in the following table 2.

| K            | Criteria |
|--------------|----------|
| 60% < K ≤ 100% | Easy    |
| 40% < K ≤ 60%  | Moderate |
| K ≤ 40%         | Difficult|

3. Result and Discussion

3.1. Feasibility
Feasibility of science teaching books consist of four aspects, there are content, language, presentation, and graphics. The results of the feasibility of science teaching books are described below.

| Indicators                   | Average Score | Criteria   |
|-----------------------------|---------------|------------|
| Coverage of concepts        | 3.84          | Excellent  |
| Contains insight into productivity | 3.56          | Excellent  |
| Stimulate curiosity         | 3.50          | Excellent  |
Based on Table 3, it is known that all sub-aspects of the contents meet the criteria of good and excellent. Overall, it shows that the content of the science teaching book already sufficient to curriculum demand, and accommodates integrated science learning.

The feasibility of science teaching books can be seen from the content that are depth and breadth in accordance to curriculum demand, moreover the contents are suitable with the level of student cognitive development. The science teaching book should be developed in accordance of national curriculum demand, so the science teaching book are able to accommodates national learning objectives such as improves student’s competency, especially in science and technology and give benefits to the society [9].

The contents of science teaching books should support learning objectives [10]. The science teaching book has a integrated concept into one theme. The science teaching books that have integrated concepts and have appropriate activities are able to encourage students to gain experience from learning science phenomena directly [11]. Representation of phenomena can provoke curiosity of students so the students can be active participate in discussions that enhance insight in community and social [12].

Table 4. Language of science teaching book

| Indicators                                      | Average Score | Criteria   |
|------------------------------------------------|---------------|------------|
| Conformity with the development of students.  | 3.63          | Excellent  |
| Communicative                                 | 3.81          | Excellent  |
| Dialogical and interactive                    | 3.56          | Excellent  |
| Straightforward                                | 3.69          | Excellent  |
| Coherence and chaos of thought                 | 3.81          | Excellent  |
| Compatibility with language rules             | 3.75          | Excellent  |
| Use of symbols and symbols                    | 3.88          | Excellent  |

On Table 4 shows that the language used in science teaching books are excellent, especially on the use of terms and symbols, communicative symbols, coherence, logical thinking, but still have lacks on dialogical and interactive sub-aspects.

The use of language in science teaching books is one form of relationship between humans, nature and social. On science teaching books, language selection is selected through the Readability test and
didactic reduction methods. From those process, it will be known the suitability of the language. The use of language in science teaching book are similar with the use of language in science learning, language is used to convey the nature phenomena which is involve humans in making, modifying, and supporting these phenomena indirectly [13]. The use of terms, symbols, and symbols in science learning must be used appropriately in order to provide an in-depth understanding of the nature, communicative and not lessen the interest of students. Those are important because there are many terms and symbols used in science learning but student still odd with it [11, 14].

Table 5. Presentation of science teaching book

| Indicators                   | Average Score | Criteria |
|-----------------------------|---------------|----------|
| Presentation Techniques     | 3.88          | Excellent|
| Presentation Supporting Concept | 3.89      | Excellent|
| Systematically              | 3.55          | Excellent|

Based on Table 5, it is known that the presentation of the textbook is excellent. The science teaching book has described the concept systematically and accurate. The science teaching book also have features that support the use of the science teaching books, such as reading guidance, concept maps, summaries, glossaries, and index lists to facilitate students while using the science teaching book.

The presentation of science teaching book follows book organization by [15, 16], which divides the book into four parts, such as cover, preliminaries pages, contents section, and postliminaries pages. In addition, the presentation also includes illustrations of the content page such as tables, quizzes and other book features. According to [10], a good science teaching book can be seen in the organization and features of the science teaching book. A good science teaching book presentation must provide readers with information about the topics presented on the covers, the objectives of the science teaching book, and other supporting features that are communicative and the illustration spoil the eye [17].

Table 6. Graphics of science teaching book

| Indicators                                           | Average Score | Criteria |
|------------------------------------------------------|---------------|----------|
| Cover design using letters that are interesting and easy to read | 3.69          | Excellent|
| Cover design using letters that are simple and communicative | 3.38          | Good     |
| Illustration of cover design                         | 3.63          | Excellent|
| Layouts inside book are consistent                    | 3.70          | Excellent|
| Layouts inside book are harmonious                    | 3.84          | Excellent|
| Layouts inside book accelerates understanding         | 3.63          | Excellent|
| Layout inside book using simple typography            | 3.88          | Excellent|
| Typography is easy to read                           | 3.38          | Good     |
| Typography facilitates understanding                  | 3.46          | Good     |
| Illustration inside book                              | 3.41          | Good     |
Based on Table 6, it is known all sub-aspects have good and excellent criteria starting from the design of the cover page to the design of contents on the science teaching book. The excellence is included the simplicity of typographic and layout harmony. The understanding and readability the typography and the illustration of content have the good criteria.

Visual and textual are the main graphics components of a science teaching book. In science teaching books, visual and textual components are essential components that trigger student cognitive processes [10]. A good science teaching book should have sufficient textual and visual, especially the visual because most scientific concepts are abstract so that they require depiction of concepts in reality.

A harmonious layout and simple typography in science teaching books is shown by the systematic illustration that are almost always on the right side of the page. The illustration is related to the paragraph beside it. The integration between paragraph concepts and the illustration makes the conveyance of concepts easier [18, 19]. Simple typography is indicated by the length of the sentence in each paragraph of no more than five sentences and the least insertion of importance terms. According to [20], the important terms taught to middle school students are ideally around 5-7 words every two weeks.

3.2. Readability
The readability test of science teaching books is useful to assess students' understanding after reading the science teaching book. The readability is the ability of students to understand the meaning of the concept / paragraphs. The tests are writing the main ideas from the paragraph and collect the opinions of students about a concept in the paragraph which is easy or difficult. Writing the main idea was chosen because by writing the main idea using the student own language, that is indicated that student understand the concept of the paragraph.

This readability test was done twice, before and after didactic reduction methods. The repetition test was done to see the effectiveness of the sentence after improvement and refinement on the didactic reduction methods. The results of readability test shown as found in the following table 7.

| Criteria     | Phase 1 | Phase 2 |
|--------------|---------|---------|
| Easy         | 65 paragraph | 69 paragraph |
| Moderate     | 19 paragraph  | 22 paragraph |
| Difficult    | 2 paragraph   | 0 paragraph |

Then the graph below shows the presentation results of the readability test of science teaching book.

![Figure 1. Persenation of improvement readability test](image)

Based on the figure 1, there is an increase in the easy category of 0.24%, the medium category is 2.09%, and the difficult category decreases by 2.33% or there are no difficult paragraphs anymore. This shows that the didactic reduction methods are successful reduces the difficulty level of science teaching book.
The results of the student opinion about the paragraph, on readability test phase 1, 67.80% students were confidence stated that the overall paragraph of the science teaching book was easy, and the remaining 32.20% of students considered that the overall paragraph was difficult. On the readability test phase 2, 71.87% of students were confidence stated that the overall paragraph of the science teaching book was easy, and 28.13% of students considered the overall paragraph was difficult. Therefore it is shown that students opinion about overall paragraph was easy increased by 4.07%.

The readability is defined as the ease of reading comprehension of the writing style [21]. Paragraph that is easy to read increases the ability of reading speed, perseverance in reading, retention and knowledge of the student. When the students are reading a new paragraph, motivation, interests, reading skills and prior knowledge affect the students. From the results of the readability test, it is shown that science teaching books have a good writing style, characterized by simple sentence structure, appropriate length of words, each paragraph does not contain the concept are overlapping and not using too many new terms [10, 21]. Furthermore, sentences that are easily understood by students are sentences that are close to the daily lives of students and described easily [22].

4. Conclusion
The STEM-Based integrated science teaching book model themed “Blood as transportation system on our body” are feasible to use as resources and guidance for students in accordance with BSNP assessment guidelines. The science teaching books have appropriate and sufficient concepts, the use of language are communicative and coherent. The organization of the teaching book, visual, and textual are systematics, and the layout are harmonious. It was also found that the ease of understanding and reading makes this book acceptable and liked by students. The ease of understanding and reading can improve the ability of reading speed, perseverance in reading, knowledge, and student’s interest.

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