The science encyclopedia based on characters to improve the natural science concepts understanding in elementary school students

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Abstract. This study is development research aimed to develop a character-based Science Encyclopaedia to improve the concepts understanding in students. The product validation was conducted by media expert, material expert, learning expert, students, and teachers. Data were gathered using questionnaires, interviews, and tests. Then the data were analyzed quantitatively and qualitatively. The validation results of media expert showed that the product is in the "good" category (79.80%), the material expert gave a "very good" category (98.87%), and the learning expert gave a "very good" category (86.90%). The total score of 2 teachers is "good" category (79.73%), while 60 students response is a "good" category (85.64%). The effect of this encyclopedia was measured by comparing the mean of the pre and post-test. The mean of posttest score (78.92) is higher than the one of pretest score (64.05). From the t-test, the encyclopedia has the significant effect on the students' conceptual understanding. It means the Science Encyclopaedia can improve students' understanding significantly. The gain score of the student achievement using the Science Encyclopaedia based on characters of curiosity and reading interest influence significantly to the students' literacy and concepts understanding in science learning.

1. Introduction
The education system has mandatory to educate intelligent human resources intellectually, socially, and spiritually. Cultivating character education is not only done through knowledge transfer/training a particular skill, but also through the essential process, model example [1], and habituation or culture in the students’ environment. Cultivating characters and values can be integrated into the learning process [2]. Through natural science learning in elementary school, students are expected to be better prepared and have good literacy of science in order to be able to integrate STEM (science, technology, engineering, and mathematics) in the future [3,4]. In principle, Natural Science learning in elementary schools provides students with the ability to know various ways and how to do it that can help students understanding the environment [5,6]. Research related to the integration of character formation in science learning will support the possibility of scientific concepts internalization to students. Then, it will reduce the possibility of misconceptions in science.
Nowadays, researches in science learning at the elementary school tend to emphasize STEM learning aspects, directed to the learning experience of applying Natural Science [7-9]. The result explains that students who have good character will be different from ordinary students. There is a correlation between the implementation of character education and students’ learning achievement [10]. Curiosity is a sense or desire within people that encourage or motivate them to want to know new things and expand knowledge with the scientific behavior of exploration, investigation, and learning [11]. There are many studies on science learning media to improve learning performance in elementary schools, but there are still relatively few studies that link reading skills and habits with learning performance. Some findings show that reading interest is the attention or preference of the heart to read, in which the character of likes to read needs to be nurtured, fostered, directed, and developed from an early age, adolescence, to adulthood involving the role of parents, communities, and schools [12,13].

In the daily teaching and learning activities, science learning tends to focus on mastering the knowledge as information only. Teachers still have not paid attention to reading habits as an important factor in learning success. Improved reading habits facilitated with various reading media that are relevant to the material will improve science learning performance. Comprehensive reading media and associated with various real phenomena is the encyclopedia of science. By paying attention to these problems, this study aims to develop an encyclopedia of science based on the character of curiosity and reading interest that is feasible and validated in relevant learning environments.

2. Method
This study is Research and Development (RnD) using ADDIE (Analyze, Design, Develop, Implement, and Evaluate) approach. The experts (learning media expert, subject matter expert, and elementary school teacher) validated the product qualitatively and quantitatively using the specific instruments. After the validation, we measured the learning effect by giving the understanding test to students. The users who give the product response were fifth-grade students and teachers of Muhammadiyah Pakel Elementary School and Muhammadiyah Karangkajen Elementary School. The number of the individual product testing phase were three students, of the small group trial phase were twelve students, and of the field trial phase were 30 students. We conducted pretest and posttest to measure the learning improvement. The data analysis techniques were descriptive statistics, inferential statistics, and qualitative data analysis.

3. Result and discussion
This research has succeeded in developing the Science Encyclopedia integrated with the characters of curiosity and love to read. The subject of the Science Encyclopedia is Human Digestive topic for fifth-grade elementary school. The result of each phase is as follows.

At the analyze phase, researchers conducted a need assessment, analysis of students' characteristics, curriculum analysis, and analysis of learning materials. During the interview with the teacher indicated that students' needs for enrichment teaching material in the form of the encyclopedia were very high. As far, teaching materials are student thematic books and teacher manuals. Therefore, teachers must be creative to add external learning resources. The developing encyclopedia would be handy to enrich students. The fifth-grade student is in a concrete operational to a concrete formal. At this phase, the encyclopedia would support the student need. The abstract material was presented using pictures and information following the original conditions to help students constructing the abstract knowledge. The Latin font material and terms were taught a particular sign and emphasis, so to facilitate the eye performance in delivering the concepts to the brain. Curriculum analysis showed data about the suitability of learning outcomes, learning objectives, learning indicators, and learning materials. Strengthening the character education in this encyclopedia focuses on curiosity and love to read, which the primary capital of literacy is also.

At the design phase, researchers compiled a storyboard and flowchart of the science encyclopedia. Storyboard and flowchart became the initial design of structuring the Science Encyclopedia concepts...
developed in the next stage. At the development phase, researchers fill out a series of storyboards and flowcharts with more complete concepts and materials. The parts developed were the introductory part, learning outcomes, user instructions for teachers and students, mind mapping, primary materials, news flash, quizzes, indexes, references, biographies. Table 1 shows the composition of the Science Encyclopedia material.

Table 1. The composition of science encyclopedia materials.

| Ch. | Material                          | Development Description                                                                 |
|-----|-----------------------------------|-----------------------------------------------------------------------------------------|
| I   | The concept of the Human Digestive System | Digestive organs; Events that occur in each organ; The function of every digestive organ |
| II  | Digestive Organ Disorders         | A toothache; Thrus, Gastric ulcer; Diarrhea; Magh; Dental caries; Constipation; Appendicitis; Intestinal thrush; Dysentery; Vomiting And Defecation; Worms |
| II  | Maintaining Digestive Organ Health| Seven steps to maintain health, i.e. Regular tooth brushing; Chewing food delicately; Drinking fresh water; Avoiding hot and cold foods; Using a healthy tool; Regular eating and balanced nutrition; Maintaining healthy environmental hygiene |
| IV  | Food and health correlations      | Nutritious food; A balanced, nutritious food menu; Processing food well                 |

The highlighted part of this encyclopedia is the character of curiosity and reading interest integrated into the science encyclopedia. Feelings of curiosity are trained using the "news flash" and "quiz" sections. Curiosity-based learning can be carried out with the help of Science Encyclopedia. The curiosity-based learning mechanism covers these activities: observe & examine, investigate, acquire,
categorize & visualize, communicate, review & discuss; and curiosity [14]. The implementation phase was including the trial of Science Encyclopedia in several participants (see Table 2).

**Table 2. Participants in the product-testing phase.**

| Participant | Number | School place of the participant |
|-------------|--------|---------------------------------|
| Individual  | 3 students | Muhammadiyah Karangkajen Elementary School |
| Small group | 12 students | Muhammadiyah Karangkajen Elementary School |
| Large group | 30 students | Muhammadiyah Pakel Elementary School |
| Teachers   | 2 teachers | Muhammadiyah Karangkajen Elementary School & Muhammadiyah Pakel Elementary School |

At the individual testing phase, the researchers assisted maximally and guided the discussion. Starting with students read the user instruction of the Science Encyclopedia, then students immediately read and look for the desired material. Students quickly understand the instructions and easily understand the material. The instructions section of the encyclopedia helped the teacher because students quickly understand the instructions. Teachers easily conveyed and understood the flow of material presented. Students were very enthusiastic, interested, and motivated by the encyclopedia display/appearance. Students could readily understand the language used in the science encyclopedia. Table 3 shows the result of the assessment of the Science Encyclopedia.

The validation score from the media expert is 79.80% (Good). Concerning the content quality and the purpose is useful. Compliance with Core Competencies, Basic Competencies, and Indicators is perfect. Science Encyclopedia is following students' needs, level of thinking, and can foster students' learning motivation. The components in the Science Encyclopedia are complete and complex, and also contain the development of learning material innovations. For the development of curiosity character value, new things, the developer have added the news flash.

**Table 3. Quantitative assessment of the science encyclopaedia.**

| Participant         | Score | Category |
|---------------------|-------|----------|
| Media expert        | 79.80 | Good     |
| Material expert     | 98.87 | Very Good|
| Learning expert     | 86.90 | Very Good|
| Students (individuals) | 84.58 | Very Good|
| Students (small group) | 88.65 | Very Good|
| Students (large group) | 83.70 | Very Good|
| Teacher of School 1 | 81.03 | Very Good|
| Teacher of School 2 | 78.44 | Good     |

| Total               | 681.97 |
| Mean                | 85.25  |

Furthermore, there is a short quiz/question that can increase students' enthusiasm for learning to know more things. The development of the character value of reading interest is developed through a colorful, attractive media display, accompanied by visual images that are appropriate to the material, and also not boring. The writing presented is not full of text, but also illustrations and supporting pictures so that students will be more interested in learning. Therefore, students will not be bored to read. The use of learning media in the teaching and learning process in the classroom can improve the effectiveness and efficiency of the learning process, and also can significantly improve students' learning outcomes [15,16].

The score from the material expert is 98.87% (Very Good). The expert comment for this aspect are:
For the content feasibility, Science Encyclopedia has been very much under the Core Competencies, Basic Competencies, and Indicators of Natural Science in 5th-grade elementary school. The Science Encyclopedia is under the learning objectives, which is the digestive system material as a whole.

For the scope of the learning material contained in the Science Encyclopedia is sophisticated, easy to understand, and can motivate students' learning according to the validity and up-to-date material. The application of real-world scenarios is an effective strategy to teach science as a process [17]. Natural Science is a subject that reveals various facts. Similarly, the material raised in the Science Encyclopedia emphasizes on the material taken from the surrounding environment, the connection between the example and the student's residence becomes the innovation of material development according to the development of sciences.

Therefore, it helps students to learn because the material in the Science Encyclopedia is familiar to the students. Besides, students can practice directly. Material presentation techniques are interrelated, systematic and coherent. The development of the Science Encyclopedia is very critical to elaborate the complex material or subject. The score from the learning expert is 86.90% (Very Good). The suggestion was:

- Reviewed by the accuracy of the teaching purpose and the students' level development, the Science Encyclopedia is very much in line with Learning Outcome and Indicators of Science subject in fifth-grade elementary school. The Science Encyclopedia is following the learning objectives of the complex digestive system learning material. Indirectly, the Science Encyclopedia can shape the students' character, especially characters reading interest and curiosity. The objective in the natural science learning means the inclusion in the values of character education in learning in class and outside the learning process. So it is expected that the input of character education values will be well embedded in students that formed into a character. Also, the implementation of character education is closely related to students' learning achievement.

- Based on the observation on the suitability of the material, Science Encyclopedia can help teachers and students in the teaching and learning process. Science Encyclopedia is suitable to use as enrichment and companion for students in a group and independent learning. There are learning material that eases to be understood supported by illustrations and pictures, and also the linkages of the examples with the surrounding environment.

- Based on the observation of the learning media and usage skills, Science Encyclopedia can motivate students in learning. Science Encyclopedia is comfortable and practical to use, and also can provide students' learning opportunities. The Science Encyclopedia component is quite complete and complex. The user instruction makes it easy for teachers and students to use and interaction in learning.

In the interview, teachers and students stated that the Science Encyclopedia is an absorbing learning media. This Science Encyclopedia has advantages such as the learning material presented is complete. Besides, the layout is proportional, attractive pictures, design, and color. This Science Encyclopedia is comfortable and practical to use. The following are the results of interviews conducted with the teachers. The concept and content are very suitable with the teaching purpose (learning outcomes and indicators). In the observation of the Science Encyclopedia product, this encyclopedia components is complete from the cover page to the authors' autobiography and back cover with a synopsis. The user instruction makes it very easy for students to find the desired material quickly. The character value in the Science Encyclopedia is constructive for students in attracting reading interest. It is equipped with colors, pictures, and short writing. Whereas for curiosity, the Science Encyclopedia is accompanied with the information about the environment around students. In the interview, students give a positive response to the Science Encyclopedia. This one is fascinating from the cover page to the back cover. Science Encyclopedia is easy to use and not dull to read. There are many new terms and information that is not known, so that broadens the horizons supported by an orderly page layout, and also there are links between pages.
At the evaluate phase, the researchers analyzed the research data in the form of encyclopedia feasibility assessment by a team of experts and participant. All validators gave a “good” or “very good” category for the encyclopedia. It means that the media is suitable to be used in Natural Science learning. The encyclopedia's potential was tested using pre and post-test as mention in Table 4.

Table 4. Paired samples statistics.

|       | Mean (Std. Error) | Mean (Std. Error) |
|-------|------------------|------------------|
|       | Pretest           | Posttest          |
| Pair 1| 64.0513 (12.68432)| 78.9231 (13.42108)|
|       | N 39              | N 39              |

The mean of posttest score (78.92) is higher than the one of pretest score (64.05). It means the Science Encyclopedia can improve students’ understanding significantly. From the correlation analysis, indicates that there is a pretest-posttest correlation in students’ concepts understanding in using the Science Encyclopedia at alpha equal to 0.05. The correlation is 81.30% which shows the contribution of Science Encyclopedia variable. Then, the contribution of other factors to the conceptual understanding is 8.70%.

4. Conclusion

The Development of the Science Encyclopedia in this research using the ADDIE model that consists of Analysis, Design, Development, Implementation, and Evaluation, has been developed by researchers and is suitable for fifth-grade students of elementary schools. Science Encyclopedia contains material about the digestive system that is associated with the surrounding environment and also based on character. Science Encyclopedia can be used independently or in groups. Feasibility tests are based on experts’ assessments, teachers’ responses, and students’ responses. The overall product test results obtained a value of 85.25 (Very Good). The experimental results give a depiction that the Science Encyclopedia based on the characters of curiosity and reading interest has a significant influence on the students' concepts understanding of Science learning. Science Encyclopedia also able to train the characters of curiosity and reading interest.

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