

Development of Science Learning Digital Media: Encyclopedia of Human Respirational Organs for Elementary School Student

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ABSTRACT

This research aims to determine the feasibility and effectiveness of products in digital encyclopedia learning media. Research and development use the Dick and Carrey development model which consists of 10 steps: (1) identifying objectives, (2) conducting instructional analysis, (3) analyzing students and learning contexts, (4) formulating performance goals, (5) developing assessment instruments, (6) developing instructional strategies, (8) designing and implementing formative evaluations, (9) teaching revisions, (10) designing and implementing summative evaluations. The results of research on digital encyclopedia learning media products developed have shown that: (1) media expert feasibility validation test gets a percentage of 74%; (2) linguist feasibility validation test gets a percentage of 90.91%; (3) material expert feasibility validation test gets a percentage of 90%; (4) product feasibility test by a small group gets a percentage of 78.58% and product effectiveness test gets 0,62; (5) the product feasibility test by a large group gets a percentage of 86.67% and the product effectiveness test gets 0,54. So it could be concluded that the digital encyclopedia as learning media could be applied in elementary school and it is effective for elementary school students.

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Introduction

The condition of the Covid-19 pandemic has posed challenges to the world of education, such as changing the learning process to go online, resulting in a minimum of active interaction between teachers and students directly. In optimizing learning in a pandemic situation, it must be carefully designed and implemented learning media to be able to encourage the learning process and provide a deep understanding of the material presented (Annisa & Sholeha, 2021; Sumar & Razak, 2016). However, learning activities are currently carried out directly in class or face-to-face, so that more interaction between teachers and students can be created and the use of learning media can be designed more creatively so that students are enthusiastic about independent learning.

Science learning is basically a field of science that understands and studies the natural environment and needs to be given to hone students' thinking skills. Through the Trends in International Mathematics and Science Study (TIMSS) survey organized by the International

Association for the Evaluation of Educational Achievement (IEA), an international association body for assessing achievement in grade 4 elementary school and 8 junior high school from 1995 until the last was held in 2019 (Hadi & Novaliyosi, 2019; Munaji & Setiawahyu, 2020). However, in 2019 Indonesia did not have the opportunity to participate. Based on the 2015 TIMSS, elementary science literacy in Indonesia ranks 44th out of 47 countries with a score of 397, this is far below the international average of 500. Based on the results obtained, it shows the low science learning outcomes of elementary school students in Indonesia. Science learning is considered as one of the subjects that is difficult to understand, because the teacher is monotonous in learning activities and influences the material received.

Based on the results of a preliminary study in the form of interviews and observations as a needs analysis carried out on the learning process for class V-B at SDN Kuningan Barat 01 South Jakarta, learning activities in class are still monotonous, namely the delivery of material is only one-way sourced from the teacher and thematic books. This is not effectively carried out during current learning activities, due to the lack of enthusiasm for student learning independently and the limitations of the learning media used because they are less varied.

Learning media is anything that can be used to channel messages from a teacher to students that can stimulate students' thoughts, feelings, attention and interests, so that the learning process occurs (Nurdyansyah, 2019). The use of learning media can represent a lack of delivery of material, so that the practical value of the media can be felt directly by teachers and students. An encyclopedia is a list of scientific terms with additional brief information about the meaning of these terms (Prastowo, 2018). Therefore, researchers want to develop digital encyclopedia learning media products that can be used as an alternative source of student learning in understanding learning material and are designed according to the needs and characteristics of students.

Based on the success of previous research and development related to the development of digital encyclopedia learning media, namely as carried out by Rochimah (2018) in the development of encyclopedia-based teaching materials on the theme of animal and plant breeding, sub-theme of animal breeding and life cycle to increase understanding of third grade elementary school students shows that the results of validation by material experts get 81.33% declared valid, the results of validation by learning experts get 90.76% are declared very valid, the results of attractiveness get 84% are declared very valid, the value of the pretest results get the average the average student learning outcomes is 60.19 and the posttest results get an average student learning outcome of 85.2. This shows that the development of encyclopedia-based teaching materials is valid to use and influences learning outcomes.

Based on the previous research explanation, it can be concluded that the development of digital encyclopedia learning media products for science learning is very important, because it can be used as a reference material to increase knowledge which can improve students' understanding of material so that learning objectives can be achieved in class. Science learning is one of the subjects given to elementary school students which discusses events that occur in nature and are close to students' lives (Hutauruk & Simbolon, 2018; Salim Nahdi et al., 2018). So, researchers want to develop digital encyclopedia learning media products for science learning that are equipped with audio explanations and are designed according to the needs and characteristics of students. Learning activities by applying digital encyclopedias aim to increase students' self-learning enthusiasm, because visual or audio explanations are available as information on learning materials.

Method

This research was carried out using the Research and Development (R&D) method with the Dick and Carrey model. The Research and Development method is a research method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2016). Research and development are always carried out to realize updates and improve existing products. The selection of methods and steps is aimed at answering problems that can be applied to research situations (Rusdi, 2018). Research and development of the Dick and Carrey (Dick et al., 2015) model consists of 10 steps, namely: 1) identify instructional goal, 2) conduct instructional analysis, 3) analyze learners and contexts, 4) write performance objectives, 5) develop assessment instruments, 6) develop instructional strategy, 7) development and select instructional media, 8) design and conduct formative evaluation of instruction, 9) revise instruction, 10) design and conduct summative evaluation.

Research and development were carried out in class of fifth grader elementary school in south Jakarta with a total of 30 students. Before being applied to students, the product was validated by media experts, linguists, and material experts, then a small group of 7 students conducted a feasibility and effectiveness test and a large group of 30 students tested the feasibility and effectiveness of the product.

Qualitative Data Analysis

Qualitative data are all materials, information, and facts that cannot be measured and calculated mathematically because they are in the form of verbal information (sentences and words) (Pohan in Chairunnissa, 2017). Qualitative data analysis was obtained from comments and suggestions from the results of the feasibility validation test of media experts, language experts, and material experts as a reference for product development design revisions.

Quantitative Data Analysis

Quantitative data were obtained from the results of the assessment of the due diligence data processing of media experts, linguists, material experts, small (limited) group tests, and large group tests using a likert scale.

Table 1. Category Quantitative Data Analysis

Category	Score
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

The simple percentage formula used to calculate the overall data from the evaluation of digital encyclopedia learning media material for the human respiratory organ system (Sugiyono, 2016):

$$x = \frac{\text{Total score}}{\text{Max score}} \times 100$$

After calculating the average, the following references are used to make it easier to explain the results of the validation data that has been calculated and then given a score interval (Sugiyono, 2016):

Table 2 Category of Validation

Score Intervals	Category	Criteria
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81% - 100%	Strongly Agree	No Revision
61% - 80%	Agree	No Revision
41% - 60%	Neutral	Need Revision
21% - 40%	Disagree	Revision
0% - 20%	Strongly Disagree	Revision

Other quantitative data were also obtained from the gain normality test (N-gain), which is a test that can provide an overview of the increase in learning outcomes scores between before and after the application of a treatment (pretest and posttest) (Hake in Sundayana, 2014). The criteria for the success of the N-gain score (Sundayana, 2014):

Table 3 N-gain Category

Nilai N-gain	Kategori
$(g) \geq 0,7$	High
$0,3 \leq (g) \leq 0,7$	Medium
$(g) \leq 0,3$	Low

Results and Discussion

Identify Instructional Goal(s)

The initial stage carried out by researchers was to conduct a preliminary study in the form of joint interviews with the homeroom teacher and several students. Based on the results of the interviews that the researchers conducted, learning was carried out still using conventional methods, namely the teacher explaining learning material using the lecture method, limitations in the use of learning media that were used only with thematic books that were less varied, as well as the characteristics of students who still require further understanding of the material being studied.

Researchers determine learning objectives to develop digital-based learning media products which are expected to be able to assist teachers in delivering learning material when face-to-face or online and foster students' enthusiasm for independent learning.

Conduct Instructional Analysis

The next step after conducting a preliminary study in the form of observing learning activities in class, the researcher conducts an instructional analysis or determines the students' initial skills. Instructional analysis is carried out to determine the initial skills possessed by students through learning activities. Through the observation of learning activities, reading activities have been mastered by all students. The development of learning media that meets students' skills in reading activities is presented in the form of digital learning media.

Analyze Learners and Contexts

The next step is to analyze students or learners and the context of learning in research. Digital-based learning media is presented according to the needs and characteristics of fifth grader in elementary school at south Jakarta, while face-to-face learning still requires learning media that can help explain human respiratory organ material in a concise and clear manner, equipped with audio explanations that can make it easier for students, and its application that can help students learn independently, and can be used during face-to-face or online learning. Encyclopedia teaching materials can increase student learning motivation and improve student understanding (Rochimah, 2018).

Write Performance Objectives

At this step the researcher formulated the research objectives by realizing the form of understanding the learning material for the human respiratory organ system based on the expected learning outcomes in accordance with the formulation of indicators and basic competencies. The success of the research objectives is expected to be in accordance with the learning objectives which are assisted by the development of digital learning media according to the needs of students.

Develop Assessment Instruments

After formulating research objectives or learning objectives, researchers develop assessments to measure abilities in understanding material or achieving learning outcomes after using digital learning media. The assessment instrument is used through an evaluation tool developed in the form of a pretest and posttest. The evaluation sheet contains two questions explaining the meaning of the human respiratory system, four questions mentioning the types of respiration in humans, six questions explaining the function of breathing in humans, three questions explaining disorders of the human respiratory system, and five questions explaining efforts to maintain the respiratory system in humans. The total on the evaluation sheet is twenty multiple choice questions.

Develop Instructional Strategy

The development of instructional strategies carried out by researchers is to develop a Learning Implementation Plan which includes pre-instructional activities (before instructional), presentations, and test evaluations.

Pre-instructional activities (before instructional) are in the form of elaboration of the material to be studied, pretest work to measure students' abilities before obtaining the required information, motivation to carry out learning activities, and presentation of learning objectives. Instructional presentation activities in the form of delivering material on the human respiratory system includes an explanation of the human respiratory system, types of respiration in humans, respiratory functions in humans, disorders that occur in human breathing, and efforts to maintain the respiratory system in humans through media developed with the participation of students. Test evaluation activities in the form of posttest work, as well as discussions.

Develop and Select Instructional Materials

Next, the researcher selects and develops learning media that will be applied, namely digital encyclopedia learning media. Digital encyclopedia learning media provides material exposure according to the level of ability and understanding of participants in science learning, namely in the form of explanation of material which includes the respiratory organ system in humans equipped with pictures and audio to increase students' understanding. Media development carried out by researchers:



Figure 1 Digital Encyclopedia Learning Media in Human Respiratory System

Design and Conduct Formative Evaluation of Instruction

At this step the researcher designs and implements a formative evaluation of learning that is structured with the aim of obtaining quantitative or qualitative data assessments to improve the product being developed. Formative evaluation aims to determine learning improvements to be more effective and more efficient in improving product quality (Tung, 2017). The measuring tool used is in the form of a questionnaire or assessment questionnaire obtained from experts in their fields, including Media Expert Validation Analysis. Quantitative data obtained from media experts reached a percentage of 74%. The results of this assessment are converted to interval score data analysis, the level of achievement of digital learning media is in a fairly good qualification. Based on these results, digital encyclopedia learning media is feasible to be tested on students. The qualitative data obtained was based on comments and suggestions from media experts on digital learning media. There are a number of things that need to be fixed, such as a faint explanatory sound with background music, there are excess slides in the section on causes of respiratory disorders in humans, one of the slides is blank and there are no pictures.

Linguist Expert Validation Analysis. Quantitative data obtained from linguists reached a percentage of 90.91%. The results of this assessment are converted to interval score data analysis, the level of achievement of digital learning media is in very good qualifications. Based on these results, digital encyclopedia learning media is feasible to be tested on students. The qualitative data obtained was based on comments and suggestions from linguists on digital learning media. There are a number of things that need to be fixed, such as punctuation that is not properly placed and the use of capital letters that are not appropriate.

Material Expert Validation Analysis. Quantitative data obtained from linguists reached a percentage of 90%. The results of this assessment are converted to interval score data analysis, the level of achievement of digital learning media is in very good qualifications. Based on these results, digital encyclopedia learning media is feasible to be tested on students. The qualitative data obtained was based on comments and suggestions from material experts on digital learning media. The advice obtained is that the development of materials can be more varied.

Revise Instruction

The next step is revision of learning carried out to produce digital learning media as expected. In the teaching revision stage, the researcher conducted a feasibility test and an effectiveness test or product trial in a small group of seven students. At this stage the researcher conducted an assessment of students who had different abilities based on recommendations from the V-B class teacher to apply digital encyclopedia media in the form of soft files. The feasibility assessment obtained from the small group trials obtained 78.58% with fairly good qualifications. Assessment of the effectiveness of small groups based on the results of the gain normality test obtained a result of 0.62 with moderate success criteria. Based on the results of the qualifications, digital learning media is appropriate and effective for use during learning activities.

Design and Conduct Summative Evaluation

The final stage carried out by researchers in developing media is to carry out a summative evaluation in accordance with the application trials to large groups. In the summative evaluation stage, the researcher conducted an effectiveness test or product trial in a large group of 30 students. The effectiveness assessment obtained from the large group trial obtained 86.67% with very good qualifications. Assessment of the effectiveness of large

groups based on the results of the gain normality test obtained a result of 0.54 with moderate success criteria. Based on the qualification results, digital encyclopedia learning media can already be used as learning media during learning activities for fifth grader of elementary school students and the teachers. The final stage of this development is the final result of making the product that the researcher has developed.

Based on the results of learning media product development it can be concluded that the digital encyclopedia of science learning is capable of feasibility and effectiveness in increasing students' understanding of human respiratory organs because it is in line with research conducted by Wahyuni, et.al., (2020) that encyclopedia could be used for fifth grader students as learning material. The digital encyclopedia is suitable for use because it is very valid and very practical as a learning resource in elementary schools based on the results of validation from media experts who got a percentage of 93% and validation from material experts who got a percentage of 92%. The student response questionnaire for practicality in one-to-one trials got results of 93%, small group trials got results of 94%, and field trials got results of 96%. As well as pretest and posttest results, pretest results with 20% completeness and then posttest results with 91% completeness. This is the same as the results of research conducted by researchers so that digital encyclopedias can become alternative sources or new learning media in the future in the digitalization era and can be developed in other learning areas.

Conclusion

The development of digital encyclopedia learning media products uses the Research and Development (R&D) method with the Dick and Carrey development model consisting of 10 steps. The feasibility level of research and development of digital encyclopedia learning media for natural science learning on human respiratory organs has been validated. The validation results of media experts get a percentage of 74% with good qualifications. The validation results of linguists get a percentage of 90.91% with very good qualifications. The results of the validation of material experts get a percentage of 90% with very good qualifications. The results of the product feasibility test in the small group obtained a percentage of 78.58% with fairly good qualifications. The results of the product feasibility test in the large group obtained a percentage of 86.67% with very good qualifications. The level of effectiveness in research and development of digital encyclopedia learning media for natural science learning materials on human respiratory organs has been tested on small (limited) and large groups. The results of product trials in small groups to measure effectiveness based on the gain normality test obtained 0.62 with moderate success criteria. The results of product trials in large groups to measure effectiveness based on the gain normality test obtained 0.54 with moderate success criteria.

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