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Development of A Digital-Based Encyclopedia on Elementary School Science Content

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Abstract: This study aims to develop a digital-based encyclopedia for elementary science content. His research and development was carried out using the Borg and Gall development procedure with 10 stages, namely: potential and problem stages, data collection, product design, design validation, design revision, product trial, product revision, feasibility trial, product revision and mass products (digital encyclopedia). The subjects of this research trial were fourth grade students at SD Negeri 162 Palembang. The results of the assessment of material experts 91%, media experts 90%, and linguists obtaining a percentage of 85.30% indicate that the digital encyclopedia being developed falls within the criteria of very valid. The results of the student response questionnaire obtained a percentage of 93.90% indicating that the digital encyclopedia being developed was included in the Very Practical criteria. So that it is suitable for use in learning.

Keywords: Digital; Encyclopedia; Science material

Introduction

The development of information and communication technology is advancing rapidly, permeating all sectors of life (Elisa et al., 2022; Pahlifi et al., 2019). Ten years ago, information and communication technology, such as computers and smartphone-based mobile phones, were still considered expensive. Developments in technology are impacting various groups, including the educational community One of these is the development of communication technology (Doyan et al., 2020).

But today, this technology can be owned by people of all ages and backgrounds. One of the information and communication technologies, often referred to as computer media, is widely used for learning purposes, both offline and online (Muhimmatin et al., 2021). Computers are also alternately referred to as multimedia, where the technological capabilities of computer devices can integrate various media functions, including audio, visual, color, animation, and hypertext, all contained within a single medium called a computer (Prawiradilaga, 2016). With the technological capabilities it possesses, computers can be used to clarify or convey a message, which can be referred to as media, such as offline and online-based learning modules, as well as many other types of media. This makes it a very effective and efficient means to be used as a modality in the learning process, such as in science education (Erwati et al., 2012). The advantages of using electronic devices are that they are easy to use, accessible, and very interesting. Students don't need to bring paper books to study, they can just use their smartphones. It's can be easily studied anywhere, including explanations, color, videos, and audio, are in high demand among students (Maharani et al., 2023).

Science education is one of the essential subjects that students need to master (N. H. Susanto et al., 2022). During the learning process, students often encounter difficulties in comprehending science materials. Based on Awang's research (2015) there are two main causes of difficulties in learning science at the elementary school level: First, internal factors that lead to students' struggles in learning science, including their interest,

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motivation, self-confidence, study habits, and aspirations; Second, external factors that contribute to students' challenges in learning science, such as the presence of many unfamiliar terms, students' difficulty in understanding the material due to limited instructional media, and monotonous teaching methods. Therefore, innovative and varied approaches are needed to effectively deliver science content to students.

Based on the needs analysis conducted at SD Negeri 162 Palembang it was found that the learning process is predominantly lecture-based, although educators sometimes introduce variations. When educators present something new, students seem to exhibit a high level of interest in science learning, as indicated by their active participation. Students appear enthusiastic in receiving new information and knowledge conveyed by educators. Additionally, when materials include illustrations, students seem interested and occasionally pose questions to the educators. The teaching materials for science instruction are currently limited to the use of textbooks, worksheets, and internet searches. However, the school provides educators with adequate resources such as projectors and laptops, although the quantity is still limited. Furthermore, students are already proficient in operating smartphones and using various applications on them. Based on the needs analysis results above, to support the delivery of science content, several solutions are being considered, including the development of an encyclopaedia.

Noviyanti et al. (2022) An encyclopedia is an instructional material created in the form of a book with an attractive design. An encyclopedia is a book that contains information such as definitions, background, and systematic, alphabetically arranged bibliographic data. Typically, it takes the form of a thick, large book with a relatively high cost. Such encyclopedias are challenging to store and transport due to their size and cost. As a result, only certain individuals can afford to purchase and own them (Mulyani et al., 2021). Therefore, to make it more portable and accessible from anywhere, the development of a digital-based encyclopedia for elementary school science subjects is also needed.

The term "Encyclopedia" originates from the Greek language, where Encylospadea represents a collection of facts presented systematically or a discipline of knowledge explained informatively and comprehensively. In Greek, the word “encyklos” means “general”, while “paedia” means “education”. In English, it is often written as “Encyclopaedia”, “Cyclopaedia”, and ”Cyclopedia” which essentially means general education (Iskandar et al., 2016). Meanwhile, according to the Kamus Besar Bahasa Indonesia (KBBI), an encyclopedia is a book or a series of books that compile information or descriptions about various things in the fields of arts and sciences, organized alphabetically or according to the realm of knowledge (Nurdiansyah et al., 2021).

An encyclopedia is a book containing information such as definitions, background, and bibliographic data that is systematically organized and alphabetically arranged (Nurhatmi et al., 2015). The advantages of an encyclopedia, according to Setiadi et al. (2016), include being easy to understand and providing detailed explanations about a subject. Teaching materials based on an encyclopedia will provide comprehensive explanations of the learning material. According to Prastowo (2015), teaching materials are a form of materials that can assist teachers in classroom teaching activities. Teaching materials are organized in an orderly manner, whether written or unwritten, creating an engaging learning environment for students. Furthermore, Kosasih (2021) explains that digital teaching materials are materials that use digital devices such as computers, smartphones, (cell phones, mobile phones), laptops, and the like. Therefore, digital teaching materials are computer-based and equipped with other multimedia devices. The presentation format of digital teaching materials is typically in PDF, making it easy to access via laptops, smartphones, and similar media. Science encyclopedias can increase students motivation to learn. Scientific encyclopedias are useful and practical, and also provide learning opportunities for students (Maryani et al., 2019).

An encyclopedia is a book that contains information such as definitions, background, and bibliographic data organized systematically and alphabetically (Nurhatmi et al., 2015). Then, the advantages of an encyclopedia according to Setiadi et al. (2016), the advantages of an encyclopedia as a learning resource include its ease of understanding and providing detailed explanations about a subject. Educational materials based on an encyclopedia will offer comprehensive explanations of the learning material. According to Prastowo (2015), instructional materials are a form of materials that can assist teachers in classroom teaching and learning activities. These instructional materials are organized systematically, whether in written or unwritten form, in order to create an engaging learning environment for students.

Furthermore, Kosasih (2021) explains that digital instructional materials are materials that utilize digital devices such as computers, smartphones, (HP, mobile phones), laptops, and similar devices. Therefore, digital instructional materials are computer-based and equipped with various multimedia tools. The presentation format of digital instructional materials can be in the form of PDF, making it convenient for use on

laptops, smartphones, and similar media (Noris et al., 2023). With this implementation, we found that the electronic encyclopedia could be used as a more interesting and meaningful learning medium because students were familiar with the content they were learning (animals) and the concepts were explained in more detail (Kumala et al., 2019). There are many research has been proving that a media changed a lesson perspective which is the students status from an object then come into the main part of a lesson (Wahyu et al., 2020). Thus, these circumstances increase students confidence to higher level so that the implications of study become more comprehend, collaborative and interactive as well.

In this study, the development of a digital-based encyclopedia for Grade IV elementary school science materials is beneficial for explaining and presenting learning materials (Dewi et al., 2022). It includes the presentation of illustrated images with concise yet clear content that can capture students' attention, foster curiosity, and make learning materials easy to understand (Saputri et al., 2023). According to Susanto (2014) Teaching materials are any kind of materials that can be used to assist teachers in conducting teaching activities. Thus, there is a connection between teaching materials and encyclopedias, which can be useful as informational materials for teaching content, serving as a guide for teachers in the implementation of the learning process.

Method

The method used was research and development (R&D). Research and development was a type of research directed towards developing products, designs, and processes. According to Sugiyono (2018) the research and development method is a research method used to create specific products and assess the effectiveness of these products. In the field of education and learning, particularly, research and development focus their studies on the design aspect, encompassing the design of teaching materials and products such as learning media. This research development model employs Research and Development (R&D) and follows a procedural approach. With reference to the model used, the procedure is based on the Borg and Gall development model (Sugiyono, 2018).

The ADDIE model consists of analysis, design, development, implementation, and evaluation Analysis analyzes the characteristics of the student in terms of the knowledge, attitudes, and skills that the student possesses Analyze learning objectives and related materials (Andani et al., 2020).

The development procedure of a digital-based encyclopedia using the Borg and Gall model consists of several stages, namel: Problem Potential, Information Gathering, Product Design, Initial Testing, Product Revision, Re-testing the Product, Product Revision, Usage Testing, Product Revision, and Mass Production. The data collection instruments used in this research were Field Notes, Validation Sheets, Questionnaires/Surveys (Enawaty, 2023).

Research instruments were measurement tools used to assess natural or social phenomena under observation (Sugiyono, 2019). Specifically, all of these phenomena were referred to as research variables. It could be understood that instruments were utilized to measure the values of specific variables that will be investigated. The data collection instruments in this research include expert questionnaires on media, language, and content, as well as questionnaires for students (Andriani et al., 2021). These questionnaires aimed to validate the developed product and to assess students' responses to the use of the encyclopedia in the learning process (Frans et al., 2023).

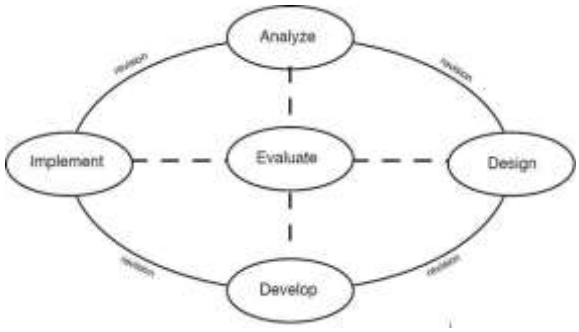

Figure 1. Flowchart of the ADDIE models (Renita, 2020)

Result and Discussion

After researchers conducted a need analysis, the next step was product design. There were several things that need to be done in the product design phase of developing a digital encyclopedia on the theme of the beauty of diversity in my country for fourth-grade elementary school. These included the preparation of the Main Content Lines or often referred to as GBIM (Rezeki et al., 2021). GBIM was a guide used as a reference for writing the manuscript. GBIM consists of learning materials such as the characteristics of living creatures, the development of living creatures, environmental balance, the conservation of animals and plants, heat introduction, changes in objects, energy and its transformations, energy conservation, and the Earth and the universe.

Next is the flowchart, which represents the design of the thought flow model of the digital encyclopedia's

content. The purpose of the flowchart was to create a communicative flow, understand the flow and process paths of digital encyclopedia development, making it easily comprehensible, navigable, and followed by researchers as a whole. Then there is the Material Description, which aims to simplify the researchers' task in developing the product. In this case, the presented material would be detailed and comprehensive to save the researchers' time and effort in product development. Lastly, there was the storyboard, which was used to outline the story's flow from the beginning to the end of the product being developed.

In the stage of developing the digital encyclopedia product, it is validated by experts, including subject matter experts, media experts, and language experts. The product development begins with designing the digital encyclopedia using the PowerPoint application. Once the design draft is completed, the researchers then creates digital encyclopedia links using the WPS Office application that can be accessed by every student through their smartphones.

Figure 2. Digital encyclopedia-based product design

The completed development product design, in the form of a digital encyclopedia, is then validated by subject matter validators, media validators, and language validators, as well as receiving feedback from fourth-grade teachers. Subsequently, product improvements were made in accordance with the suggestions from the validators and teachers to assess its validity for use in product testing.

The first product validation involved subject matter validators, aiming to assess the suitability of the content of the developed digital encyclopedia. Material validation in this product is evaluated by three validators, including two lecturers and a classroom teacher.

Table 1. Material Validation Result

Material Aspect	Validator		
	V	2	3
Content Quality and Purpose	85.70	91.40	88.50
Learning Quality	82.80	88.50	94.20
Average	84.25	89.90	91.35
Average Validator Score			88.20%
Criteria			Valid

From the material expert validation results, suggestions were obtained in the form of the material still needed revision. It was then improved and refined in accordance with the suggested improvements.

Figure 3. Encyclopedia material revision

Validation of media in terms of the development of instructional media and teaching materials. Some feedbacks were provided regarding multimedia, namely: the need to improve color and contrast, the use of attractive fonts, adding images of living creatures on the front cover, and adding backgrounds to each page of the encyclopedia.

Figure 4. The background appearance of the revised encyclopedia

Table 2. Media Validation Result

Digital Media Aspect	Validator		
	1	2	3
Graphics Software (Media)	88.50	82.80	97.10
Encyclopedia Content	96.00	84.00	92.00
Technical Quality and User-Friendliness	90.00	86.60	96.60
	91.50	84.40	95.20
Average Validator Score			90.30
Criteria			Highly Valid

The follow-up action taken was to improve the digital encyclopedia based on the validator's recommendations. Several examples of animals and plants were added to the cover.

In the language expert validation, several suggestions were provided, namely: Words in the encyclopedia need to be reviewed because some are not standardized, and they should be simplified for better understanding by students.

Table 3. The Results of the Language Validation

Language Aspects	Validator		
	1	2	3
Clarity	86.50	80.20	91.20
Language Rules	90.20	81.20	81.10
Terminology and Symbols	87.60	85.70	90.40
Average	88.10	82.30	87.50
Average Validator Score validator			85.90
Criteria			Highly Valid

Based on the table of overall validation assessment of the digital encyclopedia, specifically, the validation by science subject matter experts achieved an average score of 88.20% with the criteria "highly valid," the validation by media experts yielded a score of 90.30% with the "highly valid" criteria, and the language expert validation resulted in a score of 85.30% with the "highly valid" criteria. The overall validation results obtained an average score of 85.90%. Therefore, it can be concluded that the product meets the "highly valid" criteria and can be used in the small-scale testing phase.

Next, the product underwent a small-scale trial aimed at assessing the practicality of using the digital encyclopedia by collecting data from student response questionnaires. The student response questionnaires were distributed to 8 fourth-grade students of SD Negeri 162. The summary of student responses to the digital encyclopedia is presented in Table 4."

Based on Table 4, the questionnaire survey results on students' response to the use of digital encyclopedias obtained an average score of 92.60% with the "very practical" criteria and can be used in large-scale trial phases. From the product's trial results, it can be stated that the product is excellent and does not require any further revisions.

Table 4. The Result of Students' Responses Recapitulation

No	Subject	Score
1.	PA	93
2.	IM	92
3.	ZH	93
4.	MAY	93
5.	AL	93
6.	SGR	92
7.	RAP	93
8.	AZ	92
	Total	741
	Score	125
	Average	92.60%
	Criteria	Very Practical

After conducting a small-scale trial and making adjustments to the developed product, the researchers found it practical for use in the learning process. Subsequently, a large-scale trial was conducted to assess the practicality of the digital encyclopedia. During this stage, a questionnaire survey was distributed. The survey was carried out on November 15, 2022, among 25 fourth-grade students at SD Negeri 162 Palembang. The implementation data resulted in a score of 93.90% with the "very practical" criterion.

This research has resulted in a digital encyclopedia product covering the science curriculum for elementary school (SD). As determined during the analysis phase, the use of diverse learning resources is considered necessary to enhance students' interest in learning materials. The utilization of a digital-based encyclopedia as a learning resource is also found to be effective for both in-class and out-of-class use (Mulyani et al., 2021). Teaching materials and learning materials become more interesting when they are presented in multimedia. Graphics support comes in the form of providing information in the form of text, images, sounds, and animations, making it attractive and interactive (Rahmayanti et al., 2023).

In line with the findings of Haryanto et al. (2019) encyclopedias are highly valuable for expanding knowledge and enriching information about science for the students who use them. Furthermore, encyclopedias also hold their own appeal for students in the learning process. These findings are further supported by Susanti's research (2019), which discovered that using the developed encyclopedias in the classroom provides students with more reference sources to understand learning materials. It also enhances students' knowledge, comprehension, and insights into specific subject matter, while fostering students' interest in reading.

The development of locally-informed multimedia materials for the science curriculum has yielded results

that are both valid and practical. The validity is demonstrated by the validation scores from content experts, media experts, and language experts, which are sequentially 88%, 90.30%, and 85.90%. These scores fall within the criteria for being highly valid, meaning that the project can proceed to the next stage. Furthermore, the practicality of the materials is evident in the questionnaire survey conducted during the implementation phase, which obtained a score of 93.90%, categorized as highly suitable. It can be concluded that the digital-based encyclopedia is suitable for use in elementary schools based on these results. This assessment is made because the digital-based encyclopedia for the science curriculum presents the content concisely, clearly, and in a language that is easy to understand. It also features visually appealing graphics that align with the interests of elementary school students. It can be argued that encyclopedias have the characteristic of presenting information in a concise and comprehensive language, making them appealing to a wide range of audiences (Iskandar et al., 2016). Furthermore, the primary focus in encyclopedias is on visual design and color selection to prevent students from becoming bored (Yasa et al., 2020).

Additionally, the use of encyclopedias in education can also affect students' cognitive development, according to Nurhatmi et al. (2015) Encyclopedias can enhance students' cognitive abilities, which are acquired through aspects of comprehension and student regulation gained in the monitoring aspect. Furthermore, according to Arifah (2017) explains that one of the advantages of encyclopedias is that they can stimulate learners to think critically, actively, and creatively. Therefore, the use of encyclopedias in science education is feasible.

Conclusion

The conclusion of the research on the Development of Digital-Based Encyclopedia for Elementary Science Curriculum is as follows: The digital-based encyclopedia for the science curriculum developed in this research is categorized as highly valid. In this study, validation scores obtained from validators for each aspect of content, media, and language were 88.20%, 90.30%, and 85.90%, respectively. And, the digital-based encyclopedia for the science curriculum developed in this research is categorized as highly suitable for use, making learning more enjoyable, as evidenced by the successful testing with students from SD Negeri 162 Palembang.

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All authors contribute to the process of completing research and writing articles. The concept of research, preparation of instruments, validation, data collection, analysis and interpretation of data and drafting of articles. Conceptualization: Sylvia Lara Syaflin; Arrangement of Instruments and instrument validation. Puji Ayurachmawati; data collection, data analysis and interpretation: Sunedi; writing–original draft, writing–review & editing. All authors reviewed the results and approved the final version of the article manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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