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Development of Mathematics Encyclopedia on Spatial Building for Fifth Grade Elementary School Students

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ABSTRACT

This study aims to develop a mathematics learning media called the Mathematics Encyclopedia for 5th-grade elementary school students, to determine the feasibility of this media in understanding the subject of spatial building in the 5th-grade curriculum. This research uses the Research and Development (RnD) method, utilizing the ADDIE development model, which includes five stages: Analysis, Design, Development, Implementation, and Evaluation. The collected data are analyzed using qualitative and quantitative analysis methods. The results of the study are a mathematics encyclopedia book for spatial building materials, which has been validated by content experts, instructional experts, and media experts. The validation results indicate that the developed book is suitable for use in the learning process, with an overall assessment of "Very Good" to "Good." The book also received high praise from the mathematics teacher and the student respondents, indicating that it is suitable for use as a learning tool for 5th-grade students in elementary school.

Keywords
Elementary School
Encyclopedia
Mathematics
Spatial Building

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Introduction

Education provides learning so that learners can have an understanding of something and can become critical thinkers [1]. Education is a planned effort to create a learning

atmosphere and learning process so that learners can actively develop their potential to have spiritual and religious strength, self-control, personality, intelligence, noble character, and skills necessary for themselves, society, nation, and country as stated in the National Education System of Indonesia [2]. Students are required to have high education as long as they are capable, achieve well, and have the motivation to learn and strive to change their lives for the better. The challenges in education will become increasingly complex at the elementary school level.

Elementary school is essentially a social unit institution entrusted by the community to provide basic education systematically. Schools as centers of formal education were born and developed from thoughts of efficiency and effectiveness in providing education to learners. The function of providing education in elementary school cannot be entirely entrusted to teachers, as the basis of learning experiences can be acquired by learners throughout their lives, wherever and whenever they are [3]. The purpose of education in all levels is to create better individuals. Schools are considered the most appropriate place to realize this goal [4].

In order to improve a child's performance and abilities, they must have a strong desire to learn. However, learning can be challenging and difficult, particularly in subjects such as mathematics. Mathematics, which should be an enjoyable subject, can often become tedious and boring for students. The purpose of mathematics education is to prepare students to face changing situations in life, to equip them with the ability to use mathematics and mathematical thinking in their lives, and to teach them mathematics as a science [5].

Mathematics plays a vital role in education. To measure a student's learning outcomes, it is often necessary to provide practice exercises. If students struggle to understand the concept of geometric shapes, it will hinder their ability to achieve the learning objectives. The purpose of teaching geometry is to develop logical thinking skills, to teach students how to read and interpret mathematical arguments, to provide the necessary knowledge for further studies, and to develop spatial abilities [6]. Therefore, this is a problem that requires a solution. Educators need to use appropriate and effective teaching media to facilitate students' understanding.

Providing appropriate learning materials and media that suit the developmental level of students is essential for both students and teachers in ensuring a good learning process [7]. Learning materials serve as a reference source for students to absorb knowledge, while for teachers, they provide information on developing teaching materials to help them carry out teaching and learning activities. This is important as stated in the National Education System of Indonesia. One way to overcome learning difficulties is by using tools or learning media [8].

By using media, it is hoped that students' motivation in learning can be increased, thus improving learning outcomes. The media used in this case is an Encyclopedia.

According to Ref. [9], an Encyclopedia is a collection of writings containing comprehensive and easily understood explanations of various information related to specific categories or fields of science, printed in book form. Or it can be defined as a visual-based printed media that contains a number of explanatory articles that store information comprehensively and are quickly understood and comprehended about all branches of science or specifically in a particular field of science arranged in articles with a single topic of discussion in each article, arranged alphabetically, by category or volume, and usually printed in the form of a summary book depending on the amount of material included. A teacher maximizes the development of mastery of mathematics material, media, and teaching methods, because the better the methods used, the more effective they are in conveying the learning objectives. The use of learning media and methods is a structured action taken by teachers to motivate students towards the material to be conveyed [10]. This makes students feel motivated to learn. The purpose of using learning media is to ensure that the learning process runs effectively, and to assess the extent of students' knowledge and understanding of the conveyed learning material.

The gap in this research is the lack of innovative and interactive learning resources to enhance the students' mathematical skills and interest in learning geometry. Traditional teaching methods often rely on teacher-centered instruction, which may not be suitable for all students. An innovative and interactive learning resource, such as an encyclopedia, can help students to learn actively and independently, leading to better academic achievement. This study aims to develop an innovative encyclopedia as a solution to help primary school students in understanding the difficulty of learning geometry, especially on the topic of solid figures. The students' lack of mathematical skills is reflected in their inability to perform basic arithmetic operations and problem-solving tasks, which may result in low academic achievement. Therefore, the author proposes an interactive and engaging encyclopedia that can activate the students' learning process and encourage them to discover the concepts themselves.

Methods

The study was conducted at SD Negeri Sendang (a public elementary school), located in Gunungkidul Regency, Yogyakarta. The research method used in this study was the Research and Development (RnD) method. The development design used was the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects of this study consisted of one mathematics teacher and ten 5th-grade students from the same school. The object of this study was the quality of the development of a learning media in the form of a mathematics encyclopedia book on the topic of spatial geometry for 5th-grade students in

elementary school. The data analysis technique used was non-test, and the data collection instrument used was a questionnaire. The types of data collected were both qualitative and quantitative.

To begin with, the researcher conducted an analysis phase to identify the problems and needs of the students and teachers in learning spatial geometry. After identifying the problems, the researcher proceeded to design the learning media based on the analysis of the problems and needs. The design was then reviewed and validated by experts in the field of mathematics and instructional media. Next, the researcher proceeded to develop the learning media in the form of a mathematics encyclopedia book on the topic of spatial geometry. The book was designed to be attractive and easy to understand, with colorful illustrations and explanations that were appropriate for 5th-grade students. After the development phase, the researcher implemented the learning media by providing it to the students and teacher for use in their classroom. During this phase, the researcher observed and monitored the use of the learning media, as well as collected feedback from the students and teacher through a questionnaire. Finally, the researcher evaluated the effectiveness of the learning media in improving the students' understanding and interest in spatial geometry. The data collected from the questionnaire were analyzed both qualitatively and quantitatively, using statistical tools to determine the effectiveness of the learning media.

Results and Discussions

The research aimed to develop a mathematics encyclopedia book for the topic of three-dimensional figures for fifth-grade elementary school students. The ADDIE model was used in this research, which involved five stages: analysis, design, development, implementation, and evaluation. In the process of developing the book, the quality of the media was evaluated through expert validation, including subject matter experts, learning experts, and media experts. Additionally, evaluations from teachers and students were also taken into consideration.

To measure the quality of the mathematics encyclopedia book, the researcher used questionnaires that were given to experts, mathematics teachers, and students. The research was conducted at the school, where observation and interviews with mathematics teachers were conducted in December 2021 to identify the difficulties faced by fifth-grade students in learning three-dimensional figures. The questionnaire and interview guide were validated before conducting the research in July 2022.

Overall, the research shows a thorough and systematic approach to developing the mathematics encyclopedia book for fifth-grade students. The ADDIE model used in this research is a well-established framework that is commonly used for instructional design, which

ensures that the final product is both effective and efficient. Additionally, by conducting expert validation and incorporating feedback from both teachers and students, the quality of the book is enhanced, and the relevance and practicality of the research outcomes are increased.

The materials covered in this encyclopedia are Blocks, Cubes, Limas, Prisms, Tubes, Cones, and Spheres. Each material is equipped with definitions, related formulas, examples of everyday objects, and how to use formulas. Fig. 1. is the example of a page that explains about pyramids. As a teaching material, this encyclopedia also contains learning objectives, and evaluation questions. See Fig. 2.

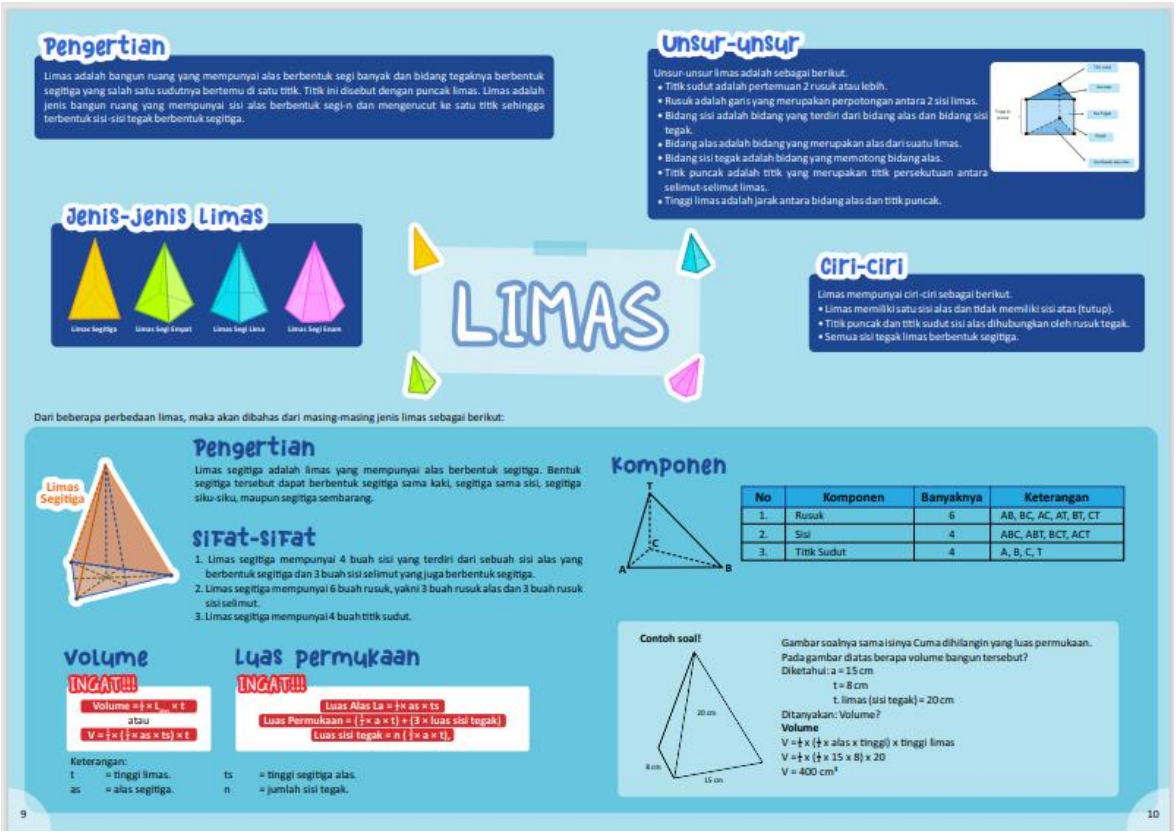


Fig. 1. Example of a page that explains about pyramids: definition, volume formula, blanket area formula, how to use the formula

The validation process involved expert validators for material, learning, and media, as well as the evaluation of the book by teachers and students. The results show that the mathematical encyclopedia was well received by the validators, teachers, and students. The validation scores for expert validators were all in the range of "good" to "very good" categories. The expert material validator gave a score of 48 with a percentage of 85.71%, categorized as "Very Good." Meanwhile, the expert learning validator gave a score of 51 with a percentage of 79.68%, categorized as "Good." The media expert validator gave a score of 54 with a percentage of 79.41%, categorized as "Good." The evaluation by the mathematics teacher yielded a score of 71 with a percentage of 93.42%, categorized as "Very Good." The evaluation by 10 students

in grade V of SD Negeri Sendang received a score of 118 with a percentage of 98.33%, categorized as "Very Good."

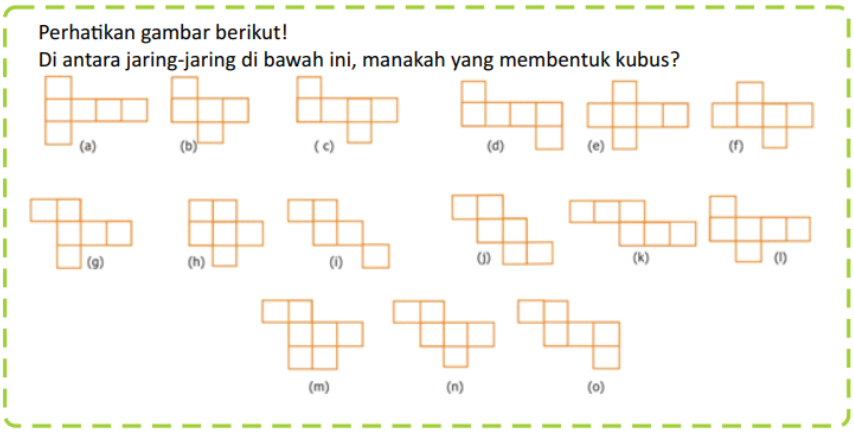


Fig. 2. Example of a question about Cubes

The conclusion drawn from the validation process is that the developed mathematical encyclopedia is suitable for use in the teaching and learning process. The positive feedback from the expert validators, teachers, and students indicates that the book effectively helps 5th-grade students in primary schools to learn about spatial structures in mathematics. This result implies that the ADDIE model, which includes the Analysis, Design, Development, Implementation, and Evaluation phases, was effective in developing this educational resource.

The finding of this research indicates that the development of the mathematics encyclopedia as a learning media for the topic of spatial building for fifth-grade students in elementary school is effective in increasing critical thinking, motivation, and deepening understanding of the material. This finding is in line with the cognitive learning theory, which suggests that learning occurs when new information is linked to prior knowledge and experiences, and that learners construct their own understanding of the material by actively engaging in the learning process [11]-[13].

The use of media such as the mathematics encyclopedia facilitates this active engagement by providing students with a visual representation of the material and interactive opportunities to apply their knowledge [14]. Additionally, the use of the mathematics encyclopedia aligns with the constructivist learning theory, which emphasizes the importance of hands-on, active learning and the role of the learner in constructing their own understanding of the material [15]-[17].

The development of the mathematics encyclopedia also aligns with the ADDIE model, which is a systematic approach to designing effective instruction. This model consists of five phases: analysis, design, development, implementation, and evaluation. The use of this model

ensures that the learning media is designed and developed with a focus on the specific needs of the students and the curriculum requirements. Overall, the development and use of the mathematics encyclopedia as a learning media for spatial building in fifth-grade students aligns with cognitive and constructivist learning theories and the ADDIE model of instructional design.

Cognitive learning theory emphasizes the role of mental processes in learning, including attention, perception, memory, and problem-solving [18]. This theory suggests that learners construct new knowledge by building on prior knowledge and experiences, and that learning occurs through active engagement with the environment. The development and use of the mathematics encyclopedia as a learning media for spatial building aligns with cognitive learning theory in that it provides an interactive and engaging way for students to learn about spatial building concepts and develop their problem-solving skills.

Constructivist learning theory is closely related to cognitive learning theory, but it emphasizes the role of social interaction and collaboration in learning [16]. According to this theory, learners actively construct their own understanding of the world around them, and learning occurs through the negotiation and sharing of ideas with others [17]. The development and use of the mathematics encyclopedia as a learning media for spatial building aligns with constructivist learning theory in that it encourages collaboration and interaction among students and with the teacher, which can enhance their learning experiences and deepen their understanding of spatial building concepts.

The ADDIE model of instructional design is a systematic approach to designing and developing effective instruction. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation, and it involves a series of steps to ensure that instructional materials are effective and meet the needs of learners. The development and use of the mathematics encyclopedia as a learning media for spatial building aligns with the ADDIE model in that it was developed systematically through a process of analysis, design, development, implementation, and evaluation. This approach ensures that the instructional materials are aligned with the learning objectives and are effective in helping students achieve those objectives.

Conclusion

The development and use of the mathematics encyclopedia as a learning media for spatial building in fifth-grade students is a suitable and effective tool for improving critical thinking, motivation, and understanding of the material. The findings of this study align with cognitive and constructivist learning theories, as well as the ADDIE model of instructional design, which emphasize the importance of active participation and engagement in the learning process. The results of the expert validation and user evaluation indicate that the

mathematics encyclopedia is a valuable resource for both students and teachers in the classroom setting. It is recommended that further research be conducted to explore the potential of this learning media in other subject areas and with different age groups. The mathematics encyclopedia has the potential to enhance the quality of education and improve the learning outcomes of students.

Conflict of Interest

The authors declare that there is no conflict of interest.

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