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Developing IT Comic-based Mathematics Learning Media for Concept of Time for Grade V

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ABSTRACT

The concept of time is a critical component of the Grade V mathematics curriculum. It is playing a significant role in the cognitive development and time management skills of elementary school students. Understanding time involves grasping the sequence of events, measuring durations, and familiarizing oneself with various units of time such as hours, days, weeks, and other intervals. One of the challenges in teaching the concept of time to fifth-grade students is their low level of abstraction, which makes it difficult for them to understand the material. In this study, the development of media focused on creating interactive comics as a teaching material for the concept of time for fifth-grade students. The research method used the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The results of the study indicate that the interactive comic learning media for the concept of time for fifth-grade students is valid and effective. Based on expert assessments, this media falls into the "Valid" category, with a validation percentage of 80% for media aspects and 92% for material aspects. Product trials were conducted on 10 students at MI Miftahul Ulum, showed positive responses with a percentage of 95.42%. Thus, this interactive comic media has proven to be highly effective in supporting the learning process of concept of time. The use of this media not only improves the quality of concept of time learning but also provides an enjoyable and effective approach for students in understanding mathematics material.

Keywords: *interactive comic, concept of time subject, grade V*

ABSTRAK

Materi konsep waktu merupakan materi pembelajaran matematika kelas V, yang memiliki peran penting dalam perkembangan kognitif dan keterampilan manajemen waktu anak-anak SD. Pemahaman konsep waktu meliputi urutan peristiwa, pengukuran durasi waktu, dan pengenalan terhadap berbagai satuan waktu seperti jam, hari, minggu, dan rentang waktu lainnya. Salah satu tantangan dalam pembelajaran konsep waktu siswa kelas V SD adalah rendahnya kemampuan abstraksi siswa SD, yang membuat mereka kesulitan memahami materi waktu. Pada penelitian ini, pengembangan media difokuskan pada pengembangan komik interaktif sebagai materi pembelajaran konsep waktu untuk siswa kelas V. Metode penelitian menggunakan model pengembangan ADDIE, yang terdiri dari lima tahap: Analisis (*Analyze*), Desain (*Design*), Pengembangan (*Development*), Implementasi (*Implementation*) dan Evaluasi (*Evaluation*). Hasil penelitian menunjukkan bahwa media pembelajaran komik interaktif untuk konsep waktu pada siswa kelas V dinilai valid dan efektif. Validitas produk berdasarkan penilaian ahli menunjukkan bahwa media ini termasuk dalam kategori "Valid", dengan persentase validasi aspek media mencapai 80% dan aspek materi mencapai 92%. Uji coba produk dilakukan terhadap 10 siswa di MI Miftahul Ulum, yang menunjukkan respons positif dengan mencapai persentase 95,42%. Dengan demikian, media komik interaktif ini terbukti sangat efektif dalam mendukung proses pembelajaran konsep waktu. Penggunaan media ini tidak hanya meningkatkan kualitas pembelajaran konsep waktu, tetapi juga memberikan pendekatan yang menyenangkan dan efektif bagi siswa dalam memahami materi tersebut.

Kata kunci: Komik interaktif, konsep waktu, kelas V

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1. INTRODUCTION

Mathematics education in elementary school plays a crucial role in building students' foundational understanding of basic mathematical concepts. One of the fundamental concepts that elementary school students need to grasp is the concept of time. The concept of time is part of the fifth-grade mathematics curriculum and holds significant importance for students' cognitive development and time management skills. Understanding the concept of time includes the sequence of events, measuring time duration, and recognizing various units of time, such as hours, days, weeks, and other time intervals.

According to the Kamus Besar Bahasa Indonesia (KBBI), time is the sequence of events, actions, or occurrences that happen continuously. The concept of time for elementary school students is usually related to personal experience, involving an understanding of when an event occurs, such as the past, present, or future. To illustrate their understanding of time, students often use sentences like "when I was in class," "last night," or "during the holidays." The concept of time is divided into two: understanding the sequence of specific events, such as waking up, taking a shower, having breakfast, and going to school, and understanding duration or how long an activity lasts, which involves the use of a clock to measure how long an event takes. The desired outcomes of students' understanding of the concept of time include the development of discipline in daily activities, such as punctuality in arriving at school by 7 a.m., maintaining a regular sleep pattern, and managing playtime or other activities that require strict time management for students. Thus, a good understanding of time can help students develop the ability to be more self-disciplined [1].

One of the challenges in teaching the concept of measurement to fifth-grade elementary school students is their low level of abstraction, which makes it difficult for them to understand the concept of time [2]. According to Piaget, at this stage, children are in the concrete operational phase, where they begin to grasp abstract concepts in a more concrete and tangible way, especially through direct experience and manipulation of real objects around them. Piaget suggests that the concrete operational phase occurs between the ages of 7 and 12. At this stage, students begin to develop the ability to think logically about events occurring around them. They also start to categorize different objects, but they are still unable to solve abstract problems [3]. This characteristic can pose a challenge for elementary school students in understanding mathematics, especially in time-related topics.

To address this issue, it is important to use instructional media that aligns with the characteristics of elementary school students. Instructional media are tools used as a means of communicating messages, which can be modified, heard, seen, and read [4]. Instructional media can help students understand abstract material by making it more concrete. This statement is reinforced by Muttaqin (in [5]), who argues that the use of instructional media can support students in understanding lesson material. Instructional media enable the presentation of abstract concepts more clearly and concretely. Furthermore, the use of instructional media also has the potential to increase students' interest and stimulate them to be more focused, think critically, and have a higher enthusiasm for learning [6].

Nurdin [7] states that the use of appropriate instructional media can enhance students' knowledge, motivation, and interest in learning. Therefore, selecting the right instructional media has a significant impact on student learning outcomes (Astuti, in [4]). According to Mifroh (in [8]), children aged 7 to 12 in elementary school generally show greater interest in learning materials that are presented with attractive and colorful images. Hence, the use of interactive comic media is considered an effective alternative to help elementary school students understand the concept of time in mathematics lessons.

According to Daryanto (in [9]), comics are narratives illustrated in cartoon form that can depict characters and stories through images. The use of comics as instructional media has the potential to be more appealing to students, as the images and dialogue between characters in comics can bring life to written text. This makes the material easier to understand and remember. Subroto (in [10]) agrees that mathematics instruction using comic media becomes easier to comprehend because it is presented in everyday conversation. Moreover, the development of comics into interactive comics can help students understand abstract mathematical concepts in a more visual way [11].

Many researchers have developed comics for mathematics learning. In [12], the researchers developed culture-based comic learning media to help students understand mathematics problems in the form of story problems. Research [13] developed comic media to help 4th grade students learn fractions. Another research [14] developed digital mathematics comic learning media for fraction material learning in 5th grade elementary school.

Interactive comic instructional media, with its elements of engaging images and narratives, can serve as an effective tool to visualize the concept of time more concretely. Thus, the use of interactive comics in teaching the concept of time to fifth-grade students, packaged as illustrated stories with a storyline, material concept illustrations, and quizzes, can make it easier for students to understand the material. This aligns with research conducted by [15], which found that the use of interactive media has a more significant impact on students' academic achievement compared to those who do not use interactive media. Based on this background,

we developed an interactive comic of the concept of time for fifth grade." By using this instructional media, students will be more motivated and interested in learning mathematics, especially regarding the concept of time.

2. METHOD

This research is a type of study that focuses on development, commonly referred to as Research and Development (R&D). In this study, we develop an interactive comic on the concept of time. The development model used in this research is the ADDIE model. According to Branch [16], the ADDIE model is a series of phases that serve as a guideline for product development. This model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The main objective of this development model is to design and produce a product with a high level of effectiveness and efficiency. The following are the details of the steps[16]:

2.1. Analyze

In this stage, we conduct a needs analysis of the students with the aim of understanding what is required in the learning process, particularly for the concept of time in fifth grade. The analysis is carried out through direct interviews with fifth-grade teachers to gather information regarding the challenges and needs of students in learning.

2.2. Design

The design stage involves the creation of the interactive comic media, which includes the design of appearance, content, and interaction:

- Appearance Design: Focuses on creating an attractive and user-friendly interface by selecting appropriate colors, images, and fonts.
- Content Design: Involves structuring the learning material with clear language, systematic layout, and alignment with the learning objectives.
- Interaction Design: Involves developing interactive elements such as animations that motivate users to learn. This stage also includes determining the story, plot, characters, and format for delivering the content.

2.3. Development

In the development stage, the interactive comic media is created according to the planned design. There are two main steps: the creation of the instructional media and the validation of the developed product.

2.4. Implementation

After the media is deemed suitable, a trial is conducted with students to evaluate the response and effectiveness of the instructional media. This trial is limited and experimental, involving a sample of fifth-grade students.

2.5. Evaluation

The evaluation stage is conducted to assess the interactive comic that has been developed. The assessment is performed through validation questionnaires from material matter experts and design experts, as well as effectiveness questionnaires from students. The collected data is used to identify necessary improvements and enhance the quality of the instructional media.

The interactive comic media for introducing the concept of time that has been developed undergoes a feasibility assessment by material matter and design experts. This assessment aims to ensure that the instructional media is suitable for use and to obtain feedback for improvements before it is utilized by students. The assessment is conducted in two stages:

Validation by Media Experts: This will be conducted by experts in the field of interactive comic instructional media. The media experts will evaluate the aspects of appearance and language that have been developed in the interactive comic instructional media. Validation by Material Matter Experts: This will be performed by experts who have a thorough understanding of the mathematical concepts presented in the developed instructional media.

The purpose of the trial is to gather information regarding students' interaction with the media and to assess the extent to which the media can effectively convey the concept of time and capture students' attention. The product trial is conducted during the implementation stage, which is the fourth stage in the ADDIE development model.

In this research, the instruments used are interviews and questionnaires. Interviews are conducted to determine the needs analysis in developing interactive comic media for the concept of time for fifth grade. Questionnaires are used as data collection tools during the development and evaluation stages. The questionnaires are provided to validators and users with scoring. Each score is defined as shown in Table 1.

Table 1. Scoring on the Validation Sheet

Answer Choice	Score
Very Suitable	5
Suitable	4
Moderately Suitable	3
Unsuitable	2
Very Unsuitable	1

The evaluation of the validity and effectiveness of the product is conducted through data analysis by calculating the validation questionnaire scores and student responses. According to Riduwan and Akdon [17], the formula for calculating the percentage of the validation questionnaire is as follows.

$$N = \frac{\sum \text{Score}}{\sum \text{Maximum Score}} \cdot 100\% \quad (1)$$

Table 2. Decision Making for Media's Assessment

Category	Rating (%)
Very Valid / Very Effective	$80 < N \leq 100$
Valid / Effective	$60 < N \leq 80$
Moderately Valid / Moderately Effective	$40 < N \leq 60$
Not Valid / Not Effective	$20 < N \leq 40$
Very Not Valid / Very Not Effective	$0 < N \leq 20$

Adapted from Riduwan and Akdon [17]

Table 2 showed the decision making of the media's assessment. If the instructional material in the form of interactive comics receives a validation and effectiveness score of at least 60% and a maximum of 80%, it can be considered valid and effective.

3. RESULTS AND DISCUSSION

The Analysis stage was conducted through interviews with fifth-grade mathematics teachers to evaluate students' needs regarding the development of instructional media for the concept of time. The analysis results indicate that students face difficulties in understanding this material. The teacher also stated that the lecture method is less effective in mathematics education in elementary school, as students are more responsive to interactive and tangible media. Therefore, there is a need for instructional media that is engaging and can motivate students to learn mathematics. This analysis serves as the basis for designing instructional media that can effectively and enjoyably enhance students' understanding of the concept of time.

The Design stage includes the preparation of the script and design planning. The script preparation in the comic is divided into two parts: the preparation of the learning material script for the concept of time and the preparation of the exercise script, which is also in the form of a comic story. The content of the comic script preparation can be seen in Table 3 and Table 4.

Table 3. Content of the Comic Script

No	Title / Theme of the Comic Story	Content of the Comic
1	Ara, Caca, and Time	- Revisiting components of a clock, such as the hands of the clock - How to read a clock - Remembering units of time: hours, minutes, and seconds - Arithmetic operations involving hours
2	Peni, Champion of the Mathematics Competition	- Remembering dates in the calendar - Remembering the names of the days - Remembering the conversion of days to hours - Arithmetic operations involving days and hours
3	Exciting Vacation Plans of Mira and Tiwi	- Remembering the number of days in a week - Remembering the number of days in a month - Remembering the number of months in a year - Arithmetic operations involving days, months, and years

Table 4. Content of the Exercise Script in the Comic

No	Theme of the Comic Story	Content of the Comic Exercise
1	Calculating how long Ari and Rina spent at the supermarket	Arithmetic operations involving minutes
2	Calculating how long Bobi's father was on the phone	Arithmetic operations involving seconds
3	Calculating the time Rara finished getting ready for school	Arithmetic operations involving hours
4	Calculating how long Prita enjoyed playing with dolls in months	Arithmetic operations involving months and years
5	Solving time unit problems with Rio and Ana	Arithmetic operations involving time units

In this design stage, we created storyboards for the media, such as storyboards for the cover, opening, menu, and content. Additionally, characters to be used in the comic were created using the Pixton application based on the prepared comic script. Figure 1 is the image of the character creation process in the Pixton application.

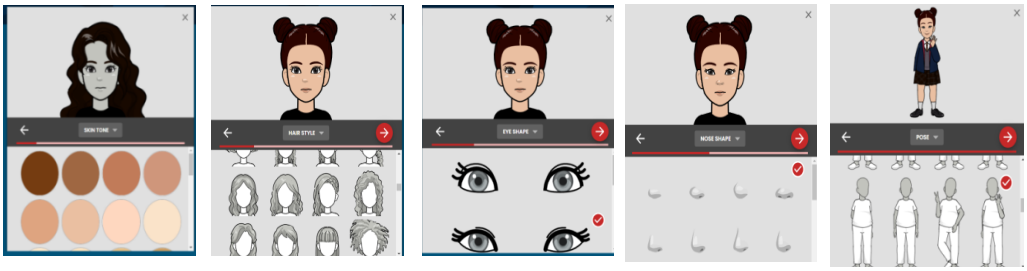

Figure 1. Character Creation Using Pixton

Next, the interactive comic media is developed using GDevelop. In this comic, there are three stories as shown in Figure 2. In each story, there are questions about the concept of time that are relevant to the story. The e-comic is also equipped with a practice page of questions about the concept of time presented in the form of a comic story as in Figure 3. Each exercise is equipped with a scoring system.

Figure 2. Comic's Cover for Each Story

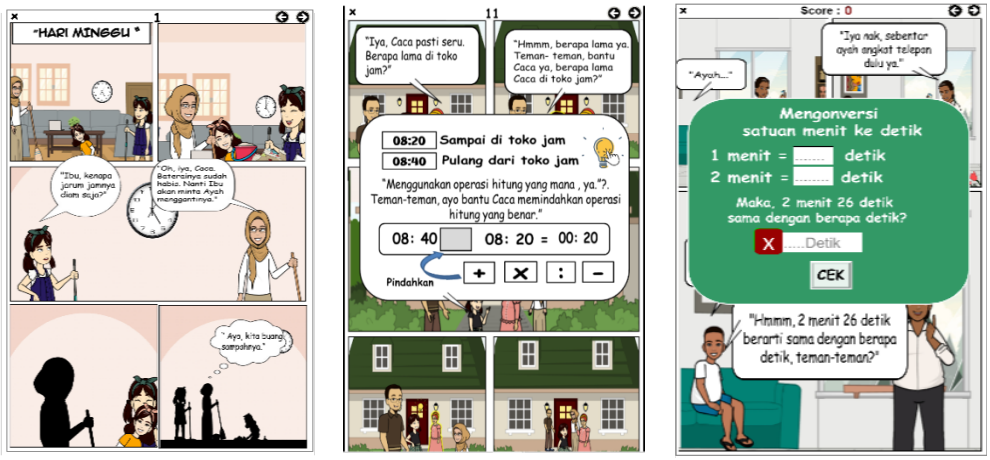

Figure 3. The appearance of the media

Before testing the media with users, it was first validated by experts. For validation, there are 2 material matter experts and 1 media expert. Based on the validation questionnaire, the results of the material matter expert validation are shown in Table 5, with a percentage of 92%, which falls under the "very valid" criteria according to Table 6. Meanwhile, the percentage of the media expert validation results is 80%, categorized as "valid," as indicated in Table 6 Based on the validation assessment results, this interactive comic media can be used as instructional media for the concept of time for fifth grade and is ready to be tested with users.

Table 5. Data Analysis Results from Material Matter Expert Validation

Assessment Aspect	Assessment Indicator		Validator Evaluation	
			a	b
Relevance of material to curriculum	Material meets learning objectives		4	5
	Material covers all aspects of the concept of time		5	3
Suitability of comic to student needs	Comic matches students' cognitive development level		4	5
	Comic matches student characteristics		4	4
	Comic is easy to use in learning activities		5	5
	Comic media can motivate students in learning.		5	5
	Comic media facilitates student understanding of time units.		5	5
Readability and comprehension of material	Learning topics presented clearly		4	5
	Storyline presented clearly		5	5
	Language used is easy to understand		4	5
		Total score	45	47
		Percentage	92%	

Table 6. Data Analysis Results from Media Expert Validation

Assessment Aspect	Assessment Indicator		Validator Evaluation
Comic design and illustrations	Comic design is appealing		5
	Illustrations presented clearly		4
	Color proportion is appropriate		4
	Text and image layout is balanced		2
	Sentences used are simple		4
Suitability to users and materials	Comic design is appealing		5
	Illustrations presented clearly		4
	Image and color selection matches student characteristics		4
		Total Score	32
		Percentage	80%

Table 7. User Trial Data

Student's Name	Assessment Item Number							Total Score
	1	2	3	4	5	6	7	
Amelia .S	5	5	5	5	3	5	5	33
Fahmi	5	5	5	5	3	5	5	33
Dewi Sulistiana	4	4	5	4	4	5	5	31
Zakli	5	5	5	5	5	5	5	35
Azza H.M.Y	5	5	5	5	5	5	5	35
Rara	5	5	4	4	5	4	5	32
Ani	5	5	5	5	5	5	5	35
Tata	5	5	4	5	4	5	5	33
Belgis	4	5	5	5	4	4	5	32
Aini	5	5	5	5	5	5	5	35
Total Score	48	49	48	48	43	48	50	334
Percentage	96%	98%	96%	96%	86%	96%	100%	95.42%

Notes on Assessment Item Numbers:
1. This comic is easy to use.
2. The comic's appearance is attractive.
3. The story in this comic is engaging.
4. The comic helps me understand the material on time.
5. I can understand the story in the comic.
6. I enjoy learning with this comic.
7. This comic makes me more enthusiastic about learning.

The final stage is the Evaluation stage, which involves revising the developed media based on suggestions for improvement from the media and material matter experts. After the media is deemed valid and has been revised according to the suggestions provided, we conducted a user's trial. The results of this trial indicate that there are no suggestions or comments from students for improving the comic media. Thus, it can be concluded that the developed comic media has been proven valid and effective for use in the learning process. Table 7 showed the analysis result from user's trial.

Based on the development results described earlier, the interactive comic got good results and feedback. The was validated by two experts: 2 material matter experts and 1 media expert. The validation results showed that the material matter expert's evaluation yielded a percentage of 92% with the "very valid" criterion, indicating that the material in the interactive comic about the concept of time for fifth-grade students is valid in terms of content, along with additional suggestions and corrections from the material validation expert. Meanwhile, the validation from the media expert received a percentage of 80% with the "valid" criterion, affirming that the digital comic learning media is also valid for use in terms of teaching materials, with additional suggestions and corrections from the media validation expert.

The media was trialed at the school with fifth-grade students The survey results showed that the comic as a learning medium was very well received by students. A total of 100% of students felt that the interactive comic media successfully motivated them to learn enthusiastically. Additionally, 98% of students stated that the comic's appearance was very appealing, and 86% of students were able to understand the comic's content well. Meanwhile, 96% of students found this comic media easy to use and helpful in understanding the concept of time. The overall results from the student trials reached a percentage of 95.42%. Thus, the interactive comic for the concept of time for fifth-grade students has proven to be very effective in supporting the learning process. Based on the results of validation and trial, it can be concluded that the developed comic media has been proven valid and effective for use in the learning process.

4. CONCLUSION

The development of interactive comic media for class V time concept material was developed using the ADDIE approach which began with the analysis stage to identify students' difficulties in understanding the concept of time. The Design stage involved compiling comic scripts and visual designs such as storyboards, comic characters, text balloons, animations, and interactive buttons. Furthermore, the Development stage was carried out by implementing the design using the GDevelop application. Validation was carried out by material experts and media experts, with the results of the validation of material experts reaching a percentage of 92% (criteria "very valid") and media experts reaching 80% (criteria "valid"). The implementation of interactive comic media was carried out by testing it on students, achieving a positive response rate of 95.42% from students. This trial showed a high level of motivation and understanding of the material. Thus, this interactive comic media has proven effective in improving the quality of mathematics learning in elementary schools, providing a fun and effective approach for students in understanding the concept of time.

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