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Development of Augmented Reality Based Comic Media Through Digital Library Applications for Visual Communication Capability

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ABSTRACT

Learning with more innovative media is needed to support students' abilities and also attract students' interest and attention. Apart from that, innovative media can also increase students' motivation and enthusiasm for learning. This research was conducted with the aim of developing augmented reality-based comic media to improve students' visual communication skills. This research was carried out using a 4D development model. The subjects of this research were class IV students at SDN Kendalrejo 01 Blitar Regency. The instruments used by researchers in conducting research are interviews, questionnaires, tests and also documentation. The data obtained by researchers was then analyzed to determine the level of feasibility and validity of the product. The media expert test results got a score of 97.5% and the material expert got a score of 95.8%. Researchers also conducted tests to see improvements in students' visual communication skills and obtained an average pre-test score of 70.75 and a post-test score of 95.5. The results of this research show that (1) Augmented reality-based comic media can improve students' visual communication skills. (2) The comic media developed by researchers is classified as very valid. This proves that comic media is effectively used in the learning process.

1. Introduction

Education plays a very important role in everyday life. Education is the main element in shaping karma, thought patterns, morals and human behavior so that they comply with applicable norms, such as religious norms, moral norms, politeness norms and legal norms. The role of education provides provisions for individuals to develop themselves and solve all daily problems (Alfi & Perdana, 2019). Complete facilities and high technology make education increasingly

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developed, just like education in the 21st century. In the last 20 years there has been a shift in the development of education as one of the education management strategies in the 21st century which includes institutional governance and human resources. According to Lase (Miahara & Fatoni, 2023) improving the quality of human resources through educational pathways from primary and secondary school education to tertiary institutions is the key to following the development of the revolution. So that a high and fast technological system makes education superior in developing.

The 21st century is known as the knowledge age, a time when all alternative efforts to fulfill life's needs in various competitions are based more on knowledge and creativity without being limited by space and time. In line with Kuncahyono's opinion (in Mardhiyah et al., 2021) who said that to face various challenges and demands, practice in the 21st century is to prepare a generation that directly requires students to carry out activities without being limited by space and time. The 21st century generation does not only rely on knowledge in one field, but demands to have very broad knowledge in all fields. As Aoun argues (in Mardhiyah et al., 2021), a new movement is designed for the 21st century which focuses on three main literacies, namely 1) digital literacy, 2) technological literacy, 3) human literacy.

Extensive knowledge can come from anywhere, someone who is active in looking for new things will find knowledge that they did not know before. Activeness in the world of education is required to achieve complex reciprocal relationships. Currently, education is still not very developed in the field of student-centered learning. Meanwhile, the nation will develop if the learning process is good and optimal. The learning process is required to be active so that learning is achieved effectively. Education is the most important factor in a person's life, because it can distinguish a person's ability to think (Bella, 2023).

When students are passive and receive material without any reciprocity, of course this method will quickly forget something they received. The activeness of students in the teaching and learning process will create an active learning situation. Active learning is needed by students to get maximum results. Activeness does not only come from physical but also non-physical. The activeness of today's students is developing slowly and the intensity of learning is lacking. The pandemic outbreak which has greatly consumed the teaching and learning process is also the reason students are more susceptible to advanced thinking patterns.

According to Taradisa (in Munandar et al., n.d.) during childhood, children should learn a lot using motor skills, actively moving around, playing while learning, learning in groups with their friends. Even before the pandemic occurred, educational attainment in Indonesia was not optimal, this can be seen in the Program for International Student Assessment (PISA) scores by the OECD in 2018. The behavior of criticizing knowledge is also very rarely carried out. Students mostly study when they have tests or homework assignments. Apart from that, methods like this will also make students quickly forget the material so

that meaningful learning will be lost or not even implemented in the learning process.

Learning is a change in behavior due to experience and practice. Learning means a process of changing a person's personality where the change is in the form of improving the quality of behavior, such as increasing knowledge, skills, thinking power, understanding, attitudes and various other abilities (Djamaluddin & Wardana, 2019). Learning is a change in students' abilities, attitudes, or behavior as a deliberate effort by educators that is relatively permanent as a result of students' experiences carrying out learning activities. The learning process has two very important elements, namely teaching methods and learning media. These two aspects are interrelated. In the teaching and learning process, teachers have the task of encouraging, guiding and providing learning facilities for students to achieve goals. One of the learning facilities provided by teachers is using appropriate learning media. Students' critical thinking abilities are very necessary to shape students' cognitive strengths (Agustia, 2024).

Learning media is a component that plays an important role in the learning process. The use of media in the learning process can arouse students' interest and motivation to learn, reduce or avoid verbalism, generate orderly, systematic reasoning, and to foster understanding and develop values in students (Nurfadhillah et al., 2021). In accordance with developments in science and technology, teachers can at least use cheap and efficient tools to achieve the expected teaching goals. Educators are required to have creativity in developing learning media that they will use if the media is not yet available (Pito, 2018). Through learning media teachers can communicate with students. Material that cannot be explained by the teacher through verbal language will be represented by the media used. Apart from that, learning media is made as attractive as possible by combining various colors to increase student motivation in learning (Fatih, 2020). So, apart from media being used as a means of transmitting information, media can also be used as a tool to increase students' motivation in learning.

The benefits of media in learning are: (1) Delivery of subject matter can be uniform, (2) the learning process becomes clearer and more interesting, (3) the learning process becomes more interactive, (4) efficiency in time and energy, (5) improves the quality of results student learning, (6) media allows the learning process to be carried out anywhere and at any time, (7) media can foster students' positive attitudes towards the material and learning process, (8) change the role of teachers in a more positive and productive direction (S & Rohani, 2018). So it can be concluded that in order for the learning process to run well, the material should be delivered using appropriate learning media. The use of learning media will make it easier for teachers and clarify the delivery of material. Learning media will also make it easier for students to understand the material presented, provide students with motivation and interest in learning.

Based on observations made at SDN Kendalrejo 01 Talun, Blitar Regency, several problems were found. These problems include the limited use of conventional learning media such as printed media in the form of textbooks, causing students to

use print media in rotation. This is in line with the opinion of Fatih (2018) who said that the limitations of this media make the learning process in class and independent learning less interesting and less enthusiastic and motivated to learn. Apart from that, teachers have not been able to maximize the use of learning media in the teaching process. The lack of teacher ability in making media and limited time in making media are also the reasons why most teachers use minimal learning media or even do not use learning media.

Based on the problems found above, researchers offer several solutions to improve the learning process for the better. There are many media that can be used to carry out learning activities, one of which is comic media. The researcher raised a story comic application project which contained interesting learning material that was easy for students to understand. Not only that, in this comic story there are practice questions and discussions which will make it easier for students to understand the learning material.

According to Gumelar (in Fadhli & Hidayat, 2022) comics are sequences of images arranged according to the creator's goals & philosophy so that a cheerful message is conveyed, comics tend to be given the necessary lettering according to needs. According to McCloud (in Lubis, 2017) comics are images lined up in a deliberate sequence, intended to convey information or produce an aesthetic response from the reader. Daryanto defines comics as a form of cartoon that reveals characters and implements a story in a sequence that is closely related to the images and is designed to provide entertainment to readers (Daulay, 2021). From several of these definitions it can be concluded that comics are a sequence of images arranged in a row as a form of cartoon that expresses character and implements a story that aims to produce an aesthetic response and provide entertainment to readers. In this research, researchers will develop comic learning media based on augmented reality.

Augmented reality is a technology that combines the real world with the virtual world (Alfitriani et al., 2021). According to Singgih Yuntoto (Setiawan & Dani, 2021) augmented reality (AR) is a 2-dimensional or 3-dimensional virtual object that is built by technology and then projected in real time, but the system is closer to the actual environment. Augmented reality has 3 characteristics, namely (1) combining the real and virtual worlds, (2) interactive in real time, (3) allowing it to be displayed in 3D (Setiawan & Dani, 2021). This technology can be used in various ways, one of which is used in the world of education as a learning medium.

Visual communication is one of the important skills that a person must have. Through visual communication, we can understand the facts and make better decisions about what to do next (Supriyadi et al., 2022). Visual communication ability refers to a person's capacity to identify visual and communicative relationships between objects in real life and to implement them habitually. Visual ability is the ability to communicate which is measured in terms of the ability to imagine objects, create global shapes by looking for small components, or to understand the differences and similarities between objects.

In the latest curriculum currently being implemented, namely the independent curriculum, there are several subjects that have been given slight changes. One of them is science subjects which are combined with social subjects. Currently this subject is known as the Science subject. One of the materials in this subject is material regarding natural resources. This material teaches children to know the importance of efforts to balance and preserve natural resources in the surrounding environment.

Research with similar variables was conducted by Elly Sukmanasa, Tustiyana Windiyani and Lina Novita with the title "Development of Digital Comic Learning Media in Social Science Subjects for Class V Elementary School Students in Bogor City". The results of this research show that digital comic learning media can increase students' interest in participating in the learning process (Sukmanasa et al., 2017). Apart from that, similar research was also carried out by Farhan Saefudin Wahid, Alim Mutaqin and Yasin with the research title "Development of Digital Comic Learning Media for Elementary School Students".

This research shows that digital comic media in online learning process activities shows that digital comics are suitable for use in online learning activities. This is concluded from the average scores obtained from material experts, media experts, students in one-on-one or group trials and students in field trials (Wahid et al., 2021). Other research was also conducted by Pramudya Gunawan and Sujarwo with the title "Using Comics as a History Learning Media in Increasing Student Motivation and Learning Outcomes". This research shows that the results of the research that has been carried out illustrate that the use of comic media in history learning can significantly increase student motivation and learning outcomes (Gunawan, 2022).

This research aims to develop media in the form of comics based on augmented reality to improve students' visual communication skills so that the researchers conducted research (RnD) with the title "Development of Comic Media Based on Augmented Reality through Digital Library Applications on Visual Communication Abilities".

2. Methodology

This research was conducted on class IV students at SDN Kendalrejo 01 Talun, Blitar Regency. In this study, researchers used several instruments in the process of collecting data. These instruments include interviews, questionnaires, tests and documentation. The following is a further explanation of the instruments used by researchers Figure 1.



Figure 1. 4D Model Stages

- a. An interview is an in-depth exploration and comprehensive observation of a phenomenon that is the object of research (Hansen, 2020). In this research, the researcher used an interview technique in the process of finding problems that occurred at school.
- b. A questionnaire is a list of questions given to other people willing to provide responses according to the user's request (Syarifuddin et al., 2021). In this study, researchers used a questionnaire instrument in the product validation process with several experts.
- c. Tests are one of the most effective measuring tools used by teachers to measure the quantity and quality of their learning (Suwanto & Musa, 2022). According to Adzimah, et al (in Resti et al., 2020) a test is a method of assessment that is designed and implemented for students at a certain time and place and under conditions that meet certain clear conditions. In this study, researchers used tests to see differences in conditions before and after the research.
- d. According to Ulfah (in Tanjung et al., 2022) documentation is a technique for collecting data through existing documents or written notes. According to Moleong in Arifudin (in Musyadad et al., 2022) documentation is a way of collecting information or data through examining archives and documents. This research uses the Research and Development (R&D) research and development method with a 4D model. Figure 1 below is a sequence of stages of the 4D model (Widiyasari et al., 2020).

3. Results and Discussion

- a. Process of Developing Comic Learning Media Based on Augmented Reality Using Digital Library Applications. The process of developing augmented reality-based comic learning media using a digital library application uses the 4D development model stages. The following is an explanation of the media development process.

a. Definition Stage (*Define*)

At this stage the researcher initially identified the curriculum at SDN Kendalrejo 01 Talun which included basic competencies, learning objectives and learning indicators. At this stage, the researcher then received information that students still did not understand the material regarding efforts to balance and preserve natural resources in their environment. Next, the researcher conducted a field study by analyzing subjects at SDN Kendalrejo 01 Talun, namely 20 grade IV students at SDN Kendalrejo 01 Talun. students to find out the characteristics of students. The results of the subject analysis were obtained from interviews with

class teachers who stated that students had used an application in the form of a link in which there was lesson material and a recording of the teacher's explanation of the material, but the application was not yet interesting and students did not understand the material in the application. After knowing the problems that exist in the school, researchers then formulate the media that will be developed. Researchers will develop comic media based on augmented reality using a digital library application.

b. Design Stage (*Design*)

At this stage, researchers began to create comic media applications according to what was needed. The comic contains material and practice questions related to material about the importance of efforts to balance and preserve natural resources in the environment. Comic media was created using a digital library application using WordPress CMS. The application was created with several categories based on menus to make it easier for users to search for material. Researchers also added an Elementor plugin extension which functions to create and beautify the appearance of the page. Added PWA plugin which aims to make it easier for users to use mobile applications via a browser. To make the appearance of the application more attractive, researchers used the Corel Draw application. After that, the researcher prepares a soft file in the form of a PDF or video which will be input into the application. As in Figure 2, the application display will consist of 3 parts, namely the material section, the comic/pdf section and the questions section.

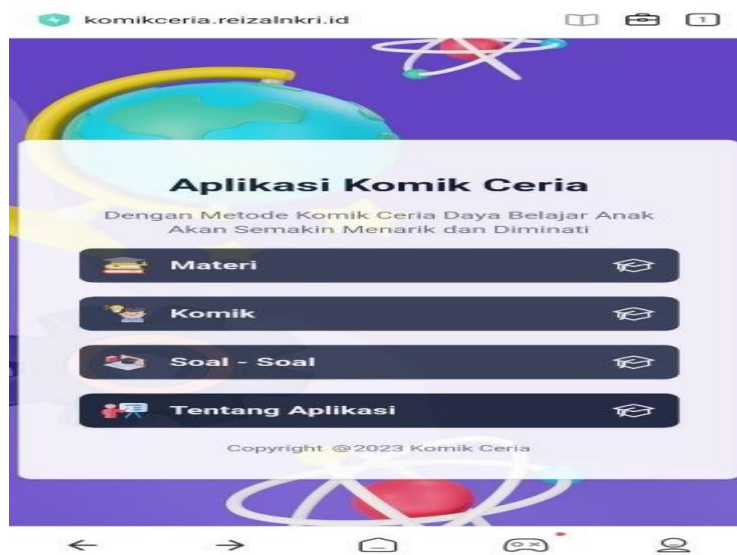


Figure 2. Display of the Digital Library Application

Figure 3 shows the application menu display which consists of three parts, namely material books, comics and questions.

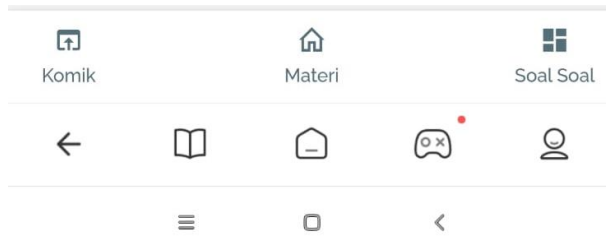


Figure 3. Menu Display

Presentation of material about the importance of efforts to balance and preserve natural resources in the environment as shown in Figure 4 below.

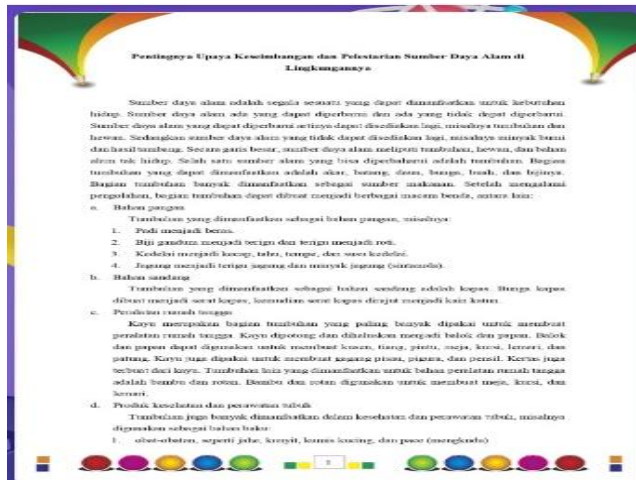


Figure 4. Material display

Figure 5 shows a comic display that tells about the importance of efforts to balance and preserve natural resources in the environment.



Figure 5. Comic View

There are practice questions in the comic learning media, namely by using the Google form included in the application. The practice questions display as in Figure 6.



Figure 6. Evaluation Questions in Comic Applications

a. Development Stage (Develop)

After preparing the comic media using a digital library application, the comic media is then tested for validity by media experts and material experts to determine the level of validity and suitability of the media that has been designed. The validity and revision of this learning media takes the form of quantitative data and qualitative data. Quantitative data was obtained from an inkert scale assessment questionnaire, while qualitative data was in the form of assessments originating from validator suggestions.

b. Thrial Phase (Disseminate)

After carrying out validation and feasibility tests on experts and the media developed by researchers was declared valid and appropriate, the researchers then conducted media trials on class IV students at SDN Kendalrejo 01 Talun, Blitar Regency, a total of 20 students. Researchers gave 2 instruments to be tested on students.

a. Validity of Augmented Reality Based Comic Learning Media Using Digital Library Applications.

Researchers conducted validation tests on material experts and media experts. Validity tests were carried out to determine the level of validity of the instrument (Pramesti et al., 2021). The following is a description of the results of the validation tests carried out by the paneliti.

a. Media Expert

The media expert validation test was carried out by researchers on Mrs. Shofi Nur Amalia, M.Pd as a lecturer in the Elementary School Teacher Education study program at Nahdlatul Ulama University, Blitar. The validation test carried out by researchers obtained a score of 97.5%. When matched with the criteria table, these results get a very valid category. However, the examiners provided a little input to

the researchers to improve the words, sentences and images as well as placing the UNU Blitar logo on the application.

b. Material Expert

The researcher carried out the material expert validation test on Mrs. Widyarnes Niwangtika, M.Pd as a lecturer in the Elementary School Teacher Education study program at Nahdlatul Ulama University, Blitar. The validation test carried out by researchers obtained a score of 96.8%. When matched with the criteria table, these results get a very valid category. However, the examiner gave little input to the researcher to add concrete material to the student environment. The following is a graph of the results of validation tests carried out by researchers in Figure 7.

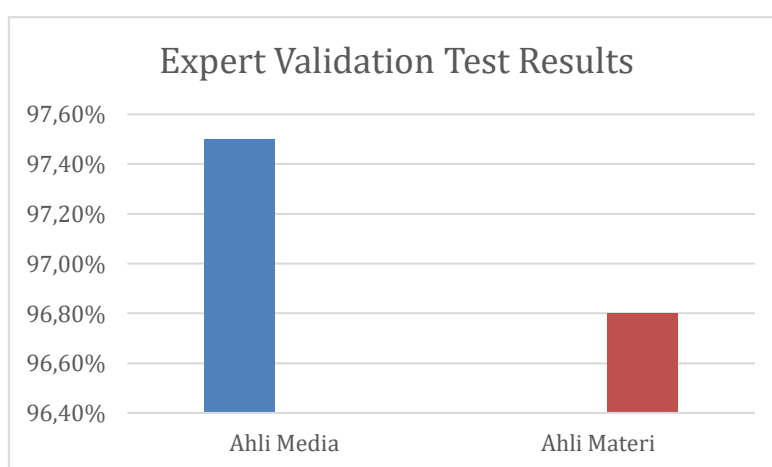


Figure 7. Expert Validation Test Results

b. Increasing Visual Communication Capabilities in the Learning Process After Developing Augmented Reality-Based Comic Media in Digital Library Applications.

Comic media using a digital library application was developed with the aim of assisting students in the learning process regarding the importance of efforts to balance and preserve natural resources in their environment at the elementary/MI class IV level, especially at SDN Kendalrejo 01 Talun. Implementing comic media in the classroom in the learning process does not require a lot of time, in the learning process students are given questions to work on. Then students are asked first to understand the material about the importance of efforts to balance and preserve natural resources in their environment. After students understand, students are invited to observe comics in the cheerful comic media application, then students are given questions and assignments to develop the material in the form of activities.

Improvement in visual communication skills in this research was measured by carrying out the pre-test and post-test stages through the t test which was implemented on class IV of SDN Kendalrejo 01 Talun, totaling 20 students. The t test is a test to determine the significance of the influence of the independent

variable on the dependent variable individually (Saputra et al., 2021). The following are the results of the students' pre-test and post-test.

Table 1. Paired Sample Statistics Calculation Results

		Paired Samples Statistics			
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreTest	70,75	20	26,620	5,952
	PostTest	95,50	20	7,395	1,654

In the table above it can be seen that the average pre-test score is 70.75 and the post-test score is 95.5. This shows that the post-test score is better than the pre-test. So there are significant differences in the use of learning media that have been developed. This difference can also be seen from the test results using the Paired Sample T-Test formula, namely Sig. (2-tailed) follows.

Table 2. Paired Sample T-Test Calculation Results

Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		Paired Differences	t	df	Sig. (2-tailed)	
			Lower	Upper					
Pair 1	PreTest - PostTest	-24,750	20,555	4,596	-34,370	-15,130	-5,385	19	,000

This data has a value of 0.000 or less than 0.05 so it can be said that H_0 is rejected and H_a is accepted. Based on the results of these calculations, it can be concluded that comic media is effectively used in the learning process to help students understand material about the importance of efforts to balance and preserve natural resources in their environment, making it easier for students and teachers in the science learning process. The results of increasing student abilities above are in line with research conducted by Juni Artha Juneli et al, (2022) with the title "Development of Digital Comic Learning Media in Concept Mastery of Class V Elementary School Students" showing the results that there is an increase in student learning outcomes before and after learning. . Apart from that, it was also carried out by Aan Putra and Ines Feltia Melania with the title "Systematic Literature Review: Comic Media in Mathematics Learning" which shows the results that comic media in mathematics learning can improve students' problem solving abilities (Putra & Milenia, 2021). This further proves that comic media can be used as a learning medium to help improve students' learning abilities.

4. Conclusion

The conclusion of the research entitled Development of Augmented Reality Based Comic Media on Natural Resource Material Through Digital Library Applications on the Visual Communication Ability of Class IV Students at SDN Kendalrejo 01 Talun, Blitar Regency is as follows. 1) This research produces a product in the form of developing comic media based on augmented reality of natural resource

material through a digital library application for the visual communication abilities of class IV students. The stages that researchers went through to develop this media were the definition, design, development, and disseminate stages. 2) Based on the validation results from media experts and material experts, it can be seen that the media developed by researchers is classified as very valid criteria so that it can be used by researchers to conduct research. 3) Based on the results of the pre-test and post-test scores and the results of the questionnaire submitted by the researcher to class IV students at SDN Kendalrejo 1 Talun, Blitar Regency, there was an increase in learning outcomes before and after the learning was implemented.

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