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Augmented Reality Media to Improve Science Literacy and Metacognitive Ability for Fifth Grade Elementary School

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ABSTRAK

Keaktifan siswa masih sangat kurang dan penerapan literasi hanya mengandalkan buku ajar. Tujuan penelitian ini yaitu mengembangkan media Augmented Reality untuk meningkatkan literasi sains dan metakognitif kelas V SD. Jenis penelitian ini yaitu pengembangan model ADDIE. Subjek penelitian yaitu 2 ahli media dan 2 ahli isi pembelajaran. Subjek uji coba yaitu 25 dan 2 guru. Metode mengumpulkan data menggunakan wawacara, angket, tes dan observasi. Instrument pengumpulan data menggunakan rating scale. Teknik analisis menggunakan metode analisis kualitatif dan kuantitatif serta analisis statistic infrensial. Hasil penelitian yaitu penilaian yang dilakukan oleh ahli materi mendapatkan 4,85 (sangat baik) dan ahli media 4,83 (sangat baik). Hasil validiasi respon guru yaitu 4,62 dan respon siswa yaitu 4,7 sehingga sangat baik. Hasil uji hipotesis yaitu diperoleh signifikasi 0,000 baik di uji secara bersama-sama maupun terpisah, sehingga terdapat perbedaan yang signifikan literasi sains dan kemampuan metakognitif. Disimpulkan bahwa Augmented Reality dapat meningkatkan literasi sains dan metakognitif.

ABSTRACT

Student activity is still very lacking, and the application of literacy only relies on textbooks. This research aims to develop Augmented Reality media to improve scientific and metacognitive literacy for fifth-grade elementary school students. This type of research is the development of the ADDIE model. The research subjects are two media experts and two learning content experts. The test subjects were 25 and 2 teachers—collecting data using interviews, questionnaires, tests, and observations. The data collection instrument uses a rating scale. The analysis technique uses qualitative and quantitative analysis methods and inferential statistical analysis. The study results are the assessments made by material experts get 4.85 (very good) and media experts 4.83 (very good). The teacher's response validation results are 4.62, and the student's response is 4.7, so it is very good. The hypothesis test results are obtained with a significance of 0.000, tested together and separately, so there is a significant difference between scientific literacy and metacognitive ability. It was concluded that Augmented Reality could improve scientific and metacognitive literacy.

1. INTRODUCTION

In building a country, advanced education is needed. Education is a learning process with a method that can make a person gain the knowledge and skills expected (Angeli & Giannakos, 2020; Guo et al., 2020). In educational activities, there are learning activities that can help students understand information. Metacognitive is awareness of students about learning. Students can use this ability to explore sources of information to improve their learning progress (Dewi et al., 2018; Yusoff et al., 2021). Students are expected to be able and aware of the ability to think so that they know something easily. Students can find out how to learn well and use various information to improve themselves for the better (Dinsmore & Zoellner, 2018; Widyaningsih et al., 2020). Students with metacognitive abilities will tend to know the best learning strategies for themselves to become effective (Berger & Karabenick, 2016; Zheng et al., 2019). It is concluded that this metacognitive is knowledge about cognitive processes that can be used to control oneself. This metacognitive experience involves metacognitive strategies. This strategy is a process that is carried out sequentially to control cognitive activity and ensure that goals have been achieved (Dinsmore & Zoellner, 2018; Mehrdad et al., 2012). This metacognition emphasizes the

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awareness of one's thinking about himself. It makes this ability very important for students to realize what must be done and conduct appropriate evaluations in learning activities so that learning objectives become effective (Jia et al., 2019; Meher et al., 2020). Through this, educational goals can be achieved optimally. Students with good metacognitive skills will certainly affect learning, so they can also improve their scientific literacy.

Scientific literacy is the ability to apply scientific concepts to everyday life. This ability can also help students explain and describe scientific phenomena based on scientific evidence (Aiman et al., 2019; Pertiwi et al., 2018). Scientific literacy is the ability to apply science and identify and draw conclusions based on the available evidence (Kimianti & Prasetyo, 2019b; Lestari & Siskandar, 2020). This scientific literacy can also make students understand and make decisions about nature and natural changes due to human activities (Afni et al., 2018; Wibowo & Ariyatun, 2020). Students who understand and have scientific literacy will be able to solve a problem based on scientific knowledge and evidence. Scientific literacy can also be said as knowledge about science and processes that can develop scientific attitudes and students' understanding of science. Students not only master concepts but make decisions based on scientific considerations and complex understandings (Andriani et al., 2018; Fuadi et al., 2020). It causes students to be expected to understand the knowledge gained at school through scientific literacy skills so that students have sensitivity and concern for nature. At the elementary school level, science is very important. This science learning can provide for students facing challenges (Agustina et al., 2020; Nofiana & Julianto, 2018). Therefore, a learning method is needed to help prepare students for good and critical metacognitive competence and scientific literacy.

However, previous research revealed that many students still had poor metacognitive skills (Hendi et al., 2020; Wardana et al., 2021). Other research findings also state that some students still have poor scientific literacy (Aiman et al., 2019; Lestari & Siskandar, 2020). Many factors affect the low literacy of students, such as the selection of learning resources that are not appropriate. It is in line with research that states that the causes of low scientific literacy are related to the selection of learning resources. Especially in Indonesia, scientific literacy is still limited to textbook material during direct learning, so learning activities are more teacher-centered with the lecture method (Kimianti & Prasetyo, 2019b; Wibowo & Ariyatun, 2020). It causes science learning to be very heavy and boring, so students do not understand science material (Andriani et al., 2018; Fuadi et al., 2020). The observations made at SD Negeri 3 Melaya also found that student activity was still very lacking, and students lacked interest in participating in learning. The application of this literacy which only relies entirely on textbooks, does not make students motivated and understand concepts well. In addition, the lecture method is also less relevant because it causes students to become passive. The low metacognitive ability causes students to be less able to plan study time and complete assignments given by the teacher, so they feel a lack of time. In addition, this low ability can also make students less confident and affect low learning outcomes. On the other hand, students who do not develop their abilities are also less able to solve problems.

The solution to overcome this problem is to use media that can help students, such as the use of augmented reality media. Augmented Reality allows learning activities to apply information technology to be more interesting, especially in learning (Lai et al., 2019; Mustaqim & Kurniawan, 2017). Augmented Reality is a media that combines two-dimensional or three-dimensional media whose application is to project virtual objects in real-time (Mortara et al., 2015; Sharma, 2019). Augmented Reality can also be said to be a technology that merges virtual and real worlds so that they are interactive and in the form of three-dimensional animation. Augmented Reality aims to simplify difficult understanding concepts so that it makes learning easier for students (Ratten, 2020; Shahroom & Hussin, 2018). Augmented reality media will create a more interesting atmosphere and clear material delivery (Chen & Chan, 2019; Kholiq, 2020). 3D features will clarify the material and can be seen directly by students through this technology. Learning activities like this will create scientific literacy and affect students' metacognitive abilities.

The findings of previous studies also state that Augmented Reality is feasible to use (Bakri et al., 2018; Gusmida & Islami, 2017). Other research findings also state that Augmented Reality helps to learn activities and can appreciate students so that learning becomes fun (Cai et al., 2020; Park et al., 2020). Other research also states that Augmented Reality can make activities meaningful and active to help and improve students' abilities (Hasan Lubis & Darwis Dasopang, 2020; Ivonne et al., 2020). There is no study on augmented reality media to improve scientific literacy and metacognitive abilities in the human organ system material for fifth-grade elementary school students. The advantage of this media is that it will use examples of material that are easier to understand by students so that learning becomes more fun. The purpose of this research is to develop Augmented Reality media. It is hoped that this media can improve scientific literacy and metacognitive abilities.

2. METHOD

This type of research is the development of the ADDIE model, which includes analysis, design, development, implementation, and evaluation (Harjanta & Herlambang, 2018). The research subjects are two media experts and two learning content experts. The test subjects were 25 fifth-grade students and two SD Negeri 3 Melaya. Methods in collecting data using interviews, questionnaires, tests, and observations. Observations were made to analyze the process and find out the problems and the use of media. The interview method collects the problems that occur—the questionnaire method to collect responses and the test method to determine student understanding. The data collection instrument uses a rating scale. The grids are presented in Table 1, and Table 2 Modified from (Sahin & Yilmaz, 2020).

Table 1. Material Expert Instrument Grid

No	Variable	Sub Variable	Number of Items
1	The truth of the material structure	1. The suitability of indicators with basic competencies. 2. The suitability of the learning objectives with the indicators. 3. The material presented is appropriate to the learning objectives.	3
2	The accuracy of the material in it	1. Completeness of the material presented. 2. The breadth of the material presented. 3. The accuracy of the material presented is based on facts.	3
3	The correctness of the grammatical presentation	1. The suitability of the Indonesian language used with students. 2. The compatibility of the Indonesian language with the Indonesian language rules.	2
4	Accuracy of punctuation	1. The use of punctuation in the material presented.	1
5	The suitability of the level of difficulty of the material with the user	1. The level of difficulty of the material according to the characteristics of students. 2. The initial material can relate to students' initial knowledge. 3. The initial material can relate to students' initial knowledge. 4. Objects or illustrations on the learning media can clarify the material presented.	4

Table 2. Media Expert Instrument Grid

No	Variable	Sub Variable	Number of Items
1.	Text	1. Text composition on the application 2. Color, size and type of text on the app 3. The text can be read clearly.	4
2.	Visual	1. The suitability of the image with the material. 2. Color and background selection 3. Ease of navigation. 4. Image compatibility.	5
3.	Audio	1. Audio clarity 2. Audio accuracy with the material. 3. Audio quality 4. Dubber voice clarity..	4
4.	Audiovisual	1. Elements of 3D objects that are displayed according to the material. 2. Interesting 3D objects. 3. 3D object quality	3

Test the validity of the instrument items using the CVR formula and content validity with CVI. This study's data is analyzed using qualitative and quantitative methods and inferential statistical analysis. Qualitative data were obtained from questionnaires to respondents, and quantitative data were obtained through data processing in the form of expert scores. Inferential statistical analysis was used to determine the effectiveness of Augmented Reality learning media in improving scientific literacy and students' metacognitive abilities.

3. RESULT AND DISCUSSION

Result

This study develops augmented reality learning media to improve scientific literacy and metacognitive abilities in the human organ system material for fifth-grade elementary school students with the ADDIE model. First, analysis. The analysis results show that students' activity is still very lacking and students lack interest in participating in learning. The application of this literacy which only relies entirely on textbooks, does not make students motivated and understand concepts well. In addition, the lecture method is also less relevant because it causes students to become passive. The low metacognitive ability causes students to be less able to plan study time and complete assignments given by the teacher, so they feel a lack of time. In addition, this low ability can also make students less confident and affect low learning outcomes. On the other hand, students who do not develop their abilities are also less able to solve problems.

Second, design. This stage is designing augmented reality learning media based on analysis. At this stage, it starts with transferring the information obtained in the analysis stage into a document which will be the basis and purpose of Augmented Reality learning media for science subjects for human digestive organs. At this stage, a scientific literacy and metacognitive ability test was also designed to determine the difference between scientific literacy and metacognitive ability in fifth-grade students of SD Negeri 3 Melaya, which was carried out using an instrument in the form of a questionnaire for scientific literacy and a description test for metacognitive abilities. The results of the design are presented in Figure 1.

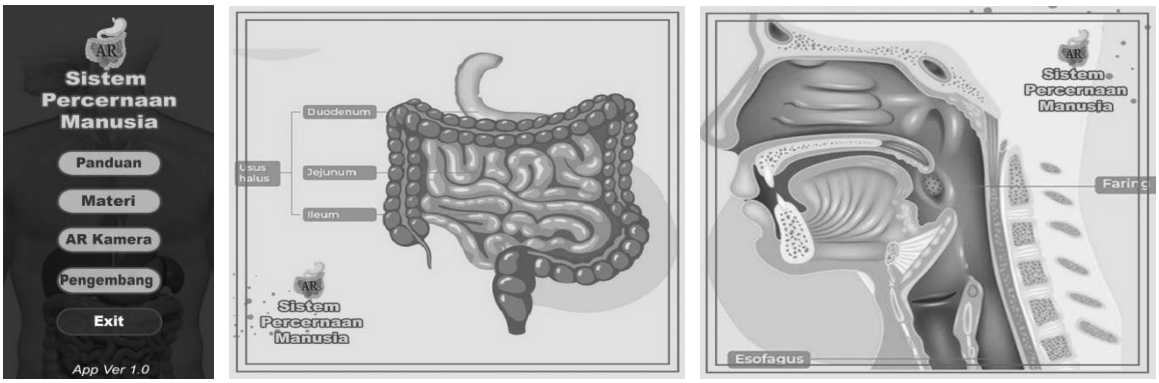

Figure 1. Augmented Reality Design

Third, development. This stage is the development of augmented reality learning media based on the design results. The main view contains an overview of the content to be studied. In addition, this media presents a guide display. This media is equipped with a display of the material to be discussed. The media is equipped with the material's content to be discussed to make it easier for users to understand the material to be discussed. This media is equipped with pictures of human digestive organs. The results of the development are presented in Figure 2.

Figure 2. Results of Augmented Reality Development

Experts then assess augmented Reality. The assessment carried out by learning material experts got 4.85, the average score with a range of 4.0 < X 5.0, so it was very good. The learning media expert assessment results are 4.83, the average score with a range of 4.0 < X 5.0, so it is very good. The teacher's response validation results are 4.62, so it is very good, and the student response is 4.7, so it is very good. It was concluded that Augmented Reality got good qualifications and deserved to be used.

Fourth is implementation. This stage tests the effectiveness of Augmented Reality media. It tests the effectiveness of augmented reality media with SPSS by performing a manova test. The normality test results, namely the significance value for the posttest results of metacognitive abilities in the Kolmogorov Smirnov column, get a price of 0.152. Then the significance value for the post-test results of scientific literacy is 0.200. At the same time, the significance value for the metacognitive ability pretest is 0.200. Then the significance value for the results of the scientific literacy pretest in the Kolmogorov Smirnov column is 0.098. It was concluded that the pretest and posttest data groups of students' scientific literacy skills and metacognitive abilities were normally distributed. The homogeneity of variance test results, namely the results of scientific literacy and metacognitive ability on the posttest and pretest results, was 0.715. Then if tested separately, the significance for metacognitive ability was 0.933, and for scientific literacy, it was 0.332. concluded that the distribution is homogeneous. Based on the results of the MANOVA test, a significance of 0.000 was obtained, both tested together and separately. It means the significance obtained is smaller than 0.05, so it can be concluded that H0 is rejected and H1 is accepted. It was concluded that there was a significant difference in scientific literacy and metacognitive ability between the students' post-test and pretest results.

Discussion

The analysis showed a significant difference in scientific literacy and metacognitive ability caused by the first. Augmented Reality increased scientific literacy. The application of Augmented Reality learning activities in delivering material becomes clearer. It is what makes students able to catch the material easily (Gusmida & Islami, 2017; Herbert et al., 2021; Zikky et al., 2017). Media use can help students develop their abilities to be more critical (Astra et al., 2015; Imamah & Susanti, 2021; Triwahyuningtyas et al., 2020). The learning process also emphasizes the delivery of scientific literacy, making it easier for students to have these abilities. Students must have scientific literacy to follow science learning activities well (Ambross et al., 2014; Benjamin et al., 2017; Century et al., 2020). Science is a provision for students to face various challenges that occur. Science literacy can be termed scientific literacy, characterized by an understanding of science in students (Amrullah et al., 2021; Putranta & Supahar, 2019). In addition, students with good scientific literacy can also be sensitive to the environment and solve problems. Scientific literacy is an ability that can make students draw conclusions or decisions based on their observations and knowledge (Kimianti & Prasetyo, 2019a; Samsudin et al., 2019). In learning activities, there is more emphasis on using scientific knowledge to improve students' scientific literacy skills. This ability is very important because it can be used in students' lives and increase their environmental awareness (Andriani et al., 2018; Lestari, 2020; Srirahayu & Arty, 2018).

Second, Augmented Reality improves metacognition. In this media learning, more emphasis is placed on delivering real material to make it easier for students to understand. It is supported by research that states that media that can present the material well will be able to improve students' cognitive abilities (Ambaryani & Airlanda, 2017; Rekysika & Haryanto, 2019). Students' high absorption ability will certainly impact rapid cognitive improvement (Febriani, 2017; Hasbullah, 2018; Nurrahman, 2019). It is what makes the media very needed and plays an important role. Students who have high metacognitive will be able to monitor themselves and have clear goals (Petty & Briñol, 2015; Wei et al., 2021). Students

who have low metacognitive certainly have low thinking processes, so they need to be improved. This ability is very important because some students also sometimes make mistakes so that when students have a good understanding, students can evaluate and correct the mistakes that have been made (Antal et al., 2017; Haghshenas, 2015; Wei et al., 2021). It certainly has an impact on improving students' metacognitive abilities and abilities. This metacognition involves strategies that must involve strategies that must be chosen by the teacher appropriately so that it will affect students in learning (Kaya & Leite, 2017; Margunayasa et al., 2019; Pacheco & Herrera, 2021). The use of media, especially Augmented Reality, will certainly have an effective impact on students.

The findings of previous research stated that cognitive processes could run optimally when the stimulus is good by the teacher and the environment (Low et al., 2019; Sukajaya et al., 2015). Other findings also state that Augmented Reality media can improve abilities (Ivonne et al., 2020; Mortara et al., 2015; Mustaqim, 2016). Other research also states that using relevant media combined with good strategies will increase scientific literacy in students (Kimianti & Prasetyo, 2019a; Wibowo & Ariyatun, 2020; Zulfa & Haryanto, 2021). It is concluded that Augmented Reality plays an important role in science learning. This research implies that the developed argumentation media can be applied to learning science. This research contributes to using argumentative Reality positively impacting students' literacy and metacognitive abilities, so it is very suitable for every lesson. Students will be greatly helped by this media so that learning becomes meaningful.

4. CONCLUSION

Augmented Reality is highly qualified by experts, teachers, and students. The analysis results also stated significant differences in scientific literacy and metacognitive ability. It is concluded that Augmented Reality can improve scientific and metacognitive literacy in students.

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