



## The effect of respiratory augmented reality media on analysis and evaluation skills of eight grades students

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### ABSTRACT

The use of learning media on respiratory system material is needed to understand the material presented thoroughly. One of the media that can be used to visualize the respiratory system material is Augmented Reality (AR). This study aimed to determine the effect of AR media on improving students' analysis and evaluation skills on the eighth-grade respiratory system material. The method used in this study is a quasi-experimental method with a non-equivalent pretest-posttest design. The sampling technique in this study used a purposive sampling technique. The research sample used was junior high school students of class VIII-A as the experimental class and VIII-C as the control class, with a total sample of 62 students. The result data were an average value of pretest, posttest, and N-Gain. N-gain data of analysis and evaluation skills of students from experiment and control class were analyzed using the Independent Sample t-test. The average data of analysis and evaluation skills was in the medium category with N-gain in the experimental class of  $0.58 \pm 0.21$  and control class was  $0.29 \pm 0.14$ . Statistical analysis with t-test results ( $0.00 < 0.05$ ) showed that the use of AR media significantly increased students' analysis and evaluation skills.

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## INTRODUCTION

Education plays an important role in educating the next generation of the nation. Education as an educational activity and teaching which main on learning and the main of learning is thinking. Education is an effort to teach students to think that emphasizes thinking skills. Students are also directed to be able to think critically, higher order thinking skills (HOTS), and be independent in learning activities in accordance with the demands of 21<sup>st</sup> century learning (Sanusi, 2013).

HOTS are indispensable in the current era of globalization. Students are no longer told but find out for themselves, it means requiring intelligent, creative, and critical thinking processes. Thinking like this requires students to be directed from remembering, understanding, and even solving complex problems (Muthoharoh, 2020). Complex thinking skills will make students accustomed to facing something difficult. To deal with something that difficult requires HOTS (Heong, Mei, 2011). HOTS based on Bloom's taxonomy lies in the stage of thinking, Bloom's taxonomy revised by Anderson and Krathwohl is considered the basis for HOTS, there are sequence of levels of thinking (cognitive) from low to high level. There are three aspects in the cognitive domain that are part of HOTS, which are analyzing (C4), evaluating (C5), and creating aspects (C6) (Anderson, & Krathwohl, 2001). The purpose of giving HOTS questions in the assessment is to encourage students to do high-level reasoning therefore they are not fix on one pattern of answers resulting from the rote process without knowing scientific concepts. Teacher's role is very important in making students have HOTS (Arikunto, 2006). However, most of the teachers in Junior High School 12 Lampung infrequently give HOTS questions that integrate with daily life hence they did not used to analyzing, evaluating, and creating on the exam.

The importance of HOTS in learning is when students use HOTS, they will decide what to believe and what to do, create new ideas, make predictions, and solve problems that do not occur in everyday life. Students are required to have HOTS in the 2013 curriculum (Sartono, Handayani, & Rusdi, 2017). While in the 2013 revised 2017 curriculum, science learning is required to apply HOTS to improve students' thinking potential. Learning oriented on HOTS involves 3 aspects which are transfer knowledge, critical and creative thinking, and problem solving (Afandi, Sajidan, Akhyar, & Suryani, 2019). Learning which was not require students think critically causing Low Order Thinking Skills (LOTS). This can be proven by learning that prioritizes memorization and most of the things taught in school are rote therefore HOTS not achieved well (Manik, 2020).

Learning process is currently slight changes due to the Covid-19 pandemic and changed many aspects of life. The government decided to work from home, so learning was required online to break the chain of transmission. This is done to prevent widespread transmission due to massive interactions. Physical distancing is one of the hopeful strategies to break the chain of transmission of this disease. With the Covid-19 pandemic causing the learning process to be hampered because learning must be done at home. Online learning provides its own challenges for teachers in planning learning in order to achieve complete learning outcomes (Shinta, Jalmo, 2021).

In fact, online learning in science subjects raises a problem that causes students' thinking skills are not yet high, because in essence learning science is learning that includes abstract concepts and events that require observation, hence students are required to see what is being studied (Rusman, 2012). Online learning creates obstacles for students who do not understand the material in science lessons caused difficulty in learning science, besides that there is also a science practicum that aims to further clarify teaching materials that can be observed directly. However, the absence of face-to-face learning makes students unable to understand and focus on split learning. Likewise, media that used by teacher was respiratory pictures on slides presentation made difficult for students to understand the material. Whereas, technology for education such as video can help students visualise respiratory process in organ. This is a challenge for a teacher in implementing learning policies wherein students stay focused on learning science, it needs creativity of teachers in using learning strategies and media to attract the attention of students to keep following learning and result optimum learning outcomes (Hidayati, 2007).

The solution for helping students' to understand respiration concepts is the use of learning media which can visualization micro object and biology process, which is of Augmented Reality (AR) videos. This is one of the technologies that are starting to be applied in the field of education. AR has recently attracted a lot of attention in the field of education as an interactive technology that allows to interact directly with virtual forms in the real world. In this era of globalization and information, the use of

Information Technology (IT)-based learning media has become a necessity and a demand, but in terms of its implementation, it is not an easy thing. In using media, it is necessary to pay attention to several techniques so that the media used can be utilized optimally and does not deviate from the purpose of the media (Muhson, 2010).

AR can be used as a learning media for teaching biology material, especially on the respiratory, this is because the learning process on the respiratory system material is still through conventional media, while the respiratory process cannot be seen directly because the process occurs in the body. AR-based learning applications have been widely used as a bridge for interactive digital learning and concepts. The AR video help students to learn and analyse the process of human physiology that can increase HOTS (Mauludin., Sukamto, & Muhandi, 2017). The use of AR video in learning is expected to improve students' understanding of respiration concepts, analyzing microscopic respiration processes, and evaluating respiration health and disorders.

## METHODS

### Research Design

This study used a quasi-experimental method with a non-equivalent pretest posttest design (Table 1). Two classes were chosen to be research subjects, one class received treatment in the form of using AR video with the other group being used as a control group or comparison class (Non-equivalent). Each class was given HOTS questions for pretest and posttest.

**Table 1**  
Research Design of Pretest-Posttest Control Group Design

Group	Pre-test	Treatment	Post-test
E	O <sub>1</sub>	X	O <sub>2</sub>
C	O <sub>1</sub>	-	O <sub>2</sub>

Note:

E = Experiment group

O<sub>1</sub> = Pretest

X = Treatment with the use of AR video

C = Control group

O<sub>2</sub> = Posttest

- = Treatment with no media

### Research Population and Sample

The population used in this study were all eighth grade students of SMPN 12 Bandar Lampung for the academic year 2021/2022 which consisted of 4 classes, totaling 124 students. The sampling technique in this study used a purposive sampling technique. The samples selected were students of class VIII A as the experimental class and VIII C as the control class

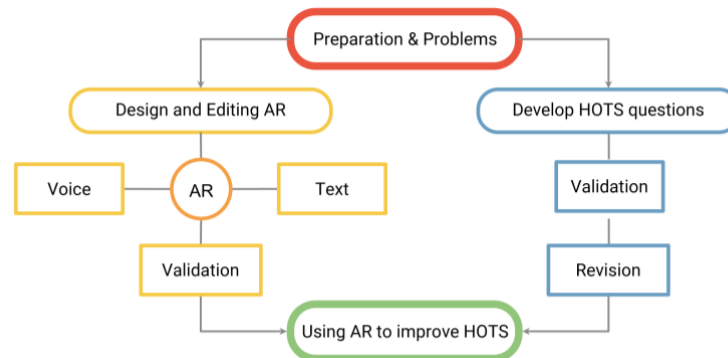
### Instrument

This study uses two data, namely quantitative and qualitative data. For quantitative data obtained from HOTS questions answer (pretest/posttest) using level cognitive C4 and C5 (Anderson, L, W., & Krathwohl, 2001), while for qualitative data obtained from questionnaires of student responses to AR videos. This study only use two aspects of cognitive domain which are analysis and evaluation based on basic competence of respiration system material which is "Analyzing the respiratory system in humans and understand disorders of the respiratory system, as well as efforts to maintain a healthy respiratory system". Before being used, the questions were tested for validity, reliability, discriminating power, and level of difficulty using Anatest. The results of the validation of the test instrument were declared valid on 10 questions with significant and very significant categories. The results of the reliability test were declared reliable on all questions with a reliability value of 0.69 which was categorized as very high. The results of the analysis of the discriminatory power of the questions were stated to be very good. Then the results of the analysis of the level of difficulty of the questions stated that there were moderate questions and moderate questions.

### Procedure

This research procedure through several steps in Figure 1, research begins with determining the school, population, sample, and preparing learning media in the form of AR videos which used in the study were obtained from educational sites and social media, then the AR videos were edited by filling

in Indonesian voices and given narration on the AR videos. The next step is the development of a test instrument that refers to the HOTS aspect. After the instrument test is completed, the validity, reliability, discriminatory power, and level of difficulty of the questions must be measured. Test instruments that meet the test of validity, reliability, discriminating power, and level of difficulty of the questions can be used to measure HOTS twice, namely before learning (pretest) and after learning (posttest) in the experimental class and in the control class. At the time of learning the experimental group used AR video media while the control group did not use AR video media, so it can be seen the differences and the influence of learning media on the experimental and control classes.



**Figure 1.** Research procedure.

### Data Analysis Technique

The data analyzed are quantitative and qualitative data. Quantitative data use for discovering the increase students' HOTS, the data results were analyzed using a normalized gain score (N-Gain). This increase was taken from the pretest and posttest scores obtained by students. After that, the learning outcomes data were tested for normality and homogeneity tests. Data analysis of students' HOTS scores in this study used independent sample t-test on SPSS 22.0. Hypothesis testing is carried out with the requirement of normal distribution and homogeneous variance. The sample t-test was conducted to analyze the effect of using AR video on students' HOTS improvement. Independent Sample t-test with a significance level of 5% is a statistical test that aims to compare the average of two unpaired samples (Sugiyono, 2011).

### RESULTS AND DISCUSSION

Test results for analysis (C4) and evaluation (C5) aspects of HOTS on respiratory concepts have average N-Gain score in the experimental class, which is 0.58, was included in the moderate criteria, while in the control class the N-Gain value of 0.29 was included in low criteria (Table 2). The N-gain in the experimental class has moderate criteria, because not all students get a high posttest score, but compared to the control class, the N-gain value in the experimental class is higher. Hence, it showed that learning using AR video in experimental class was better than slide presentation media in control class. For clarifying that result, average difference of two classes measured with independent t-test that previously tested for normality and homogeneity.

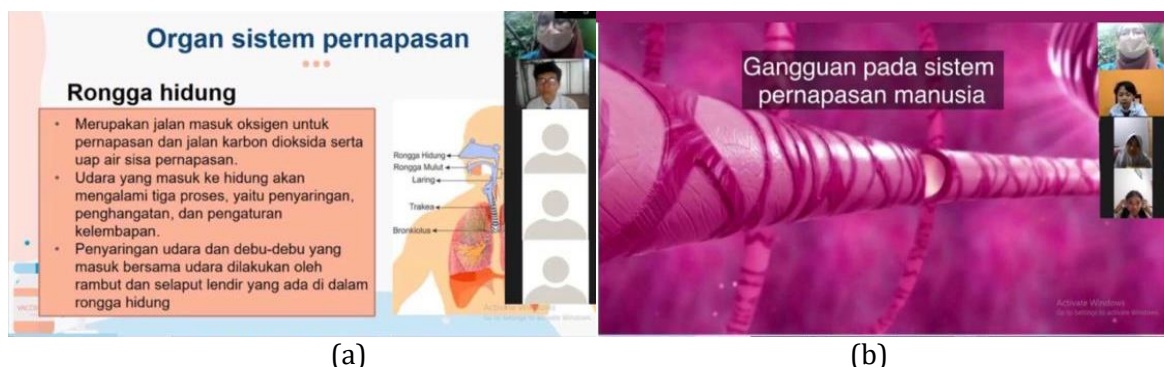
Normality test result showed signification scores were more than 0.05 therefore data distribution were normal (Table 2). Homogeneity test result also showed signification scores more than 0.5 hence the variance of the data of the two data groups were homogeneous (Table 2). The value of t-test Sig. (2-tailed)  $0.00 < 0.05$   $H_1$  was accepted and  $H_0$  was rejected, from these results there was a significant increase in students' HOTS which was better in the experimental class than in the control class, it means that the use of AR video had an effect on increasing HOTS score. This is in line with research on android learning media in the form of AR-based videos that are effective for increasing HOTS and students' open attitudes (Prasetyo, 2018). The result indicate that students can learn respiratory system because of better visualization to undertand the physiology process, it affected improvement of HOTS. Students gave positive response for this learning media and access the AR video several times. Furthermore, AR apps can significantly improve students' motivation and performance (Lai & Chang, 2021).

**Table 2****Pretest, Posttest, and N-Gain . Data Statistical Test Results**

Score	Class	$\bar{x} \pm Sd$	Normality test	Homogeneity Test	Independent Test Sample t-test
Pretest	E	57.10 ± 10.064	Sig. 0,071 > 0,05	Sig. 0,238 > 0,05	Sig. (2-tailed) 0,000 < 0,05
	C	50.97 ± 8.309	Sig. 0,068 > 0,05		
Posttest	E	82.26 ± 10.234	Sig. 0,171 > 0,05	Sig. 0,708 > 0,05	
	C	65.16 ± 9.616	Sig. 0,87 > 0,05		
N-Gain	E	0,58 ± 0,21 (moderate)	Sig. 0,125 > 0,05	Sig.0,085 > 0,05	
	C	0,29 ± 0,14 (low)	Sig. 0,125 > 0,05		

Description : E = Experiment (using AR video media), C = Control, Sd = Standard deviation,  $\bar{x}$  = Average

Students' HOTS improvement in the experimental class was obtained from the implementation of learning using AR video media for respiratory system, it can be seen in [Figure 2](#). Learning process used zoom in the experimental class (VIII A), the researcher explains the respiratory system material using AR video media through zoom ([Figure 2a](#)). Interesting and creative learning media make students focus on learning, because many researchers bring up AR video visualizations about respiratory system material, which previously students knew only theories and explanations. The understanding of the material is obtained from AR videos. The concepts explained can be easily understood by students because the teacher explains the concepts accompanied by direct examples in form of 3D videos (Nurhayati, 2014). There are many influences in the implementation of learning using AR video media, such as classroom conditions during online learning which are more active and enthusiastic for students in participating in learning. The cause of the high average HOTS results of experimental class students is the understanding of the material obtained by students.



**Figure 2.** Implementation of Learning Via Zoom, (a) Learning in the control class using power point; (b) Learning in the experimental class using AR video

Learning in the control class ([Figure 2a](#)) at class VIII C conducted with the teacher explained the material of the respiratory system using power point via zoom. Giving material using power point media with respiratory pictures makes students clearly imagine respiratory organs and its functions, however it was not enough for describing circulation oxygen in blood stream and physiology process of cellular respiration. Consequently, students did not completely understand the concepts and less responsive in learning process, they did not answer questions from the teacher. Then, in the middle of the learning process students do not concentrate on learning, this is because students are bored just listening to the teacher and seeing pictures on power point (Nuri, 2014). The use of power point media in learning can attract students' interest in learning because it provides an interesting visual aspect to assist teachers



in explaining the respiratory system. The pictures of the respiratory organs and processes presented on the presentation slides are 2D concrete images that students can observe when the teacher explains the respiration material. However, it still has deficiency in explaining the physiological processes that occur when humans breathe because 2D images do not move whereas it involves the movement of the thorax muscles, oxygen binding by red blood cells in the alveoli, and cellular respiration.

The experimental class has higher HOTS cognitive level of C4 and C5 compared to the control class. This is because during learning, the experimental class used learning media in the form of AR videos to explain the respiratory system material. The use of AR video media in learning makes it easier for students to observe and understand how breathing mechanisms can occur in the human body. This is in accordance with HOTS C4, which is that students can correlate how oxygen will enter the body and will be circulated in the body, then carbon dioxide will be removed from the body, just like when humans are breathing, because the breathing mechanism is presented in 3D so that easier to understand. Learning the concept of the human respiratory system using 3D video media such as AR video can make it easier for students to understand various respiratory processes in humans in more detail, and can display effects in the form of movement, how the processes that occur when humans inhale and exhale, so that 3D videos are able to create an abstract concept becomes concrete (Azhar, 2010).

Students understand the material delivered through AR video media because they are more motivated in learning by using media that are new to them, thus making students more interested in understanding all the material being taught. Learning will be better understood by students if using the right media, so that students can be active in learning. Through the media that is delivered, where students when learning takes place can hear, see, do, then can analyze how the processes that occur in the AR video, as well as the interaction between students and learning media, and interactions between students and teachers. The involvement of students in learning is the activity of asking when they have seen the video that is shown in accordance with HOTS C5, namely students can clarify the mechanism that occurs when breathing takes place in the body, questions that arise from students are questions based on AR videos that are required by students to analyze and understand the video. Then many students turn on the camera when learning takes place, the reason is that after I asked indirectly, that is to be more focused and new learning using AR video media makes students more enthusiastic and can understand better after the AR video is shown then confirm by asking related questions. with AR video that is not yet understood. The condition is different in the control class that uses power point media, even though the image is supported by arrows indicating that the image shows the meaning of a movement, students still find it difficult to understand the respiratory process in humans. For this reason, by using AR videos, it is easier for students to understand concepts, so that abstract concepts become concrete (Yosi, R. Gili MA. Ruth, 2008).

At the HOTS cognitive level, the experimental class obtained a higher increase in learning outcomes than the control class as shown in Table 2. This is because students are invited to explore information and analyze based on the AR learning videos that have been presented. If usually the respiratory system material is only presented in 2D images, which causes students to not understand how the mechanism of the respiratory system in the body is. However, by using AR video learning media, the presentation of the respiratory system mechanism can be displayed in 3D and can be seen from various sides, so that students are required to predict the respiratory process that occurs in the body, then students can then conclude related to the respiratory system material used has been presented using AR video media.

In accordance with the indicators in the student response questionnaire regarding the ability to participate in science learning using AR video as a learning medium, the percentage is 72% (Table 3), which means the category is very good. By using AR video learning media, the process can be shown, so that the observed process is clearly visible, and students can relate the structure of the respiratory system organs to the functions of these organs through explanations and images that appear on AR videos. Learning media directs students to gain various learning experiences. The learning experience depends on the interaction of students with the media. The right media will be in accordance with the learning objectives so as to provide a better learning experience, so that students can improve learning outcomes (Hamalik, 1994). Students responses to power point used in learning did not account in questionnaire because we focus on AR implication, therefore we just ask for several students response

directly in open question. They argue that the power point used in learning is interesting and clarifies the description of the material from the teacher, but it is easier to understand physiological processes by looking at animations, but most of the animations available are in English.

The use of AR video media in the experimental class is very influential on increasing students' HOTS, seen from the advantages of AR, which are more interactive, effective in use, can be widely implemented in various media, manufacture that does not reduce costs too much, is easy to operate, and easy to understand in Indonesia language. by students. In the implementation of AR videos, there are no obstacles when learning takes place, it's just that learning is delivered online, so the obstacles experienced if the signal to students is not good, then the AR video that is displayed will be slightly hampered. But the researchers got around this by sharing the AR video in google classroom so that students who were constrained by the signal would still learn clearly the explanation of the AR video. Some of the functions and advantages of 3D videos such as AR videos are attracting the attention of students, returning the focus of students, presenting actual objects and steps, making imitations of actual objects, making abstract concepts into real concepts, providing perceptions, overcoming time barriers, re-presenting information consistently to students (Arsyad, 2013).

The data analysis of student responses to AR video questionnaire is useful for knowing the percentage of each indicator of success in using AR video media. The following are the results of the analysis of student questionnaire data on AR videos obtained as shown in Table 3. The responses of students to implementation of AR video media on the explanation of the respiratory system material, were assessed using a questionnaire given when the learning was finished. The questionnaire contains 8 questions that students must respond to by choosing one option that has been provided on the google form. The results of the responses of students in the experimental class are indicators showing the ability to follow science learning using AR video as a learning medium to get a percentage of 72%, which is a very good category, which means that almost all students can understand science learning using AR videos during the learning process of respiratory system material. AR as a learning tool help students to learn better for certain subject and visualizing abstract concepts to be 3D object, it reproduced real objects in learning and practicing (Liono, Amanda, Pratiwi, & Gunawan, 2021). In addition, indicators of usefulness showing interest in science learning using AR videos as learning media get a percentage of 65% which is good category, which means that most students are interested in using AR videos when learning respiratory system materials. And the indicators show the usefulness of participating in science learning using AR video as a learning medium, getting a percentage of 67%, which is a good category, which means that most students feel the benefits of AR video media in explaining the respiratory system material. From these indicators, an average of 68% is obtained, namely the good category, which means that most students understand better if the respiratory system material is explained using AR video media, and the use of AR video media can be well received by students.

**Table 3**  
Student Response Questionnaire

Measured Aspect	Indicator	Experiment class	
		Percentage	Category
Student responses to science learning using AR video as a learning medium	Ability to participate in science learning using AR video as a learning medium	72%	Very good
	Interest in learning science with AR	65%	Good
	The usefulness of learning science with AR as a learning medium	67%	Good
Average		68%	Good

AR video as an educational medium, has the ability to be able to explain something complicated or complex, which is difficult to explain with just pictures or words to be simple and easy to explain. With this capability, AR video is very well used for materials that are actually invisible to the eye to be more described in visual form. With visualization, the material described can be well described by students. So that AR video as a learning medium can be used as a device that is ready anytime, anywhere to be used (Junaengsih, 2015). The use of AR videos in explaining material related to the work of the

human body, such as the human respiratory system material can make it easier for students to capture messages or information during teaching and learning activities. In addition, AR videos can attract the interest and attention of students during the learning process, so that they can understand the material of the respiratory system as a whole (Junaengsih, 2015). In the respiratory system material, it is better to use AR video media than other media such as power points, ordinary learning videos, or video media in the form of lectures, because when using AR video media it will be seen specifically the organs of the respiratory system, as well as what substances are involved. The use of 3D videos or AR videos in explaining material related to the work of the human body, such as the human respiratory system, can make it easier for students to capture messages or information during the learning process (Suwarno, 2015). AR video visualize breathing occurs in organ; it can show clearly how the mechanism of breathing in the human body, and can show about diseases or disorders that occur in the respiratory system, such as the process of human infection by the Covid-19 virus, the growth of lung tumors, sinusitis in nose, laryngitis, pharyngitis, as well as the dangers of smoking to the health of the respiratory system, and can clearly see how the lungs work in smokers.

## CONCLUSION

Based on the results of the research and discussion that has been carried out, it can be concluded that there was improvement of students' analysis and evaluation skills at eighth grade on respiratory system material at SMPN 12 Bandar Lampung after using AR media.

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