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IMPROVING STUDENTS' SCIENTIFIC LITERACY THROUGH DISTANCE LEARNING WITH AUGMENTED REALITY-BASED MULTIMEDIA UNDER CONDITION OF COVID-19 PANDEMIC

M. Ahied[*1], L. K. Muharrami[2], A. Fikriyah[3], I. Rosidi[4]

[1,2,3,4]Natural Science Education, Faculty of Education, Universitas Trunojoyo Madura

ABSTRACT

Scientific literacy is a capability to identify problems, analyze questions, and create solutions by applying scientific knowledge and integrating science with technology and society. This literacy needs to be enhanced in order students are able to develop their skills in identifying science phenomenon and addressing on various solutions. Although the learning was conducted in distance since the current situation is still under COVID-19 pandemic, the literacy can be taught during the learning process. This study aimed at improving students' scientific literacy through distance learning with augmented reality-based multimedia under condition of COVID-19 pandemic. The research included in a descriptive quantitative study with pre-test and post-test design. The distance learning was conducted in the lecture of anatomy and physiology of organism during even semester, on May 2020 toward 111 students from three classes in the academic year of 2018. The science content provided in the online learning was supported by augmented-reality based multimedia in the topic of respiratory system in human. This multimedia has been already evaluated and stated as valid and appropriated to be implemented in the learning process. Furthermore, the scientific literacy was measured using a test in the online form. Findings indicated that the students' scientific literacy enhanced moderately both in class A and B, meanwhile it improved low in class C. Enhancement of scientific literacy in class A reached a score average of N-gain about 0.31, class B reached 0.38, class C reached 0.22. Furthermore, students also gave positive response, showed by the percentage of students' response in class A about 89.1%, class B about 87.0%, and class C about 84.8% which was categorized in the criteria of very strong. Therefore, it can be concluded that students' scientific literacy improved well through distance learning with augmented reality-based multimedia under condition of COVID-19 pandemic.

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Keywords: augmented reality-based multimedia; distance learning; scientific literacy; COVID-19 pandemic

INTRODUCTION

Science is the organized study of the structure and process of the physical, social, and natural worlds through various investigation activities, such as observation and experiment (Costa & Araujo, 2018). Science is also a main component to create creativities, innovations, and developments since by having science, students can identify and explore world phenomenon (A. Rusilowati, N, & S., 2015). Therefore, science is important to be learned by learners at schools and universities.

Moreover, by learning science, students can develop abilities to examine questions, identify problems, collect information, organize ideas, overcome problems, apply knowledge, and make conclusions (Bertling, Marksteiner, & Kyllonen, 2016; Glaze, 2018). Even more, science also compromises ways for learners to develop

*Correspondence Address
E-mail: ahied@trunojoyo.ac.id

scientific attitudes and processes by increasing the abilities in conducting science investigations and developing science skills such as responsibility, curiosity, carefulness, confidence, and communication (Rokhmah, Sunarno, & Masykuri, 2017).

According to the observation results from the preliminary research that has been conducted in the previous semester in which the students have learned in basic science lecture; it can be assumed that mostly students have difficulties in learning science. It also indicated that there were students who did not master the science concepts well, especially concepts related to anatomy and physiology of human. They argued that science concepts are hardly to remember and comprehend since the concepts are abstract. In addition, there are also many difficult terms that need to understand strongly because if not, it can impact on misconception or misunderstanding.

It has been also supported by research results that indicates about difficulties in science concepts which impact on cognitive achievements (Schneiderhan-Opel & Bogner, 2020). One of concepts that are difficult in the students' perspective are about the human organ system, for instance the respiratory system since this topic consists of abstract concepts that cannot observed directly and also includes various difficult terms. From this point of view, it is assumed that learning process has not been conducted effectively yet, therefore students cannot comprehend the science concepts well (Bertling et al., 2016). If it is so, then students are not able to reach learning achievement and skill excellently (Costa & Araujo, 2018).

Outstandingly, the role of science learning process not only aims at transferring science knowledge to learners but also developing students' scientific literacy. International large-scale surveys (ILSA) such as the Programme for International Student Assessment (PISA) argued that the science learning should be provided by inquiring students in conducting actively science activities (OECD, 2018). Furthermore, it is also suggested that educators should not only focus on the students' outcomes but also the progress in which students learn. Students' scientific literacy is also important to develop during the learning process.

According to PISA, scientific literacy is defined as a skill to identify science-related problems and involve them with the ideas and thoughts of science (OECD, 2018). Furthermore, a scientifically literate one is curious to engage in science and technology, in which it requires the abilities to describe phenomena scientifically, evaluate scientific problems, design scientific inquiry, and interpret findings, facts, and evidences systematically (Knain, 2015; Ani Rusilowati, Kurniawati, Nugroho, &

Widiyatmoko, 2016). However, it is announced that students in Indonesia reached lower score than the OECD average in science. Since 2001 to 2018, students' performance in science has fluctuated but remained flat overall in which means that students attained higher level in science from 2006 until 2012, but the enhancement was not high, then in 2015 and 2018 students reached lower level but the score was still around 500, not far from the score before (OECD, 2018). Therefore, educators have to provide effective science learning process that aims not only to transfer science knowledge but also to develop scientific literacy indeed.

Additionally, learners have to be also guided to master scientific literacy covering its scientific knowledge, process skill, and attitudes since scientific literacy is important in solving problems in the daily life (Pahrudin, Irwandani, Triyana, Oktarisa, & Anwar, 2019). Because by having this literacy, student can contribute in society, as well as to apply the scientific knowledge in making decision and offering solutions of the problems (Fakhriyah, Masfuah, Roysa, Rusilowati, & Rahayu, 2017). As it is stated that scientific literacy is a skill that refers to the science knowledge and links to understanding of scientific process and the integration between science and technology (Asrizal, Amran, Ananda, Festiyed, & Sumarmin, 2018; Janse van Rensburg, 2018). Students have to be guided to develop scientific literacy since it also pertains to the application of science, technology, and society (Asrizal et al., 2018). Student's scientific literacy can be outstretched by presenting the science knowledge which correlated with technology and society issues (Mamun, Lawrie, & Wright, 2020).

In addition, the development of students' scientific literacy is also based on the learning process that is provided by educators. The quality of science teaching and learning process is also linked to the structural and process of how it goes, the way of educators teach, and the methods that they use to provide science learning process (Asrizal et al., 2018; Harun, Tuli, & Mantri, 2020). Educators have to ensure students can achieve learning concepts easily. Therefore, educators have to provide interactive learning environments during all comprehensive learning situation. It is proved that students can learn easily if they study in interactive and effective learning environment (Baratè, Haus, Ludovico, Pagani, & Scarabottolo, 2019; Turgut & Yakar, 2020).

However, the current condition is under COVID-19 global pandemic in which the government in many countries implements rules that limit people congregating in public places (Janse van Rensburg, 2018; Rapanta, Botturi, Goodyear, Guàrdia, & Koole, 2020). This also impacts on learning process at schools and

universities in which students and educators cannot attend the places and have face-to-face learning activities as before. Moreover, the science learning process is conducted in open online technique.

Distance learning offers new learning experiences both for students and educators. During distance learning process, learners are able to study actively and responsibly (Arulogun, Akande, Akindele, & Badmus, 2020). Students are also able to increase higher thinking during the online learning, because it provides a plenty of information that can serve as a flexible substitute for distance learning (Reimers, Schleicher, Saavedra, & Tuominen, 2020). Furthermore, by having distance learning, students can undergo best learning practice that leads to concept comprehension and literacy improvement. In contrast, for educators, distance learning offers quintessential adaptive and transformative challenges, in which they should provide effective learning environments although in online form (Littenberg-Tobias & Reich, 2020).

One of the challenges that can be done by educators is by conducting fun and effective distance learning that can also develop scientific literacy. It can be provided by integrating science distance learning process with new technology (Yip, Wong, Yick, Chan, & Wong, 2019). For instance, the technology that can be used in the distance learning activities is augmented reality (AR). AR is an interactive experience of a real-world environment in which the objects that reside in the real world are developed by computer-generated perceptual information with the use of visual elements, sound or other sensory stimuli that can be operated in computer and smart phone (Crider, Greene, & Morey, 2020; Sahin & Yilmaz, 2020).

AR is proved that are able to provide learning environments where students are able to build concept comprehension in a real-life three dimensions world (Garzón & Acevedo, 2019; Harun et al., 2020). By using AR, educators are also able to improve learning outcomes by increasing engagement between teacher and students (Jamali, Shiratuddin, Wong, & Oskam, 2015). AR also provides various aspects that are able to increase learning skills and learning motivation. As we know that nowadays about 80% of youths have smartphones, however mostly use phones for social networking and playing games, only a few who uses them for learning (Bursali & Yilmaz, 2019). Therefore, the potential of combining smartphones and AR is important, since AR can offer students to have experience in applying science knowledge with new technology.

AR-based multimedia during the distance learning in this study provided learners to be able to understand human respiratory organs, consisting of upper and lower respiratory organs.

This learning media was used to accomplish the learning activities during online education. In addition, this media is expected that also can gain students' learning motivation since it contains of animation, sound, and visual three dimensions model of human respiratory organs.

Furthermore, this learning media also has benefits to render objects that are hard to imagine and turn them into three-dimension model, which make it easier to comprehend (Garzón, Kinshuk, Baldiris, Gutiérrez, & Pavón, 2020; Iftene & Trandabăt, 2018). As it is argued by most students that human respiratory system is one of difficult concepts that is considered as an abstract science content. Therefore, it is presented through augmented reality-based multimedia during the distance learning so that learners are able to understand the concept easily and improve the scientific literacy indeed.

This study focusing on the implementation of distance learning using AR-based multimedia acts as the solution of learning process during COVID-19 pandemic. Moreover, current science learning process is conducted in ineffective methods in which students are not motivated and it impacts on the students' learning achievements and skills (Reimers et al., 2020). It has been proved that if learners are less motivated during their learning process, it can impact on their learning achievements and skills (Rapanta et al., 2020). Therefore, it is expected that students can be motivated during learning process because they can undergo fun learning experiences through AR-based multimedia. Once they are motivated in learning, it will be easier for them to comprehend the concepts (Bursali & Yilmaz, 2019). In addition, the importance of this study is to provide interactive distance learning during COVID-19 pandemic. It is also beneficial since distance learning with AR-based multimedia can be used not only to provide effective learning but also to enhance students' scientific literacy.

According to those previous views, this study aimed at improving students' science literacy through distance learning with augmented reality-based multimedia under condition of COVID-19 pandemic.

METHODS

This descriptive quantitative study was conducted during even semester in the academic year of 2019-2020, exactly on May 2020. The distance learning process was implemented asynchronously in the lecture of anatomy and physiology of organism toward 111 students from three classes (from A to C) in the academic year of 2018 from a public university in Indonesia. The research subject decision included in non-probability sampling technique, in the type of purposive sampling. In this type of sampling, the

students were chosen according to the purpose of this study and selected based on the certain characteristics and criteria (Mohsin, 2016). There were 36 students in class A consisting of three boys and 33 girls. Meanwhile 38 students were involved in class B consisting of six boys and 32 girls, and 37 students in class C consisted of four boys and 33 girls who learned the concepts of respiratory system in human on the lecture of anatomy and physiology of organism.

The study was implemented referring to ASSURE instructional design. It has been decided that the research was conducted according to ASSURE because ASSURE instructional design is assumed as an instructional design which has detail and systematical stages (Heinich, Molenda, Russell, & Smaldino, 2012). Furthermore, ASSURE design also aims at producing effective teaching and learning process (Turgut & Yakar, 2020).

In this study, the first stage was conducted by analyzing learners in which the learning subjects were decided. In addition, students' learning styles were also analyzed. The learners as research subjects were 111 students from three classes in the academic year of 2018. According to the observation, students are in the age of 20 years old, they also have studied general biology in the previous semester in which the concepts are correlated with the concepts in the lecture of anatomy and physiology of human. Furthermore, mostly students also have audio-visual learning styles, so that it is appropriate if the learning process is conducted with technology-based multimedia.

Furthermore, the second stage was conducted by stating objectives. In this study, the learning objectives were about learners are able to comprehend science concepts and improve scientific literacy. The third stage was about selecting instructional methods, media, and materials. The method that was used in this study was distance learning in asynchronous. In addition, the media was augmented reality-based multimedia. The materials were about concepts in human respiratory organs.

The fourth stage was utilizing media and materials. In this study, the AR-based multimedia was developed in the form of .apk program that can be installed both in smartphone and also in computer. Before the AR-based multimedia was implemented during the learning process, it has been evaluated and validated by experts. The validation of the media asked about the content and construction aspect. This media has been

evaluated by two lecturers and stated as valid and feasible with 3.25 on total score. Therefore, the augmented reality-based multimedia was appropriate to apply in enhancing the students' scientific literacy on the distance learning as one of solutions for learning process in the condition of COVID-19 pandemic.

The fifth stage was conducted by requiring learner participation in which the students were involved actively during learning process. The learning process was implemented in distance and asynchronously. The multimedia was shared to leaners during the learning process in order they are able to be easily comprehend concepts of human respiratory organ. Furthermore, augmented reality-based multimedia was presented in the topic of respiratory system in human in which was provided in the learning process not only to support the implementation but also to increase the students' scientific literacy.

Finally, the last stage was about evaluating and revising according to the results of the implementation. The results that were measured were about learners' scientific literacy and students' response toward the learning process. Data of students' scientific literacy was measured using pre-test and post-test design. Test in the online form with eight multiple choice-questions related to the topic of respiratory system in human was given to students both in initial and final of learning process to know its enhancement. The questions on the test asked about the respiratory system in human with four aspects of scientific literacy; science knowledge, investigation about science hierarchy, science as thinking process, and interaction between science, environment, technology, and society.

The first aspect of scientific literacy asked about two indicators (Knain, 2015); 1) explaining facts, concepts, principles, and laws; and 2) answering questions related to science knowledge. The second one asked about two indicators; 1) answering questions from graphs, tables, and figures; and 2) explaining procedural stages. Furthermore, the third aspect asked about two indicators; 1) analyzing relationship of cause and impact, and 2) presenting facts and evidences. Lastly, the fourth aspect also asked about two indicators; 1) describing benefits of science and technology for society, and 2) discussing problems about science and technology. The test instrument was provided in online and answered by students through https://bit.ly/TesLSPIPA. Furthermore, the test instrument is represented in the Table 1 below.

Table 1. Test of Scientific Literacy

Indicator	Sub-indicator	Number	Translated Version
Science knowledge	Explaining facts, concepts, principles, and laws	1	Respiration occurs as the impact of ….
	Answering questions related	2	The respiratory organ consisted of cartilage and

Indicator	Sub-indicator	Number	Translated Version
	to science knowledge		has function to protect glottis is ….

No.	Volume pernapasan	Jenis kelamin (ml)	
		Wanita	Pria
1	Volume tidal	500	500
2	Kapasitas inspirasi	2400	3800
3	Kapasitas vital	3100	4800
4	Volume residu	1100	1100

Indicator	Sub-indicator	Number	Translated Version
Investigation about science hierarchy	Answering questions from graphs, tables, and figures	3	Table above explains about the comparison of respiration volume in men and women. Which is the incorrect one?
	Explaining procedural stages	4	Respiration consists of internal and external. The external respiration is also known as pulmonary ventilation. Which is the correct order of mechanism of external respiration?
Science as thinking process	Analyzing relationship of cause and impact	5	These statements consist of the relationship between cause and effect. Which is the true one?
	Presenting facts and evidences	6	The correct statement about human respiratory mechanism is ….
Interaction between science, environment, technology, and society	Describing benefits of science and technology for society	7	Pulmonology is a knowledge about the way of overcoming disorders and diseases in respiratory system. There are a lot of instrument tools that are used to detect the respiratory disorders and diseases. Which one is the correct one related to the tool and its function?
	Discussing problems about science and technology	8	The decreasing of pulmo physiology is normal according to the increase of age. However, it can be minimized by having some stages. The ways that can be completed are ….

The test instrument also has been validated and reviewed by two lecturers before used to enhance students' scientific literacy in this study. The decision of experts was based on their major capabilities. Validation asked about the aspect of content in the instrument. This validation results revealed that the test instrument can be used to assess the student's scientific literacy. Furthermore, the test instrument was shared with all students in the first and the last meeting of this lecture to know the enhancement of students' scientific literacy. Both in the initial and last meeting, students filled out the test instrument through online form for 30 minutes individually.

Data of scientific literacy were analyzed quantitatively using N-gain formula as following:

$$<g> = \frac{(<Sf> - <Si>)}{(Smax - <Si>)}$$

Note:
$\langle g \rangle$: Score of N-gain
$\langle Si \rangle$: Score of pre-test
$\langle Sf \rangle$: Score of post-test
$\langle Smax \rangle$: Maximum score

Furthermore, the score of N-gain was categorized as follows: 1) if the score is more than 0.70, then the enhancement is high; 2) if the score is more than equal to 0.30 and less than 0.70, the enhancement is moderate; and 3) if it is less than 0.30, the enhancement is low (Balta, Michinov, Balyimez, & Ayaz, 2017).

In addition, students' responses toward the implementation of distance learning with augmented reality-based multimedia were also measured using an online questionnaire of student response with Guttman scale in which the scale is used to determine the consistent answers (Dewi, Khery, & Erna, 2019). Questionnaire of student response consisted of eight questions that have to be filled out by students as the respondents in this study. The students' answers were valued with score of 1 and 0. Furthermore, the percentage of student response was measured using a formula below.

$$\% = \frac{\sum K}{\sum N} \times 100\%$$

Note:
$\sum K$: Number of yes answers
$\sum K$: Number of total respondents

All in all, the percentage of student response was categorized in criteria as follows: 1) If the percentage is less than 100 and more than 81, the response is very strong; 2) If the percentage is less than 81 and more than 60, the response is strong; 3) If the percentage is less than 60 and more than 41, the response is moderate; 4) If the percentage is less than 41 and more than 20, the response is weak; and 5) If the percentage is less than 20, the response is very weak (Ani Rusilowati et al., 2016).

RESULTS AND DISCUSSION

Distance Learning with Augmented Reality-based Multimedia

The augmented reality-based multimedia in the topic of respiratory system in human has been developed by researchers in the collaboration with students in the academic year of 2015 who studied in the lecture of production of learning media. The view of augmented reality-based multimedia in this study is represented in the Figure 1 and 2 as follows.

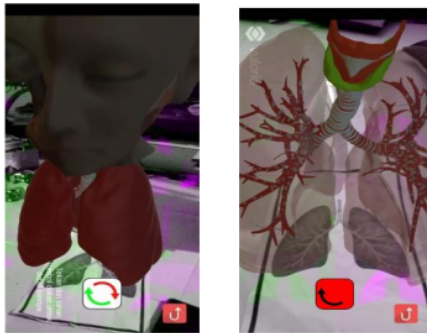**Figure 1.** Menu view of augmented-reality based multimedia

Figure 2. Content view of augmented-reality based multimedia

According to the Figure 1 and 2, it can be known that human respiratory organ consisting of upper and lower respiratory organs can be observed and analyzed contextually through AR-based multimedia. The augmented reality-based multimedia was implemented during distance learning under the condition of COVID-19 pandemic. Learning process was implemented through online since on March, 2020 as the impact of condition of COVID-19 pandemic. Therefore, various learning strategies and methods were applied to fulfill the learning aims and reach students comprehension although they were carried virtually both in the synchronous and asynchronous ways. One of these was implemented by having distance learning with augmented reality-based multimedia.

Augmented reality-based multimedia that has been developed was used to improve students'

scientific literacy since by utilizing this learning media in learning process has been proved that was able to make students comprehend the concepts easier (Iftene & Trandabăt, 2018). Furthermore, students are also able to have a review of related literatures on the learning environment, science learning, and components of science knowledge in which that integrates in scientific literacy (Yip et al., 2019). As it is also explained that students need to enhance the scientific literacy because it is a skill that not only refers to the science knowledge but also links to understanding of scientific process and the integration between science and technology (Asrizal et al., 2018; Janse van Rensburg, 2018).

The distance learning in this study was implemented in three virtual meetings through application of google classroom, include pre-test and post-test. The first meeting was started with pre-test to know the initial scientific literacy on students. Furthermore, the explanation of human respiratory system concepts was carried asynchronously in the form of digital sources through a platform of learning management system, and then the augmented-reality based multimedia was also shared to students during the second meeting. The third meeting was finished by having review of concepts and post-test to measure the final scientific literacy on students.

As we know, education now days is becoming diverse, as new technologies can be easily used within the learning process as sources of learning, interaction, and communication among students and among students and educators (Asrizal et al., 2018; International Baccalaureate, 2020). One of technologies that can be used in the learning activities is augmented reality (AR). AR is an interactive experience of a real-world environment in which the objects that reside in the real world (Arsici, Yildirim, Caliklar, & Yilmaz, 2019; Uriel et al., 2020). This technology is enhanced by computer-generated perceptual information through the use of visual elements, sound or other sensory stimuli (Harun et al., 2020; Jamali et al., 2015).

AR is proved that are able to provide learning environments in which students are able to build concept comprehension in a real-life three dimensions world (Xiao, Feng, Yang, Xu, & Guo, 2020). By using AR, students do not get completely disconnected from real environment; however they can add any objects from the real-world (Techakosit & Wannapiroon, 2015). Furthermore through AR, educators are able to improve learning outcomes by increasing engagement and interactivity between teacher and students (Garzón et al., 2020). AR in education provides various aspects that are able to enhance learning of abilities like problem-solving, collaboration, and creativity in order learners are able to better prepare for the future (Pujiastuti & Haryadi, 2020).

In addition, AR has a potential to change the location and timing of studying, and also to

introduce new and additional ways and methods of learning (Díaz, Gómez, & De-la-calle, 2019). As we know that nowadays about 80% of youths have smartphones. Most of them are active smartphone users that use these gadgets to access social platforms and play games (Anitha Kumari, Hemalatha, Subhani Ali, & Naresh, 2020). In the meantime, much lesser part of youths uses phones for learning. Therefore, the potential of combining smartphones and AR is important, since AR can grant students to experience extra digital information about any science knowledge, and make complex information easier to comprehend.

AR-based multimedia that has been implemented during the distance learning in this study provides learners to be able to understand human respiratory organs, consisting of upper and lower respiratory organs. This media was used to fulfill the learning activities during online education. This also can catch students' learning motivation since it contains of animation, sound, and visual three dimensions model of human respiratory organs. These contents would give students wider concept comprehensions.

It has been proved that AR-based multimedia was able to improve learners' motivation (Videnovik, Trajkovik, Kiønig, & Vold, 2020). AR-based multimedia has been also presented only in general. Therefore, this study was conducted by implementing the distance learning using AR-based multimedia since AR-based multimedia in this study was presented in science concepts especially in difficult concept, i.e. human organ system. It also can be used to provide effective distance learning process and enhance students' scientific literacy.

Furthermore, this learning media also has abilities to render objects that are hard to imagine and turn them into three-dimension models, thus make it easier to grasp the abstract and difficult concepts (Iftene & Trandabǎt, 2018; Pujiastuti & Haryadi, 2020). This is important for learners in order they are able to substitute the concept into a real concept. Human respiratory system is one of difficult concept that is considered as abstract content. Therefore, it is presented through augmented reality-based multimedia so that learners are able to comprehend the concept easily and improve the scientific literacy.

Connecting distance learning environment with AR-based multimedia to enhance students' scientific literacy is also important to be taught during learning process (Janse van Rensburg, 2018; Mamun et al., 2020). Since by having this, students are able to do a review of related literatures on the learning environment, science learning, and components of science knowledge (Harun et al., 2020).

Moreover, by having this learning process, students are able to connect to the network to share and find out new information (Goodsett, 2020; Layona, Yulianto, & Tunardi, 2018). Then, the learners' beliefs based on new learning will be modified, and be linked to the network to share perceptions and search for new information (Anitha Kumari et al., 2020; Widodo et al., 2020). All in all, the communication between distance learning and AR-based multimedia are able to help learners to study in an interesting environment.

Students' Scientific Literacy

According to the findings of pre-test and post-test that have been filled out by students in class A, B and C, the students' scientific literacy can be analyzed respectively. Furthermore, students' scientific literacy level and its enhancement through distance learning with augmented reality-based multimedia under the condition of COVID-19 pandemic are figured out in the Table 2 below.

Table 2. Students' Scientific Literacy Level and Its Enhancement

| Class | Score | | N-gain | Criteria |
	Pre-test	Post-test		
A	40.6	59.0	0.31	Moderate
B	47.0	67.1	0.38	Moderate
C	40.7	53.7	0.22	Low

Findings obtained from pre-test and post-test indicated that students' scientific literacy varied in class A, B, and C. The score average of pre-test reached by students in class A was 40.6, the post-test was 59.0, and the score average of N-gain was 0.31 and categorized as moderate criteria. Furthermore, students in class B reached 47.0 on pre-test of score average, 67.1 on post-test of score average, and then 0.38 in the score of N-gain which was categorized as moderate criteria. However, the score average of pre-test in class C got 40.7, the score of post-tests was 53.7, and the score of N-gain was 0.22 and categorized as low criteria.

According to those findings, it can be assumed that there were differences of enhancement of scientific literacy between students in class A, B, and C. Students in class A and B reached moderate improvement of scientific literacy through distance learning that has been implemented. Meanwhile, the scientific literacy on students in class C only increased low.

However, it can be supposed that the distance learning process with augmented reality-based multimedia that has been implemented in

this study was able to improve students' scientific literacy. Students experienced new learning environment through this kind of learning process. The augmented reality-based multimedia was also able to assist students in building new concepts easier (Arslan, Kofoğlu, & Dargut, 2020). Scientific literacy consists of various knowledge and information in which the ways of understanding the scientific concepts and scientific process are important in analyzing problems, identifying phenomenon, and making conclusions (Sinaga, Kaniawati, & Setiawan, 2017).

In addition, every learner is commanded to master scientific literacy covering its scientific knowledge, scientific process skill, and scientific attitudes (Sinaga et al., 2017). Every learner is also invited on not only mastering this literacy but also improving this since scientific literacy development is important in facing and solving problems in the daily life (Harun et al., 2020; Widodo et al., 2020). Scientific literacy is very essential because by having this literacy; student can contribute and interact in society, as well as to apply the scientific knowledge in making decision and giving solutions of the problems (Ratini, Muchtar, Suparman, Tamuri, & Susanto, 2018; Rokhmah et al., 2017).

Scientific literacy is a skill that refers to the science knowledge and links to understanding of scientific process and the integration between science and technology (Dewi et al., 2019; Techakosit & Wannapiroon, 2015). Scientifically literate learners are able to analyze problems, find answers to daily life questions, predict natural phenomena, read science literatures, and identify scientific problems (Knain, 2015; Ani Rusilowati et al., 2016). They also have abilities in expressing positions that are scientifically and technologically informed, gauging the value of scientific information on the basis of its source and the methods used to create it, evaluating arguments based on facts and evidences, and applying conclusions appropriately (Fakhriyah, Masfuah, & Mardapi, 2019; Pahrudin et al., 2019).

Moreover, scientifically literate learners would have certain knowledge, principles, attitudes, and responsiveness, along with problem solving and higher order thinking skills (Lampropoulos, Keramopoulos, & Diamantaras, 2020; Syawaludin, Gunarhadi, & Rintayati, 2019). Therefore, scientific literacy is greatest perceived as a continuum along which a learner's improvements, not as a finale state. This continuum has two dimensions-breadth and depth (Parno, Yuliati, Hermanto, & Ali, 2020; Rusli, Rahman, & Abdullah, 2020). Breadth ranges from recognition of vocabularies to conceptual and contextual comprehension. Meanwhile depth involves an understanding of the scientific concepts, scientific inquiry process, and scientific skills (Rusli et al., 2020).

The results also showed that students reach low score in pre-test, meanwhile some of them could reach better score in post-test. However, there were also students who reach same score both in pre-test and post-test. Several factors caused the difference of enhancement on students' scientific literacy. Students varied on the way of transforming knowledge and comprehending information. In addition, the factor of learning styles and health condition during learning process could be also cause the difference.

It is also found that several external factors are presumed to be the cause of low scientific literacy. The learning environments can affect learners in understanding science knowledge and concepts, so that learners can inhibit higher order thinking skills in analyzing the problems and answering the questions (Costa & Araujo, 2018; López-Faican & Jaen, 2020). Therefore, various learning strategies and methods have to be implemented to improve students' scientific literacy. Although the recent learning process is under the condition of COVID-19 pandemic, educators have to fulfill the effective learning situations in order learners are able to understand the concepts and increase their literacy skills.

During distance learning process, learners are invited to be able to study actively and responsibly. Students are also able to purse higher thinking during the online education, since it offers online learning objects with many benefits, such as a plenty of information literacy information that can serve as a flexible substitute for distance learning (Glaze, 2018; Reimers et al., 2020). Furthermore, by having distance learning, students can undergo best learning practice which is defined as a practice that are most appropriate under all learning circumstances, techniques, methods through many experiences to lead to concept comprehension and literacy development (Littenberg-Tobias & Reich, 2020).

Additionally, it has been proved that online learning permits for college students to figure at a time and an area that's compatible with their learning wants (Pahrudin et al., 2019; Rusli et al., 2020). Online learning process also provides the environment to utilize their comfortable and enjoyable time and place not only those even slow learners also can fasten the concepts by repeatedly listing to the online learning sources (López-Faican & Jaen, 2020; Parno et al., 2020; Rapanta et al., 2020).

There are three main interactions in online learning process that have to be involved: interaction between student and content, between student and teacher, and between one student and other (Gargrish, Mantri, & Kaur, 2020; Jeong & Gonz, 2020). However the other two which are the interaction between student and educator and between every student may be offered at minimal levels, or even eliminated, without degrading the educational experience (Jeong & Gonz, 2020). It is

assumed that cognitive presence or the interaction between students and content only was recognized as a critical component of both in face to face learning process and distance learning (Littenberg-Tobias & Reich, 2020). Whereas, the interaction between one student and other, and the communication between student and teacher are also important in building an effective distance learning.

Student-content interaction can stimulate a learning environment in which students can commit more to be independent and self-regulated learning (Reimers et al., 2020). Students learning in an online learning environment need to have acquired a degree of independence for successful learning (Arulogun et al., 2020). The ability of learners to engage learning by themselves is an important factor to consider. However, educators have to ensure that students are able to learn actively without any mistakes and misconceptions (Jufrida, Basuki, Kurniawan, Pangestu, & Fitaloka, 2019; Primasari, Miarsyah, & Rusdi, 2020). In addition, educators have to provide effective communications between one student and the other. All in all, even though the learning process is implemented through online way with

synchronous and asynchronous method, educators have to provide learning environments that can improve concept comprehension, scientific literacy, and communication.

To sum up, online learning process is required or even desirable in order to support the effective and interactive learning. Online learning provides opportunities for learners to study more independently, expand their skills, and learn to use strategies that they otherwise might not have. As the current condition, it is supposed that distance learning has to be implemented in which it is discovered that they need to be adaptive and fast-thinking in order to ensure that learning continues in a good way.

Students' Response toward Distance Learning with Augmented Reality-based Multimedia

Students shared the opinions and arguments toward the implementation of distance learning with augmented reality-based multimedia in the aspect of the learning environment, the use of augmented reality-based multimedia in the learning process, and also its content. This response is represented in Table 3 as follows.

Table 3. Students' Response toward Distance Learning with Augmented Reality-based Multimedia

Number	Students in Class	Total Percentage (%)	Criteria
1	A	89.1	Very strong
2	B	87.0	Very strong
3	C	84.8	Very strong

According to the findings above, it indicates that students gave positive opinions toward the learning process. Students in class A gave response with total percentage about 89.1% which is categorized as very strong criteria. Furthermore, class B showed a total percentage of response about 87.0% that is lower than class A. Lastly, students in class C gave the lowest total percentage, with 84.8%. However, all the total percentage from class A, B, and C are categorized as very strong responses. Those positive arguments showed that students were having fun and interactive learning, and they were motivated during the process. As it is already stated that if the learning process is interesting, and then it can make easier to understand the concepts.

Additionally, it also shows that distance learning with the augmented reality-based multimedia was able to assist students to understand the concepts of human respiratory system. This learning activity also helped students to identify and solve the problems while strengthen the scientific literacy. It also guides students to experience self-study by applying science knowledge and concepts.

In addition, by implementing distance learning with the augmented reality-based multimedia, students are also easily to learn

actively whenever and wherever they want. Students can operate the learning sources by themselves and have review of the concepts more than once. As it is already explained that length of time on learning is one of important factor that can effect on students' achievement (Iftene & Trandabăt, 2018). This also can enhance students' motivation since they can access the learning materials that they need to study whenever, for instance during their break time (Syawaludin et al., 2019).

Furthermore, students also can monitor and manage their learning activities by having the distance learning and the augmented reality-based multimedia. It shows that open online learning can help students to learn more. This links to the benefits of learning science concepts through distance learning and learning media which can be used anytime and anywhere (Parno et al., 2020; Rusli et al., 2020).

However, it is suggested that educators need to improve both the quality of learning process and the content of multimedia. This effort has to be conducted to provide more effective learning environments, enhance students' scientific literacy, and overcome problems of learning process during the condition of COVID-19 pandemic.

CONCLUSION

This research aimed at improving students' science literacy through distance learning with augmented reality-based multimedia under condition of COVID-19 pandemic. According to the findings obtained in this study, it can be concluded that students' scientific literacy improved well through the learning process that has been conducted. However, it also showed that students in class A, B, and C reached different score of enhancement in scientific literacy. Even though the students have done the same condition of learning process, however they have different ways to understand the concepts and transform the knowledge related to anatomy and physiology of human. In addition, the internal factor from every student also varied in which students have different learning styles. Nevertheless, the students have experienced new learning environment through this kind of learning process. They have given positive response toward the learning since they argued that the learning process was new and interactive for them. Therefore, it can be assumed that the distance learning with augmented reality-based multimedia was able to improve the students' scientific literacy well. In addition, it is suggested that the learning process should be conducted more effectively and continually. Lecturers also should provide interactive learning media in order that students are able to understand the concepts well.

ACKNOWLEDGMENT

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*Correspondence Address
E-mail: ahied@trunojoyo.ac.id

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13