Teaching Global Warming with Millealab Virtual Reality

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Abstract *– Virtual Reality (VR) is a new technology in education applied to the learning process. The development of VR technology in education meets several problems. This research develop a learning media based on virtual reality technology developed by Millealab. Millealab is a platform for developing VR media with more specific features to create a good visualization of reality to support the teaching and learning process. The development of VR media named "GoWarm with Millealab" has been made through researching, creating, validating, and trial. The validation process was assessed by six validators (Physics media lecturers, Physics teachers, and media experts) and got an average score of 87%. It means the media is good and very valid. The trial was limited and conducted online because of the COVID-19 pandemic. The result shows that the media is categorized as very good. Indeed, "GoWarm with Millealab" received positive feedback from the respondents (20 High School Students). In brief, "GoWarm with Millealab" is successful developed to gain attention to Global Warming issues. Further research in VR-based physics learning media needs to be done by improving content and evaluation.*

Keywords: *Global warming, learning media, Millealab, virtual reality*

I. INTRODUCTION

Education is one of the factors for the improvement of a Nation. Strategy and innovation for supporting learning process is an effort to provide well-made and exciting education for students. The innovation in education can be affected by Technology's rapid growth and communication in the Industry 4.0 era. It also demands teachers to choose the right strategy in the learning process. Good learning strategy could be indicated by students involved in some activities that accomplished the learning purpose (Dalyono, 2016).

The rapid growth of Technology impacted not only adults but also children. Technology growth is possible affected student's behaviour such as decreased interest in the study, involvement in criminal cases, and drugs (Barni, 2019). Overcoming these problems, teachers must use some innovation. Technology utilization can be combined with alternative ways of digitization to the learning process to have more interest in the study than before (Baihaqi, 2017).

Subekti et al. (2018) state that the indicator of success for a nation in competing and overcoming the globalization era is human resources quality. One effort can be made by preparing human resources experts in Science, Technology, Engineering, and Mathematics (STEM) both in quality and quantity. STEM

education aims to have scientific and technological literacy skills to apply things related to STEM in their life (Subekti et al., 2018). This statement is supported by Zubaidah (2018) about the skills needed to face the 4.0 revolution are complex problem solving, critical thinking, and creativity. Indeed, teaching science physics needs to adapt to the technology and globalization era in providing better education for the millennials.

Physics is a natural science branch focused on natural phenomena, mainly deals with the structure of matter and the interactions between the observable universe's fundamental constituents (Weidner & Brown, 2020). One of the goals in Physics subjects written in the curriculum 2013 is developing reasoning skills in inductive and deductive analytical thinking by using physics concepts to solve problems both qualitatively and quantitatively (Suharto, 2015). Physics teachers deliver information about the nature of inanimate objects tend to give an abstract thinking process to the students' caused by no tangible object, for example, when the teachers talked about atoms. Toward Physics lessons, students feel indifferent because of the concepts' complexity (Hesti et al., 2017; Astuti et al., 2020). Those situations can foster a sense of boredom and laziness in students learning experiences. Andriani et al. (2021) also stated that students tend to be passive when lecturers deliver materials can cause the low enthusiasm of students in learning. Overcoming those problems, the teacher needs to use learning media combined with Technology to give the best visualization in a subject that cannot be explained with words, such as the global warming process.

Effort can visualize an abstract concept to be more concrete and easier to understand to use teaching media. A teaching media or learning media presented digitally provides the subject explained thoroughly with images or video support. Nugroho (2017) states that teaching the greenhouse effect using a good visualization through Instagram increases students' learning motivation. Furthermore, students result in the study increased after teachers using media or some audio-visual illustration. It is proven by an increase in value on test results and increased student absorption in receiving lessons given by the teacher (Purwono et al., 2014). According to the literature, one learning media that applied audio and visual is Virtual Reality (VR).

There is an alternative way to deliver instructional materials. Rather than using a conventional lesson model, Technology applied in learning media will be more interactive and attractive for Millenial students. Instructional Technologies (IT), particularly suitable for increasing student interest, reducing the time needed for classroom activities and supporting educational efficiency (Yumusak & Aycanm, 2002; Durukan et al., 2020). One Technology that has a rapid growth in conjunction with the revolution industry 4.0 is Virtual Reality (VR)

technology. VR environment has been classified as Immersion, Interaction, and Engagement (Almeida, 2002; Durukan et al., 2020).

In the past, VR is not one of the popular Technology to use in education due to its high cost and limited availability. As a learning media in the learning process, VR tends to give more stimulus to the student (Ratriana, 2017). Furthermore, research also shows that students' desire to study tends to be very high for using VR technology in learning (Sunarni & Budiarto, 2014). In time, Indonesian need to be more focused to develop and utilize this Technology better. The utilization of VR technology in education face some problem. One platform that can help teachers to develop learning media using VR technology is Millealab. This local platform product has been designed to make it easier for users to develop VR-based learning media (Millelab, 2019).

One topic of physics subject that must be more attractive to be understood through visualization is global warming. This subject is one of the physics materials that integrated science, combining physics, chemistry, and biology. Global warming has been explained to students as a theory, but global warming is such worrying issues nowadays. In a study conducted by Pradini, Sudarti & Prihandono (2017), out of 36 students, only two students received excellent predicate in understanding the concept of global warming. As many as 63.6 % of 33 students admitted that the teachers had used the media as teaching materials, the explanations given are less concrete than the subject (Ariska et al., 2016). Global warming can be prevented from an early age, one of which is through learning physics. By preventing climate change, it has helped to realize one of the goals of the Sustainable Development Goals, namely Climate Management.

Research in teaching media using VR has been started recently, and it has various themes such as simulation of relativity theory (Sumardani et al., 2020); Using VR in the classroom (Yildrim et al., 2020); Increasing elementary student's interest and learning outcomes in Science topic (Dewi, 2020); VR field trips learning about climate change (Markowitz et al., 2018); Using VRs' application for solar system (Arifin, 2018); and Using Virtual Reality in mathematics learning for elementary students (Sulistyowati & Rachman, 2017).

Based on the literature review and the challenge in preparing better education for Millenials. This research developed GoWarm with Millealab with high school teachers and students as targeted audiences. This research's primary basis is the education problem in Indonesia, especially in innovation and learning activities, and the difficulties students to understand physics. The constraint VR technology development on education in Indonesia and identifying Millealab potential can develop VR-based learning content.

II. METHODS

This research using Research and Development (R&D) method. There are ten procedures in this research model, but there is some modification with this GoWarm with Millealab (Sugiyono, 2015). It included (1) Problem and potential analysis; (2) research and collecting; (3) preliminary product development; (4) product validation; (5) major product revision; (6) limited trial to determine students' responses toward the VR-based learning media. The results for each step mentioned in the method explained in the results and discussion.

GoWarm with Millealab got validation from six learning media experts. They are two physics media lecturers in one university in Surabaya two teachers with five years of teaching experience, and two media experts who have developed online learning media. The Likert scale was used to know the score from six validators using the formula (Asyhari & Silvia, 2016).

$$Percentage\ (P) = \frac{Total\ Score\ (\sum x)}{\text{Ideal Score Maximum (ISM)}}\ x\ 100\%$$

Table 1 shows the interpretation criteria scale to determine valid or invalid the VR-based learning media using Millealab. The validity score must be ≥ 61% to get the valid criteria.

Table 1. Interpretation Criteria Scale

Interval	Criteria
0%-20%	Very Invalid
21%-40%	Invalid
41%-60%	Enough
61%-80%	Valid / Good
81%-100%	Very Valid / Very Good

GoWarm with Millealab also got responses from high school students and university students in questionnaires form. A limited trial was conducted and had 23 participants included 20 high school students and three college students, with online testing because of the COVID-19 pandemic. This procedure was conducted to determine the participants' responses to VR-based learning media using Millealab in the global warming topic. Both validity and response on GoWarm with Millealab are used to evaluate VR-based learning media development's success in this research.

III. RESULTS AND DISCUSSION

In this part, the process of R&D is described to give a clear picture how the media defined, designed, developed, and disseminated. Following the research methods, R&D, this research able to develop prototype of *"GoWarm with Millealab"*. However, due to time and access to school limitation, the dissemination process has not fullfiled yet.

A. Problem and Potential Analysis

The first analysis step is students' understanding of the global warming subject. In curriculum 2013 global warming subject was delivered in the last semester of second-

year high school. The concept explanation is not in-depth and can cause difficulties in student learning experiences and understand a flawed concept. According to research conducted by Pradini, Sudarti & Prihandono (2017), there's only two students out of 36 students who have a super predicate to the global warming topic evaluation.

Indonesian teachers facing some problem to develop VR-based learning media, due to develop these VR-based learning needs complex programming languages and the high quality of VR-based learning was produced in high specification laptop (Millealab, 2019). One platform, namely Millealab, focused on overcoming teachers' problems with the development of VR-based learning. The making of VR-based learning content in Millelab only requires laptop specifications with 2GB RAM and takes 30 minutes to create one straightforward VR-based learning content. Therefore, the use of Millealab was possibly enough to develop VR-based learning media more efficiently so that classroom learning can be more innovative and interactive.

B. Research and Collecting

The Millealab platform was developed by an Indonesian company, namely Shinta VR that has been developing many Virtual Reality and Augmented Reality platform and products. In education, VR technology has been applied to an elementary student for learning mathematics in an exciting way (Sulistyowati & Rachman, 2017.

In the physics syllabus according to the Ministry of Education and Culture No. 37 the Year 2018 about *Kompetensi Inti* (Main Competence) and *Kompetensi Dasar* (Basic Competence) stated that global warming subjects that will be taught are symptoms of global warming. Moreover, it covers the impact of global warming, the general solution to prevent global warming, and the international agreement about global warming (Permendikbud, 2018).

C. Preliminary Product Development

There are four virtual worlds in this VR-based learning media: Sea, Sumba, Forest Fire, and International Agreements, as shown in Figure 1a-d. The VR-based learning media is not about the virtual world but also involved text information, video support information, and audio.

Figures 1. Virtual world

Figure 1a. Sea as the first virtual world

Figure 1b. Sumba as the second virtual world

Figure 1c. Forest Fire as the third virtual world

Figure 1d. International Agreements as the final virtual world

After the four virtual worlds are completed, the next step is to create a classroom using my classroom feature, namely Go-Warm with Millealab. According to the student's responses about global warming subject at the end of the learning process, the students will be given a quiz using Millealab in VR-based learning content. After every component of learning has been completed, the VR-based learning media can be seen through the Millealab viewer application in the Android play store.

D. Product Validation

The VR-based learning media using Millealab has been validated by six validators with some suggestions that were used as main product revision. The validation instrument includes four aspects: 1) Media processing, 2) Media display, 3) the suitability of learning media in Physics learning and, 4) the Learning process for the six validators without any differentiation.

Table 2. The Validation Result of VR-based Learning using Millealab

Aspect	Experts	Total Score	Percentage Value and Criteria
Media Process	Physics media lecturers	45	93 (Very Valid)
	Physics Teacher	45	93 (Very Valid)
	Media Expert	43	89 (Very Valid)
Media Display	Physics media lecturers	60	83 (Very Valid)
	Physics teachers	68	94 (Very Valid)
	Media Expert	64	88 (Very Valid)
Suitability of media in physics learning aspect	Physics media lecturers	24	100 (Very Valid)
	Physics teachers	24	100 (Very Valid)
	Media experts	24	100 (Very Valid)
Learning Process	Physics media lecturers	34	85 (Very Valid)
	Physics teachers	40	100

	Media experts	28	(Very Valid) 87 (Very Valid)

The total result from six validators is shown in Table 2 and the percentage and criteria scale are based on Table 1. Table 2 was showed the score result from every validator that gives a checklist using the Likert scale which for aspect given scores 3 means good and scores 4 means very good.

Based on Table 1 the criteria of average score from the validation process need to be ≥ 61% and it can be seen in Figure 6 that the average scores for four aspects in VR-based learning media are above 90%, so VR-based learning achieved a very valid category.

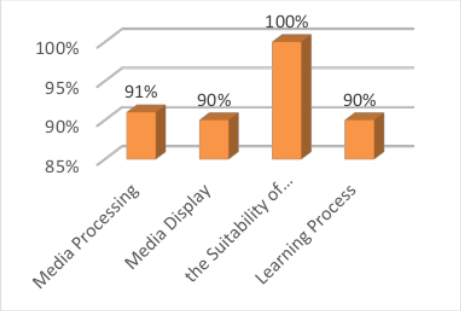


Figure 6. The average score of VR-based learning media aspects validation

The lowest average score in Figure 2 consist of two aspects: 1) media display aspect which includes background music, object, audio, and language that used in learning media obtained 90% and, 2) Learning process aspect is 90% achieved on the learning media presented material coverage from Curriculum 2013 syllabus. Moreover, the six validators recommend several revisions as shown in Table 3. Mainly, the validators' commentary is very interested in learning media using Millealab because of the new technology that applied in the learning process and the creativity for using real phenomenon and put into a virtual world.

Table 3. The validators revision recommendation

Validators	Description
Physics Teacher	1. The sky background in the Sea scene must be good if in a clear/bright sky 2. Add one portal to go to the last scene 3. Add some video to show the real or easier way to preventing global warming
Media experts	1. The audio volume must be balanced with the background music 2. Add YouTube video date release 3. The pop-up info must be clearly

E. Limited Trial

The respondents consist of nine science students and two social students in 11th grade, 12th grade of science and social students both consist of 4 students, three students in 3rd year, and one student in 2nd year both as physics students. Students from Social Science Class included in this limited trial because global warming consists of various subfields from physics, chemistry, and geosciences, and also the preventing of climate change has involved

political, economic, and environmental issues (Haunschild, Bornmann & Marx, 2016).

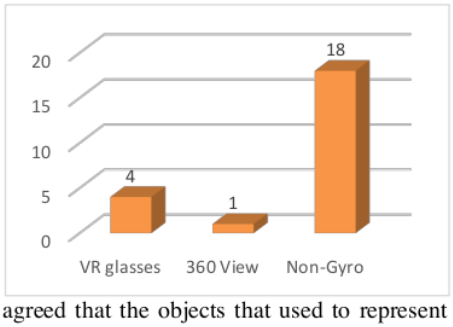
The limited trial also tested students' understanding of the global warming concept by giving evaluation test. The score result from students' evaluation is lower than the minimum score, which 70; only ten students can pass the minimum score. The reason behind it can also cause by 1) According to the global warming topic syllabus, there were four sub-topic such as, symptoms of global warming, the impact of global warming, the general solution to prevent global warming, and the international agreement about global warming. The learning duration using GoWarm with Millealab is about 20-30 minutes. The fast duration can make it difficult to students to have a well-understanding of all the global warming sub-topics; 2) The online method on a limited trial because of COVID-19. It also concludes that teacher supervision is required during the learning process or when a limited trial is conducted

Table 4. The result of limited trials

Statement	Yes (%)	No (%)
It is easy to operate VR-based physics learning media using Millealab	95	5
It is easy to access the application	95	5
The illustration and image in this VR-based physics learning help to understand the global warming concept	100	-
The VR-based physics learning media's display is interesting	100	-
The virtual world display felt real	82	18
The objects that used to represents the real-world can help to have more understanding of the global warming concept	100	-
The explanation, audio, and video can help me understand the global warming concept	95	5
This VR-based physics learning media is suitable for the technology growth	100	-
These VR-based physics learning media can engage the motivation to study physics	91	9
This VR-based physics learning media is suitable with the material	100	-
This VR-based physics learning media built the curiosity	100	-
Average	96	4

Table 4 shows that 95% of student agreed that VR-based physics learning media using millealab is easy to operate. About 95% of students agreed that the application (Millealab) is easy to access as long as the respondent uses Android smartphones. All of the students (100%) said "Yes" that the illustration and image help global warming concept and, 100% of students also agreed that the display is fascinating.

As many as 82% of students agreed that the virtual world felt real, 100% of students



agreed that the objects that used to represent the real-world can help the more

understanding to global warming concepts, where 95% of students agreed that the explanation, audio, and video helping they to understand global warming concepts. As many as 100% said, using GoWarm with Millealab is fit in with the growth of technology-supported learning strategy for Millenials. Around 91% of students agreed that these GoWarm with Millelab media could motivate them to study physics. All of students (100%) agreed that GoWarm with Millealab is fit in with global warming material. Furthermore, all students agreed that the features in GoWarm with Milliealab increase their curiosity. The total average score is 96% and it can be categorized as “very good” according to Table 1.

The viewer mode also impacts the result of the limited trial that students use when running the application. There was three viewer mode to use this GoWarm with Millealab media which, VR-glasses mode, 360 View mode, and Non-Gyro mode. In this research, students are expected to use VR-headset. According to Allcoat & Mühlenen (2019) states that participants showed better performance for ‘remembering’ in VR condition than those in traditional and video condition. The information about students' selection on viewer mode can be seen in Figure 8.

Figure 8. Number of students based on viewer mode selection

Based on the research, from the validation process, it is known that GoWarm with Millealab is very valid to use in the physics learning process. The use of YouTube videos in the learning process is also received positive responses so that students can learn outside the class (Aca & Sulisworo, 2020). Students' assessment while using GoWarm with Millealab media are low than the minimum score, this result is opposite with Nurwahid (2017) which stated that the students’ and educator assessments result in the learning media development are positive.

To make a VR-based physics learning media using Millealab is easy to access and operate (Millealab, 2019) but needs the creative idea to make the real-world implementation to the virtual world and make physics concepts more straightforward and easier to understand. These GoWarm with Millealab can engage students with interest in physics learning especially in global warming so that the students interest can increase in the environment (Markowitz et al., 2018).

IV. CONCLUSION AND SUGGESTION

The GoWarm with Millealab media which was developed has received 87% and can be categorized as "Very Valid" and able to test as limited trials and overall the validators give positive commentary. Based on the limited trial, the questionnaire responses have been categorized as Very Good criteria, and the score of about 96% included 11th and 12th-grade science and social students in Senior High School and some physics department's students.

The GoWarm with Millealab media can be used as the learning media to teach global warming topics, so that teachers can make the learning process more interactive and the other topics in physics can be developed using Millealab platform.

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