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Development of Virtual Reality Endogen Energy (VREE) Media for Physics Learning Mechanical Wave on Class XI

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Abstract

Computer Virtual Reality (VR) is another innovation in the realm of training that is applied to the educational experience. The improvement of VR innovation in the field of training has experienced a few issues. This study creates learning media in view of VR innovation created by MilleaLab. MilleaLab is a phase for making VR media with extra specific components to make a fair impression of reality to help the educating and developing experience. The headway of VR media which is named "Virtual Reality Endogen Energy (VREE)" This is finished through research, production, approval, and testing. The approval cycle was evaluated by 10 validators who are physical science media speakers and physical science instructor, the media has been pronounced substantial and solid. It shows that the media is suitable for teaching. A limited trial was conducted at one of Senior High School in Sidoarjo. The results show that the media categorised as very good. VREE received positive responses from the respondents who are 30 high school students and 10 students of undergraduate program Physics Education. In brief, " VREE " has been successfully developed as an interactive Physics learning medium that can explain mechanical wave material with volcanic eruptions as themes of study. Further research needs development of VR-based learning media on other topics and need to reiterate the answers to filling out questionnaires by students.

Keywords: Mechanical Wave, Learning Media, MilleaLab, Virtual Reality

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INTRODUCTION

Instruction is a course of cognizant and arranged endeavors to make an air of procuring and educational experience to effectively foster their capability to have strict, profound strength, discretion, character, knowledge, ethics, and abilities required without help from anyone else and society. One of the essential bases of tutoring is to show culture by the more young ages. The learning stage is one of the stages that choose the advancement of an informative cycle. Learning media expects a critical part in the instructive experience (Sulistyowati & Rachman, 2017). Learning media is a gadget or go-between that is important for working with the instructing and developing experience to streamline correspondence among theachers and students. Learning media is a gadget that can be used as an instrument for conveying all learning materials (Wahyuni E.S. & Yokhebed, 2019). The utilization of informative media can help educators and convey learning material (Okediran, 2014). Learning media is extremely vital for expanding, stirring new longings and interests in the growing experience. (Zulherman, 2021).

In the computerized time, different developments will be focused on administrations that are not difficult to get, simple to get to, simple to give knowledge and illumination, even extremely modest (Terracina A. & Mecella, 2015). Likewise, in preparing, pioneers battle to

find different learning models that are helpful, humble, and basic then with modernized and adaptable characters (Rusnandi, 2015). This media was made through the MilleaLab application, which is used expressly for android headway on PCs (Monita F.A. & Ikhsan, 2020). Virtual Reality (VR) is an innovation that permits clients to connect in a climate mimicked by a PC (Prayudha, 2017). VR is a development used like we can team up with an environment imitated by a PC. VR can be used in learning media during the times in the continuous time of globalization (Mandal, 2013). In fact, VR is utilized to depict a three-layered climate produced by a PC and collaborate with somebody (Sarosa, 2019).

VR can attract a person to a different universe and can deal with the idea of preparing by opening the likelihood to learn more than beforehand (Darabkh, 2018). Recalling and understanding books and paying attention to the topic conveyed by the educator becomes exhausting for understudies. The utilization of VR for schooling is extremely proper to focus on illustrations paramount so it becomes in the realm of training. Considering that age Z (or regularly known as the millennial age) is more keen on getting the hang of utilizing innovative media that simply utilizing conventional media (Karageorgakis T. & Nisiforou, 2018). VR empowers figuring out how to take advantage of understudies' personal center in new and fascinating ways (Tomchinskaya, 2018).

Physics is a branch of science that forms the basis for the development of advanced technology (E.D. Putriani., 2014). Physics is considered a difficult subject because the formulas are many and complicated. This is in accordance with the exploration led by Handayanto in a few junior and senior secondary schools in Bandung as statement by Prapti (2010) which stated that more than half (56%) of students are less happy to study physics, the minister of National Education, Culture, Research and Technology of Indonesia stated that the direction of learning physics tends to be rote, verbal, and not related to student life. In physics learning, concepts should not be accepted procedurally without understanding and reasoning. The low interest and comprehension of understudies in learning physical science can be brought about by the absence of intuitive learning media that can increment understudy interest in learning in the learning climate. Advancing by using innovation in VR based learning meadia can contribute to increasing student motivation quite well. To achieve quality learning, innovation in learning is must to achieve a good learning quality (Esteves, 2019).

Talking about the use of VR in education, this is one of the strategies learning through media. The VR media used must be the result of research the development of VR-based media, which are mostly models of a theory. Because theory is a kind of rational abstract thinking about a phenomenon, or the result of thought, which means that its form is still abstract, therefore it is necessary to build a model in learning. For example, develop VR on materials relativity by Sumardani teaching the special theory of relativity is challenging. It's difficult because this topic has never happened in real experience, and there hasn't been technology launched at the speed of light (Devianti, 2021). To understand this theory, VR has the potential to visualize the true concept of relativity by presenting artificial environment to students (modelling).

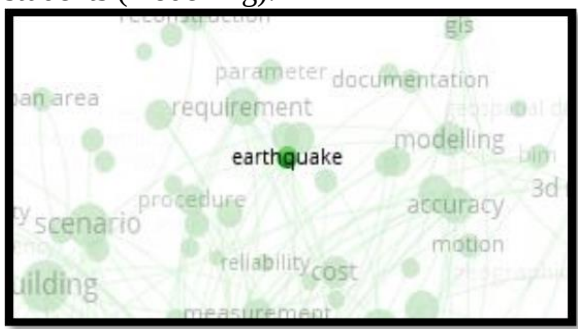


Figure 1 The relationship between VR earthquake

Figure 2 The relationship between VR and and disaster

In order to know the novelties related to disasters and earthquakes in VR research on physics learning, the specific connections between variables were examined, the results have several findings Figures 1 and 2. These figures show that research related to disasters and earthquakes has not much done. This is indicated by the absence of a *link* in the image. Disaster risk reduction or education about earthquake or other natural disasters is very much needed (in some in some disaster-prone areas). Some problems of disaster education can be overcome with VR. Making a virtual natural disaster situation make it possible to learn, train, and also reduce the limitations and challenges of actual learning in class. These situations include responding to mass casualties, dealing with natural disaster. Simulation-based training can be a valuable training modality in these situations, as it allows opportunities to practice and prepare for high-risk and often low-frequency events (Devianti, 2021).

In light of the clarification over, the current stusy aimed to report the consequences of the advancement of Virtual Reality Endogen Energy (VREE) learning media on mechanical wave material as one of the efforts in reducing the risk of earthquake disasters due to volcanic eruptions. Furthermore, the media was tried for practicality (legitimacy and reliability)and tried on various understudies and teachers to decide the practicality of the media that had been created.

METHOD

This exploration applies innovative work (R&D). As per Borg and Gall (2003) "instructive R&D is an examination used to create and approve instructive item" (Gall M. D., 2003). Furthermore, Sugiyono (2016), explains that R&D methods are research techniques used to create specific items, and test the viability of these items. In education, the products produced are in the form of teaching materials, curriculum, assessment instruments and so on. According to Sugiyono (2016) the R&D procedure follows the development steps. These steps, specifically problem identification, information assortment, item plan, item approval, plan update, item trial, item revision, and end result (Sugiyono, 2016). These steps are shown in Figure 3

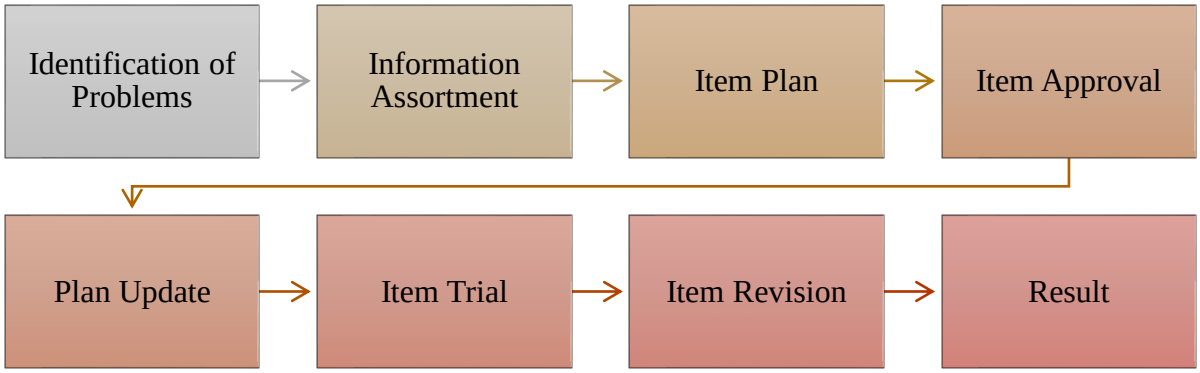


Figure 3 Development model of Sugiyono (2016)

Research can depart from the existence of a problem. The problem is the gap between the desire and the existing reality (Sugiyono, 2016). To find out whether or not this gap exists, a preliminary study is conducted. In the preliminary study activity, the researcher reviewed the literature on VR learning media in physics lessons on mechanical wave material. It turns out that VR learning media in Physics lessons material for mechanical waves is difficult to find, either from books or journals. Therefore, Physics is often considered less attractive because of the limitations of interactive learning media. Under these circumstances, the researcher felt the need to develop the instrument.

Indonesian educators likewise deal with a few issues in creating VR-based learning media, this is on the grounds that the improvement of VR-based learning media requires a

mind boggling programming language and to get excellent VR-based learning, it should be delivered from high detail PCs (MilleaLab, 2019).

After there are problems that can be shown factually, then, at that point, the scientists then, at that point, gather different data that is utilized as material for arranging specific items that are supposed to defeat existing issues (Sugiyono, 2016). At this stage, the researcher collects data to obtain information. Information was obtained from books and journals relevant to the development of VR learning media in physics lessons on wave mechanics.

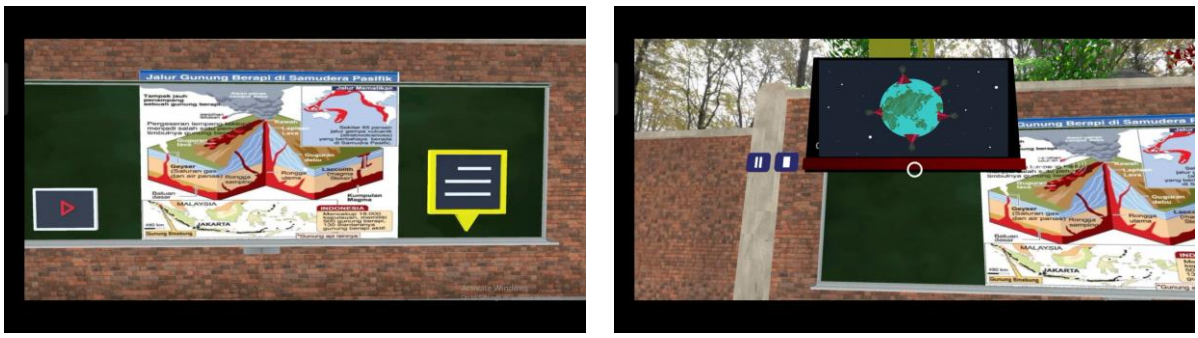
One of the stages that can be utilized to foster VR-based learning media, specifically MilleaLab, which centers around defeating instructor issues by creating VR-based learning. Making VR-based learning content at Millelab simply requires a PC assurance with 2GB RAM and it requires 30 minutes to make one VR-based learning content directly. Thusly, the use of MilleaLab is entirely possible to encourage VR-based learning media even more successfully with the objective that concentrate on corridor learning can be more innovative and natural.

The MilleaLab stage was made by an Indonesian association, Shinta VR, which has made various Virtual Reality and Augmented Reality stages and things in the Education region. VR development has been applied to simple students to learn math in a captivating way (Sulistyowati & Rachman, 2017).

Material actual science Syllabus, insinuating the Regulation of the Minister of Education and Culture Number 37 of 2018 concerning Core Competencies (Knowledge) and Basic skills (Skills), stated that the Physics subject in the mechanical wave material that will be taught is to analyze the characteristics of mechanical waves (Permendikbud, 2018). In view of the guideline of the Minister of Education and Culture Number 37 of 2018, a VR-based learning media was created which aims to enable students to analyze the characteristics of mechanical waves that are concave to the phenomenon of Mount Meletus, besides that students will also be given insight into disaster mitigation in dealing with Mount Meletus.

After the data collection process, product design or media development is carried out VR-based learning. Design is the stage where researchers make product designs in the form of VR-based learning mediaas an interactive learning medium. At this stage, the steps that must be carried out are the collection and manufacture of products that have been designed, Develop implementation or development objectives, and develop testing strategies. Sugiyono (2016) explained that the final result of this activity was in the form of a new product design.

In this VR learning media, students will be directed to a setting that tells of a high school student study tour at a volcano exhibition. There are six explanations of mechanical waves that will be conveyed to students in the mediathis VR based learning: *Volcanic Activity, Seismic Waves, Seismometers and Seismograms, Relation of Seismic Waves to the Physics of Mechanical Waves, 6 types of volcanic eruptions, Volcanic disaster mitigation,* as shown in Figures 4 to 9. This VR-based learning media isn't about the virtual world yet in addition text data, supporting data recordings, and sound.



(a) (b)

Figure 4 Volcanic Activity

(a)

(b)

Figure 5 Seismic Waves

(a)

(b)

Figure 6 Seismometers and Seismograms

(a)

(b)

Figure 7 Relation of Seismic Waves to the Physics of Mechanical Waves

(a) (b)

Figure 8 Six types of volcanic eruptions

(a) (b)

Figure 9 Volcanic disaster mitigation

After the six clarifications are finished, the subsequent stage is to make a study hall utilizing the my homeroom include, in particular VREE. Toward the finish of the example, understudies will be given a test involving MilleaLab in VR-based learning content after each advancing part is done. VR-based learning media should be visible through the MilleaLab watcher application on the Android play store.

The sort of information in this advancement comprises of quantitative information got from approval sheets filled out by lecturers who are media experts and questionnaires distributed to students to decide the legitimacy and realibility of the survey. Validity test aims to determine the level of accuracy of a test against what is measured by the test (Hairida, 2017). While the realibility test aims to the extent to which the level of consistency or confidence in the results of a measurement or the extent to which the question can be understood so as not to cause differences in interpretation in understanding the question (Dhamayanti, 2018). VREE received validation from 10 lecturers who are media experts. They are two physical science media speakers at a college in Surabaya and eight educators with five years of instructing experience. The Likert Scale is used to determine the scores of the 10 validators using the formula (Asyhari, 2016).

$$Percentage\ (P) = \frac{Total\ Score\ (\Sigma x)}{Ideal\ Score\ Maximum\ (ISM)} x100\%$$

Table 1 shows the size of translation measures to decide the legitimacy or shortcoming of VR-based learning media utilizing MilleaLab. Legitimacy score should be 61% to get legitimate measures.

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

VREE likewise got reactions from secondary school understudies and undergrads as a survey. Limited trials were carried out and followed by 40 participants consisting of 30 high school students and 10 students of undergraduate program Physics Education. The procedure was carried out to determine the participant's response to VR-based learning media using MilleaLab on mechanical wave material. The validity and response of VREE were used to evaluate the success of developing VR-based learning media in this study.

Student response sheets to VR-based learning media using Millealab on mechanical wave material are presented in the form of dichotomous questions. In the response sheet students will be given two choices "Agree" and "Disagree" to the questions that have been asked. After being grouped based on the same points in the student response sheet questions, the percentage of students' answers will appear using the formula.

$$Percentage\ (agree\ answer) = \frac{Total\ Students\ Agree}{Total\ Students} x100\%$$

$$Percentage\ (disagree\ answer) = \frac{Total\ Students\ Disgree}{Total\ Students} x100\%$$

RESULTS AND DISCUSSION

Validity is the main criterion of scientific research. In general, validity can be divided into two, namely internal validity and external validity. In addition to internal and external validity, there is also qualitative validity and quantitative validity (Abdillah & Hartono, 2015). The validator gives a decision that the instrument can be used without repair, there is an improvement, and it may be completely overhauled (Sugiyono, 2016). VR-based learning media using MilleaLab has been endorsed by 10 validators with a couple of thoughts that are used as the principal thing update. The endorsement instrument consolidates four viewpoints: 1) media taking care of, 2) media show, 3) the sensibility of learning media in actual science learning and, 4) the instructive experience for all validators without separation.

Table 2 The Validation Result of VR-based Learning using MilleaLab

Aspect	Eksperts	Total Score	Precentage Vlaue
Media Process	Physics media lecturers	52	87 (Very Valid)
	Physics Teacher	226	94 (Very Valid)
Media Display	Physics media lecturers	63	90 (Very Valid)
	Physics Teacher	260	93 (Very Valid)
Suitability of media in	Physics media lecturers	27	90 (Very Valid)
physics learning aspect	Physics Teacher	120	100 (Very Valid)
Learning Process	Physics media lecturers	45	90 (Very Valid)
	Physics Teacher	139	87 (Very Valid)

The absolute consequences of all validators are displayed in Table 2 and the Likert scale rate standards depend on Table 1. Table 2 shows the score outcomes of each validator who uses a Likert scale plan to give a score, where a score of 4 techniques incredible and a score of 5 strategies superb.

Considering Table 1 models, the commonplace score of the endorsement cycle should be ≥ 61%. It will in general be found in Figure 10 that the ordinary score for the four pieces of VR-based learning media is above 90%, so VR-based learning shows up at a very significant class.

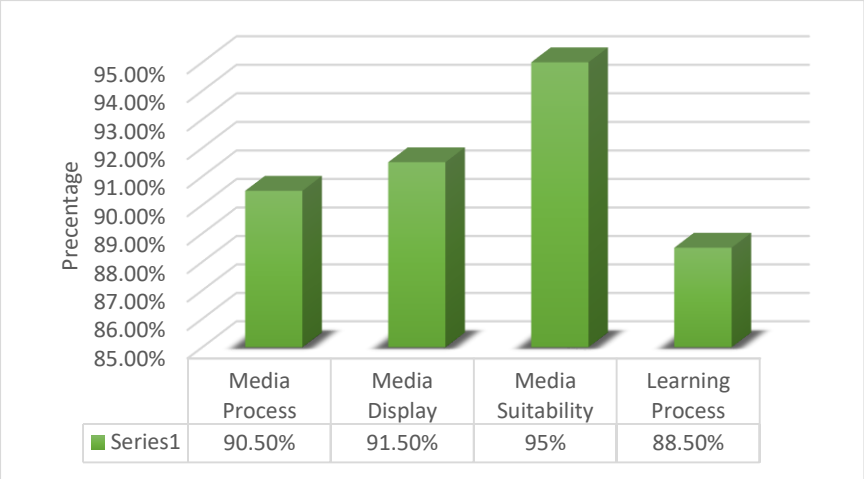


Figure 10 The averagescore of VR-based learning media aspects validation

The most minimal typical score in Figure 10 is in the part of the growing experience of 88.5% accomplished in Learning media presents material inclusion from the 2013 Curriculum prospectus. The average of the validation process with a range of 81%-100% included in the very valid criteria. In addition, from all validators recommend a revision that is almost the same, namely regarding "the need for re-examination of the suitability of the information and images displayed". Validators by and large remarked "exceptionally intrigued" in learning media utilizing Millelab as a result of the new innovation applied in the growing experience and imagination to picture genuine phenomenain a virtual world. This is in accordance with the exploration led by Agusty (Agusty, 2021).

After the validation process, the product is tested.Respondents consisted of 40 participants consisting of 30 students at one of Senior High School in Sidoarjo class XI who had studied the material of mechanical waves and 10 students of undergraduate program Physics Education, Faculty of Mathematics and Natural Sciences, at one of University in Surabaya who were taken randomly from Class 2018 to Class 2020.

Table 3 Grade of students evaluation results

Grade	Total students
100	6 person
90	2 person
80	4 person
70	8 person
60	10 person
50	7 person
40	3 person

This restricted preliminary tried's comprehension understudies might interpret the idea of mechanical wave by giving an assessment test. Grade of understudy assessment results is lower than the base score of 70; just 10 understudies at one of Senior High School in Sidoarjo and all students of undergraduate program Physics Education can pass the minimum score, as shown in Table 3. This can be caused because, in the topic syllabus of wave mechanics, there are six explanations of mechanical waves that will be conveyed to students in the mediathis VR based learning: *Volcanic Activity, Seismic Waves, Seismometers and Seismograms, Relation of Seismic Waves to the Physics of Mechanical Waves, 6 types of Volcanic eruptions, Volcanic disaster mitigation* as shown in Figures 4 to 9. With the span of getting the hang of utilizing VREE around 20-30 minutes. The quick span can make it hard for understudies to see well all sub-topics of wave mechanics.

Table 4 The result of product trials

Statement	Yes (%)	No (%)
It is not difficult to work VR-based physical science learning media utilizing MilleaLab	95	5
Getting to the application is simple	100	-
The delineation and picture in this VR-based physical science learning help to figure out the mechanical wave idea	93	7
The VR-based physical science learning media's presentation is fascinating	100	-
The virtual world showcase felt genuine	95	5
The items that used to addresses this present reality can assist with having more comprehension of the mechanical wave idea	97	3
The clarification, sound, and video can assist me with grasping the mechanical wave idea	92	8
This VR-based physical science learning media is appropriate for the innovation development	97	3
These VR-based physical science learning media can connect with the inspiration to concentrate on physical science	95	5
This VR-based physical science learning media is appropriate with the material	100	-
This VR-based physical science learning media assembled the interest	100	-
Average	**96.7**	**3.3**

Table 3 shows that 95% of understudies concur that VR-based physical science learning media utilizing MilleaLab is not difficult to work. All understudies (100 percent) concur that the application (MilleaLab) is not difficult to access as long as the respondents utilize an Android cell phone. Around 93% of understudies replied "Yes" that the outlines and pictures help the idea of mechanical wave and, and 100 percent of understudies likewise concurred that it looks intriguing.

As numerous as 95% of understudies concur that the virtual world feels genuine, 97% of understudies concur that articles used to address this present reality can assist with working on comprehension of the idea of mechanical wave, while 92% of understudies concur with the clarification. , sound and video have assisted them with figuring out the idea of mechanical wave. In the mean time, 97% concur that the utilization of utilizing VREE is in accordance with the development of innovation upheld learning procedures for Millennials. Around 95% of understudies concur that this utilizing VREE media can inspire them to concentrate on physical science. All understudies (100 percent) concur that utilizing VREE fits the mechanical wave material. Moreover, all understudies concurred that the elements in utilizing VREE expanded their interest. This is in accordance with the exploration led by Agusty (Agusty, 2021).

Watcher mode additionally affects the consequences of the restricted preliminary that understudies use while running the application. There are three watcher modes that can be used in VREE with MilleaLab's media, explicitly VR-glasses mode, 360 View mode, and Non-Gyro mode. In this review, understudies are supposed to have the option to utilize a VR-headset. As per (Allcoat & Mühlenen, 2018) members showed better execution for 'recollecting' in VR conditions contrasted with conventional and video conditions.

In view of the exploration, from the approval cycle it is known that VREE exceptionally legitimate for use in the physical science growing experience. The usage of YouTube accounts in the developing experience has moreover gotten a positive response so students can learn outside the review corridor (Aca & Sulisworo, 2020). Understudy

evaluation while utilizing VREE with MilleaLab media lower than the base grade, this is contrarily relative to (Nurwahid, 2017) which expresses that the aftereffects of understudy appraisals in learning media preliminaries are higher than the base fulfillment rules.

VR-based physical science learning media utilizing MilleaLab is not difficult to get to and work (MilleaLab, 2019) however clients need inventive plans to make certifiable executions into the virtual world and make physical science ideas more direct and straightforward. VREE can draw to understudies' advantage in learning material science, particularly mechanical wave and can assist with expanding understudies' attention to the climate (Markowitz, 2018).

CONCLUSION

Results Development of VREE learning media utilizing Millelab which has been approved and dependable in light of Table 1 standards, the typical score of the approval cycle for the four parts of VR-based learning media is above 90%, so VR-based learning arrives at an extremely legitimate class and shows that learning media VREE worth utilizing. Validators by and large remarked "exceptionally intrigued" in learning media utilizing Millelab in view of the new innovation applied in the educational experience and imagination to picture genuine phenomenain a virtual world.

Besides that learning media VREE have been through a limited trial. Based on a limited trial, 100% of students also agreed that it looks interesting, around 95% of students agree that this using VREE media can motivate them to study physics, and the answers to the questionnaire from students were included in the "very good" criteria with a percentage score of 96.7%.

RECOMMENDATION

VREE learning media can be utilized as learning media to show the subject of mechanical waves or different points in Physics subjects, so there is a requirement for additional exploration on the improvement of VR-put together learning media with respect to different subjects so the Physics educational experience is more intuitive and fascinating. Scientists need to repeat the responses to finishing up surveys by understudies so the advancement of VR-based learning media that is created is more intelligent in its utilization.

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