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Validity Test and Practicality Test of Virtual Reality Based Learning Media on Optical Equipment Material

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A B S T R A C T

One of the physics materials that is included in the abstract category is optical devices, especially the process of light entering the eye through a lens that cannot be seen directly by humans. The use of learning media combined with virtual reality is an alternative problem by providing visualization of material that becomes concrete in 3D or can be seen in 360°, making it easier for teachers and students in the learning process. This research aims to determine the feasibility of virtual reality-based learning media for optical devices in order to increase understanding of concepts in optical equipment, especially eyes and glasses. Validity testing is carried out by validating the learning media by experts and practicality testing is carried out by testing the media on teachers and high school students. The results of the research show that the average value of the validity test for virtual reality-based learning media reached 87% with valid criteria and while the practicality test by teachers and students obtained an average score of 90% by teachers and 89% by students with practical criteria so that the media Virtual reality-based learning is suitable for use to help the learning process in schools. Based on the validity and practicality analysis, the media can be used in real learning processes and can be tested further regarding its effectiveness.

1. Introduction

Physics is a part of science that studies the phenomena of the universe in terms of matter and energy through scientific processes that produce scientific products. Studying physics is useful for improving analytical and reasoning capabilities which, if continuously developed, can enrich more detailed knowledge so that a person will more easily overcome problems that occur in everyday life (Erviani et al., 2016). Physics has two types of scientific concepts, namely factual concepts and theoretical concepts. The concepts of states of matter such as solid, liquid, and

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gas are concepts of fact because real examples exist in the environment and can be easily observed. (Harefa, 2019). Concepts such as Light, atom, electron, electric current and the like find no real examples in the environment and also cannot be expressed from the perception of an object, event or situation. (Musliman & Kasman, 2022) (Kurniawan et al., 2018).

For teachers, explaining factual concepts is less difficult than explaining abstract concepts because examples of factual concepts are easier to find in the living environment. There is a close relationship between one physics learning object and another, resulting in several abstract concepts that are difficult for students to understand (Rizaldi et al., 2020). Understanding abstract physics concepts requires high-level thinking processes (Zahroh et al., 2021). Students generally learn abstract concepts using practical tools in laboratories where theoretical knowledge is converted into practical knowledge through experiments. Collaborating and sharing information with peers can also help students learn to work together, ask questions, and find joint solutions to problems encountered in experiments. Laboratories play an important role in developing students' understanding and practical skills by providing an environment for direct interaction with course material and peers (Gunawan et al., 2017).

The importance of laboratories in schools is in contrast to implementation in the field which does not meet expectations. Curriculum planning for some materials does not consider laboratories and short learning, negative views and attitudes of some teachers towards the implementation of laboratories (Rizal et al., 2018; Yasmina, 2020). There is still a lack of attention to laboratory conditions which do not have complete facilities. Laboratory safety aspects are also considered trivial, compounded by the lack of guidance to students regarding instructions for good use of the laboratory in order to minimize risks during practicums or experiments (Harijanto, 2018). Afroz (2024) Continuing Professional Development is provided institutionally, teachers will get the opportunity to develop professionally, and students will also be benefited through it.

Physics is not a collection of formulas, facts, concepts, principles and laws, but also studies the steps to extract information and implement it with technology, hone oneself to work systematically and scientifically, and improve critical thinking skills (Arafah et al., 2020). Superior student competency is a learning process that results from collaborative learning methods and the use of interactive learning media. Interactive learning media will help teachers convey the meaning of the material to students so that indirectly students' motivation in learning physics will increase (Bekti et al., 2021). Active student involvement is highly expected in the learning process. The use of media will direct students to obtain information or solve certain problems based on perceived experiences. Especially for abstract material, the use of media will be very useful in implying things that are difficult to explain verbally in a shorter time and minimizing students' misconceptions of the material (Sukaryawan et al., 2019). Choosing media as a source for independent learning can enrich the learning experience and help students prepare material that will be discussed at the next meeting. According to the Department of National Education (2008), independent learning media has the

characteristics of self-instructional (learning yourself), self-contained (one unit), stand alone (stand alone), adaptive (adjustment) and user friendly (friendly) (Ministry of National Education, 2003)

One of the physics materials that is classified as abstract and requires special media to provide an understanding of the concept is optical devices. Learning media intended to visualize the concept of light refraction are not always effective if only using the lecture method. This material is very important for students to understand because it plays a role in everyday life. The use of virtual reality-based learning media allows students to interactively explore complex concepts related to light refraction and shadow formation. Virtual reality allows students to gain information on the process of image formation through lenses in a more in-depth way and helps their understanding of difficult concepts with more fun thanks to virtual reality technology. This not only increases students' understanding but also develops important skills such as problem solving and creative thinking (Joko Sumarsono, 2009).

As technology advances increasingly rapidly and develops, it has become a golden opportunity that must be utilized in dealing with educational problems. Moreover, now all sectors of life can be controlled by the internet, such as the phrase "The world is in your hands" which has provided changes in all aspects and age groups. According to UNICEF research data in 2014 in Broto (2014), Indonesia is one of the top five countries in the world in terms of gadget use, with around 47 million active smartphone users and 79.5% of this number are children and teenagers. . This shows that technological advances are increasingly accessible to the younger generation, especially in the context of education and schools. The use of technology by children and teenagers shows a shift in learning methods and access to information. By integrating technology into the curriculum, it is hoped that it will be able to optimize the learning potential and interest of future generations (Farhana, 2017).

In the era of globalization, rapid and innovative technological developments give rise to global demands for education to adapt and improve its quality by incorporating technology into the learning process (Maritsa et al., 2021). In the 21st century, teachers are expected to be productive, creative, innovative and independent. They must also be proficient in using available technology to improve student learning processes and outcomes. An interesting learning environment can encourage students to actively develop their potential. These efforts can be realized by using learning media (Rochmania & Restian, 2022). The learning media that has emerged as a result of current technological developments is virtual reality (Sukaryawan et al., 2019).

Virtual reality, also known as virtual reality, is a computer simulated environment that allows users to interact with it. This technology is able to create an immersive experience that makes users feel like they are truly in the environment. According to Arifuddin & Mustagfirin (2022), virtual reality has the potential to become a valuable tool in the classroom because of its ability to involve students directly in the learning process. Jessica et al. (2023) also support the use of virtual reality in

education. Language is an important tool to express and communicate with the others (Sari, 2023). Virtual reality can help explain complex and abstract concepts and visualize difficult-to-understand material. To give a more real impression, users can wear virtual reality glasses (Ma & Metro, 2022).

The result of the visualization can be selected objects and animations that float in front of the user to interact with or even 360° the room, allowing the user to walk around and interact within it. In addition to providing students with an immersive learning experience, another benefit of virtual reality (VR) in education is its ability to inspire students' creativity and spark their imagination. And this can motivate them to explore new academic interests (Sukaryawan, 2019).

In the Society 5.0 era, virtual labs will be a renewal and reinforcement for individuals to be more modern and technologically savvy in using technology. The use of virtual reality in the learning process can help teachers convey physics concepts which were previously thought to be easier and more fun with the help of 3D visualization or which can be seen from various points of view (Jessica et al., 2023). With the help of virtual reality you will also save space, time and costs. This activity is expected to increase students' learning motivation in physics subjects. Based on the information above, the author wishes to carry out research and development of virtual reality-based learning media on optical instrument material.

2. Methodology

The research method used is Research & Development with the ADDIE model which consists of analysis, design, development, implementation and evaluation (Branch, 2009). The research data collection instrument uses a validity sheet and a practicality sheet. Validity sheets are useful for measuring the suitability of a media. The practicality sheet is used to determine the efficiency of the media in the physics learning process. The validity assessment aspect is divided into media aspects and material aspects. The assessment indicators from the media aspect are display design and accessibility. Meanwhile, the assessment indicators from the material aspect are the curriculum, material presentation and language. There are several indicators in carrying out practicality tests, namely ease of use, time efficiency, attractiveness, benefits, suitability to learning objectives, and suitability to the material. The data analysis technique used is a descriptive analysis technique which refers to the indicators on the validity and practicality sheet with the following formula (Purwanto, 2011):

$$K = \frac{R}{SM} \times 100\%$$

Information : N.P = Valuepercent
R = Scoreobtained
SM = ScoreMaximum

The placement of the score size can be seen from the assessment criteria within the ideal assessment range in Table 1 (Munawarah, 2022):

Table 1. Validity and Practicality Conversion Values

Percentage (%)	Statement of Validity/Practicality
81≤x≤100	No Revision Required
61≤x≤80	No Revision Required
41≤x≤60	Needs Revision
21≤x≤40	Needs Revision
0≤x≤20	Needs Revision

Learning media is said to be valid and practical if the percentage value obtained is in the range 61≤x≤80 (no need for revision).

3. Results and Discussion

The product developed is virtual reality-based learning media on optical equipment, especially eyes and glasses. This media can be downloaded to smartphones in APK format and used with virtual reality glasses for a more immersive experience. The use of media will give a more real impression if paired with VR glasses. To operate the media, simply point to the yellow dot to select the application menu option. The results of creating virtual reality-based learning media can be seen in Figure 1.

Figure 1. Main Menu Display

Figure 1 is a display of the main menu for virtual reality-based learning media which is presented as if it were in a virtual laboratory room. Users will be invited to 2 available menu options. If the yellow dot hits the Observing Lens menu, it will display a 3D visualization like Figure 2. Meanwhile, on the Observing Eyes menu it will also look like Figure 3.

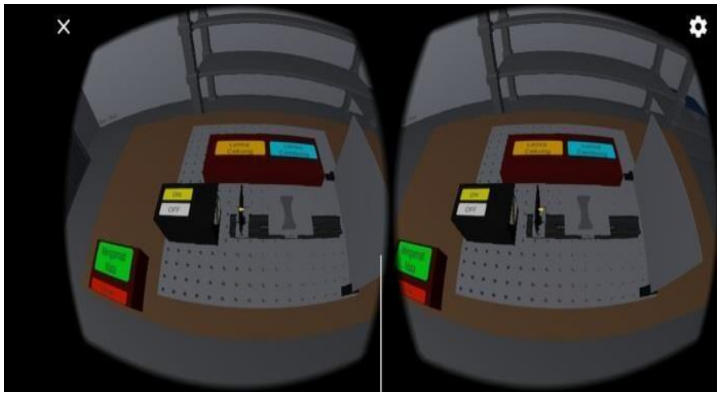

Figure 2. Lens Viewing Menu Display

Figure 2 shows the 3D condition of the optical kit with 2 lens options, namely concave and convex. How to run the lens concept visualization by selecting one of the lenses then directing the marker to the ON button. The visualization displayed is in the form of a process of light refracting through a lens. On this page, it can be seen that concave lenses have the property of spreading light (divergent) and convex lenses have the property of collecting light (convergent). The OFF button functions to turn off the Light visualization.

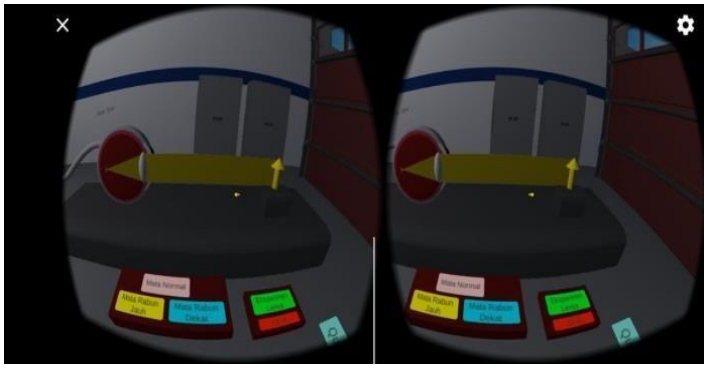

Figure 3. Eye Observation Menu Display

Figure 3 shows the appearance of the human eye's process of seeing an object under normal eye conditions. Objects in front of the eye that are exposed to reflected light will be refracted through the eye lens until an image is formed on the retina. This page also presents a visualization of the process of capturing the image of an object in nearsighted eyes (myopia) and farsighted eyes (hyperopia). The process of image formation in normal visible media occurs right on the retina, whereas in farsighted eyes the image formation is located in front of the retina, and in nearsighted eyes the image formation of objects is located behind the retina. The application of lenses in helping eye defects can be seen in Figure 4.

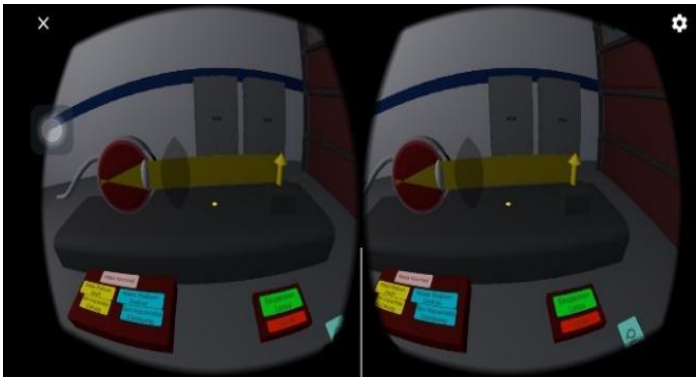

Figure 4. Application of lenses as glasses

Figure 4 shows the appearance of using lenses for myopic and hypermetropic eye defects. There is an option to use the "Give concave glasses" button to help people with myopic eye defects and the "Give convex glasses" button to help people with hypermetropic eye defects. Using glasses allows people with visual impairments to see objects in front of them clearly. This is indicated by improvements in the formation of images that fall directly on the retina or return to normal condition.

Validity Test Results

The next step after the media has been created is to carry out a validity test by 3 physics education lecturers at FKIP Riau University. The validity test consists of two assessment aspects, namely the material aspect and the media aspect, each of which is developed from several indicators. Validation results are shown in Table 2 and Table 3.

Table 2. Material Aspect Assessment Results

No	Indicator	(%)	Category
1	Curriculum	90	Valid
2	Presentation of material	84	Valid
3	Language	83	Valid
	Average	86	Valid

Table 3. Media Aspect Assessment Results

No	Indicator	(%)	Category
1	Display Design	88	Valid
2	Accessibility	88	Valid
	Average	88	Valid

Based on these two aspects, the results of the recapitulation of the validity test assessment obtained an average score of 87% in the valid category. This valid category states that virtual reality-based learning media is suitable for use in the learning process. This feasibility can be seen from the media being developed which presents an attractive appearance and is fast and easy to use, in line with research (Dinar and Waluyo, 2019). Lesson material is not solely seen from the content of the material, but rather how the material is delivered using media that attracts students' attention in class learning so that it can help teachers understand

the classroom atmosphere (Asari et al., 2023). A well-designed display provides user comfort so that students can easily obtain information from the media without confusion. The convenience factor refers to the ease of use of an information system, without requiring significant effort from the user. Ease of use indicators include frequency of use and interaction between users and the system. A system that is used more frequently will likely be better known and more accessible to users.

The feasibility of virtual reality-based learning media can also be observed from its content. This media contains material that is in line with the basic competencies outlined in the revised 2013 curriculum (Kemendikbud, 2018). The learning objectives presented include abstract concepts such as concave and convex lenses, the eye as an optical tool, and the application of lenses in glasses to treat eye defects. These concepts are visualized through 3D animations with accompanying audio, making it more engaging. Consistent and clear presentation of the material improves user understanding and prepares them for the next topic. The use of language in virtual reality-based learning media also uses language that is communicative and easy to understand in accordance with EYD rules. Clear and accurate language is essential for effective delivery of information and avoiding confusion as well as guiding users smoothly through the learning experience. Thus, virtual reality-based learning media can be used in the physics learning process.

Practicality Test Results

After the learning media is declared valid, the next stage is to carry out a practicality test on a limited scale. The practicality test was carried out on 2 physics teachers and 21 students. The practicality test results can be seen in Table 4 and Table 5.

Table 4. Teacher Practicality Results

No	Indicator	(%)	Category
1	Ease of Use	90	Practical
2	Time efficiency	90	Practical
3	Attractiveness	89	Practical
4	Benefit	90	Practical
5	Conformity to learning objectives	90	Practical
6	Suitability to Material	89	Practical
	Average	90	Practical

Table 5. Student Practicality Results

No	Indicator	(%)	Category
1	Ease of Use	89	Practical
2	Time efficiency	89	Practical
3	Attractiveness	88	Practical
4	Benefit	90	Practical
5	Suitability to Material	91	Practical
	Average	89	Practical

Based on Table 4 and Table 5, virtual reality-based learning mediastated to be practically used in the physics learning process. Media practicality is obtained from the assessment results of each indicator which has reached an average value of 61≤x≤80. Operation of media-based learning*virtual reality*It is very easy to use in the learning process, namely simply directing the yellow dot to the existing menu options either with the help of virtual reality glasses or just using a smartphone (Arsyad, 2011). The menu display in it is also easy to select and navigate. Apart from that, virtual reality-based learning media is also considered flexible because its use is not tied to time, place and circumstances.

Virtual reality-based learning media can also help teachers explain material to students according to the desired learning objectives, because it allows visualization of objects from a 360o perspective. This can increase students' understanding of optical instrument material. In line with the statement of Sumantri et al. (1999) that the aim of learning media is to make it easier to understand certain concepts, principles, attitudes and skills. Media visualization is presented creatively with attractive color combinations and neat object layouts. This display can motivate and provide comfort for students to study. In learning activities, student motivation is a determining factor for success. Educators must prioritize fostering student motivation to ensure successful learning outcomes. Students who lack motivation will have difficulty carrying out learning activities, which ultimately hinders the achievement of learning goals (Pagarra et al., 2022).

In addition, student-centered learning is achieved by involving them in gathering information and knowledge based on real experiences through virtual reality-based learning media. Continuous interaction between students and the media will produce effective learning (Kemp in Nurani et al., 2003). A positive learning environment can improve conceptual understanding of abstract material related to concave and convex lenses, the use of the eye as an optical tool, and the application of lenses to correct vision problems. This approach can help prevent students' boredom and increase their curiosity, resulting in a better understanding of the material.

4. Conclusion

The results of the research and discussion show that virtual reality (VR) based learning media on high school level optical equipment material developed through the ADDIE model has proven to be valid and practical in improving the physics learning process in schools. By utilizing VR technology, it is useful to visualize physics concepts which are usually abstract and complex into 3D animations that are easier to understand. The application of VR in physics learning not only enriches students' learning experiences but can also improve understanding of difficult concepts. Future research can focus on testing the effectiveness of this media in improving student learning achievement and complement it with explanations of other sub-materials related to optical devices, especially eyes and glasses.

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