

TECHNOLOGICAL INNOVATIONS IN DISTANCE LEARNING IN AUGMENTED REALITY-BASED OPTICAL COURSES

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Abstract

The use of technology can be the best solution in increasing the understanding of abstract eye optic system materials, especially in distance learning at the Open University. The purpose of this study is to describe the need for Augmented Reality (AR) technology in supporting the improvement of the quality of distance learning in eye optic system materials and; describes the initial design of AR technology on the material of the eye optic system. This type of research is descriptive and qualitative. In exploring the initial needs of AR technology, this research involved 18 UT Physics Education study program students. The research instrument includes a questionnaire on students' misconceptions and needs for AR technology in eye optic system materials. The data were analyzed descriptively and qualitatively. The results of the data analysis showed that 90% of students experienced misconceptions about the material of the eye optic system. Further analysis was carried out on several aspects, including as many as 69% of students agreed that the material of the eye optics system could not be studied without visualization media; as many as 67% of students think that the material of the optical system of the eye is complex and challenging to understand. Based on these findings, as many as 81% of students agree and need AR technology to support the improvement of understanding of eye optic system material. Therefore, AR-based learning media developed with unity technology is designed and equipped with visualizations that can help the advancement of student material understanding of the eye optics system material.

Keyword: Learning Innovation, Distance Learning, Augmented Reality

1 INTRODUCTION

1.1 Technology and Distance Learning

Learning is the main thing in education whose implementation is carried out continuously [1]. With the Covid-19 pandemic, the education system has undergone significant changes. Learning that is closely related to the face-to-face system is turning into distance learning. Distance learning is a learning system without face-to-face activities directly between educators and students, but is carried out online which is supported by the use of technology [2].

Distance learning is enforced at all levels of education, as is higher education. Remote lectures are carried out with an online system. Teknologi became the fulcrum in this long-distance lecture. Technology can facilitate all needs in the teaching and learning process [3]. Technology makes it easy for educators and students to do distance learning. Various platforms are provided with the intention of facilitating the implementation of distance learning, including making it easier for educators to assess students even though it is not carried out face-to-face / in person, the use of technology can help students in obtaining subject matter. Technology also plays a role in increasing the creativity of educators and students, educators can innovate in the delivery of learning materials by utilizing various social media sites, applications, platforms, and students can

take advantage of various social media sites, applications, platforms in fulfilling the tasks given. Technology can provide benefits in supporting the success of online learning in the midst of a pandemic like today [4].

The use of technology allows for a more efficient way of developing aspects of student thinking than is achieved when using traditional teaching practices [5]. The use of information and communication technology in distance learning has a positive impact on the learning process, students and educators. Information technology and telecommunications can remove the constraints of space and time and are cheaper and easier, despite the challenges of cost, infrastructure readiness, community readiness, and supporting regulations [6].

Distance learning means that educators and students are not in one place. To facilitate learning, technology is used as a medium. Learning media is everything that is used to channel messages in the form of teaching materials to stimulate students' attention, interest, and thinking to learn [7]. Media is used to channel messages and encourage the learning process to students; The media can also be said to be props [8]. Several types of media that can be used in learning activities, namely print media such as images or charts and electronic media [9]. Media that have been used in distance learning include interactive games, PPT, quizizz, google sites, microsoft sway, android-based learning media etc. Platform that can help implement online learning such aserti e-learning, Google Clasroom, Edmodo, Moodle, Learning houses, and even platforms in the form of video conferences have become more and more including Google meet, Zoom, and Visco Webex.

12 Technology in Physics Learning

Physics is one of the branches of Natural Sciences (IPA) that contributes to the development of advanced technology and the concept of living in harmony with nature. As a science that studies natural phenomena, physics also provides a good lesson for humans to live in harmony based on the laws of nature. The management of natural resources and the environment and the reduction of the impact of natural disasters will not run optimally without a good understanding of physics. The process of learning physics, often faced with material that is abstract and outside the daily student experience . So that the material becomes difficult to teach by educators and also difficult for students to understand. Visualization is one of the ways that educators can describe something abstract [10].

Various technologies are used as physics learning media. Learning media is a means to visualize the learning process that is often also used in physics learning [11]. The use of technology, especially in physics learning, can be done using the *Learning Management System* (LMS), the

use of sensors in smartphones, the use of various webs for quizzes, and interesting *games* can be done so that physics learning becomes fun even though it is carried out at home [12]. Distance learning will be effective if it meets essential components such as discursive, adaptive, interactive and reflective integrated with the environment or meets the components of the digital learning ecosystem, all of which are combined to bring out positive feelings by accommodating learning styles, flexibility and learning experiences [13]. By utilizing the right media, it is hoped that distance learning will be effective.

13 Topics of Subject Systems in Optics Lectures

Eye system/optical material is one of the important materials in physics learning. Various media are developed as learning media for eye system materials. As a multimedia-based content media for optical tool materials made by combining animation, sound, text, images and videos whose appearance consists of optical tool materials, practice questions, evaluations, videos, figures, and games. Media is presented offline and inserted into a CD or flashdisk so that it can be used at any time without having to take into account internet access. The animated display on the media is presented in a three-dimensional visual manner, which is in the form of imitations of optical tools so that students can better understand the concept because the animation resembles the original shape of optical tools and is expected to attract students to learn concepts a lot of optics [10].

Edmodo's web-interactive-based learning media was also developed as an eye system learning medium. In his research Ari sudibjo, 2013 showed that interactive web media can help students to improve student learning outcomes in cognitive aspects [14]. Other research by developing contextual-based knowledge enrichment books as a learning medium on optical materials. equips students with more meaningful knowledge, flexibly applicable (transferred) from one problem to another and from one context to another [15]. Learning media for the existing eye system is less efficient so it is still needed to develop other media to support the learning of the eye system. Eye system material requires visualization of images of parts and optical tools, to make it easier to understand by applying 3D animation.

Augmented Reality or in Indonesian called augmented reality is a technology that combines two-dimensional and or three-dimensional virtual objects into a three-dimensional real environment and then projects the virtual objects in real time [16]. This opinion is reinforced that Augmented Reality is a technology in the form of an application by combining the real world and the virtual world into three dimensions that are projected at the same time and can be displayed on an Android camera [17]. This three-dimensional Augmented Reality display is a virtual image that

is accurately superimposed on a real environment [18] Augmented Reality in 3D form can be displayed through a smartphone camera. So that Augmented Reality technology can be applied using a mobile phone that uses the Android operating system. The use of the Android system strongly supports the strategy on the learning process to be used in today's digital era [19]. Besides being able to be applied using mobile phones for learning media, Augmented Reality can also be developed again in the form of entertainment media, social media, medical media, industrial media and trade, and media in designing robots [17].

Previous research conducted by L. R. Dewi & M. Anggaryani (2020) showed that augmented reality can be displayed via smartphones indirectly has its relationship with the way optics works so that it is necessary to create augmented reality learning media with the topic of discussion on optical tool material [20]. Related research was also conducted by W. M. Putri, et al. (2016) shows that AR media has good quality to be used as a learning medium in optical materials with an achievement percentage of 86.43% [16]. However, in the research conducted by W. M. Putri, et al. Augmented Reality media, there are shortcomings, namely that the eye image is not close to the real shape, there is no designation on the parts of the eye. If these shortcomings are not corrected, then the use of Augmented Reality media will run less optimally and boringly.

2 RESEARCH METHOD

This type of research is descriptive and qualitative. In exploring the initial needs of AR technology, this research involved 18 UT Physics Education study program students. The research instrument includes a questionnaire on students' misconceptions and needs for AR technology in eye optic system materials. The data were analyzed descriptively and qualitatively. In this study, the data collection instrument used was a student misconception assessment sheet, a questionnaire to analyze student needs for AR media. Data analysis is carried out in a qualitative descriptive manner. After the entire initial data is analyzed, the design of the AR media product on the eye system material is designed.

3 FINDING & DISCUSSION

3.1 Material Characteristics of the Eye System

Optics is a branch of physics that discusses the nature and interaction of light using matter. In essence, optics talks about the symptoms of optics. The field of optics is divided into two, namely geometry optics and physical optics.

Students are given a printed questionnaire and asked to provide a response by providing two answer options, namely yes / no. Each student provides responses about several things, including: misconceptions that have the potential to be caused to the material, the need for material visualization, the level of understanding of the student material on the material, the complexity of the material and media needs in accordance with the topic of the material in the optics course. Based on the results of the analysis of 9 modules, each module consisting of 2 Learning Activities (KB), it was concluded that AR media needs to be developed in KB 2 Module 3 which discusses the optical system of the eye. The results of the analysis can be seen in the following figure.

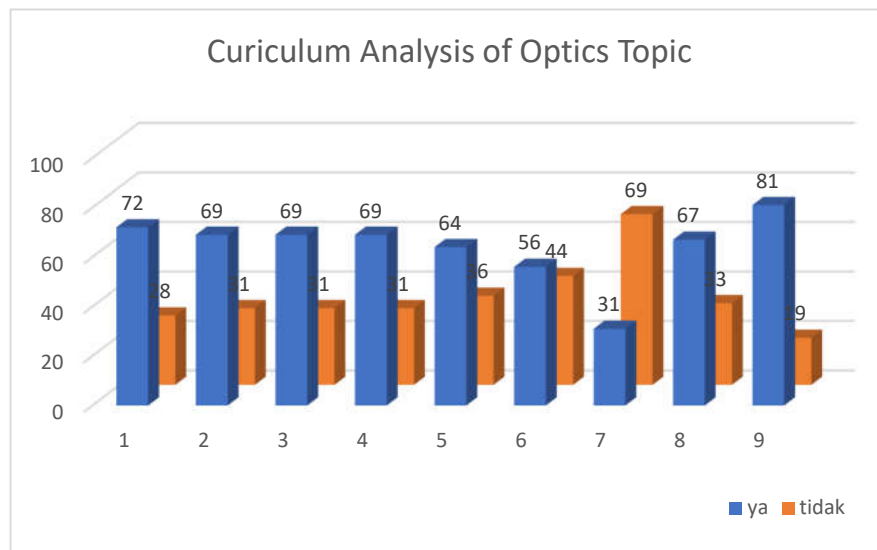


Figure 1. Results of Curriculum Analysis and AR Media Needs by Students on Eye Optics System Materials

Information:

- 1 = Material Has the Potential to Cause Misconceptions
- 2 = Need to Visualize The Material
- 3 = Low Student Material Comprehension
- 4 = Material Is Abstract
- 5 = Elusive Material
- 6 = Low Percentage of Learning Objective Achievement
- 7 = Can Be Learned Without Media
- 8 = Matter Is Complex
- 9 = Need AR Media

The findings in the curriculum analysis based on student perceptions can be concluded that

the material of the eye optics system has material characteristics that have the potential to cause misconceptions. The presentation of optical material also requires a lot of demonstration and visualization so it requires complex tools and equipment and is often difficult to use in learning for a variety of practical reasons

In the eye system material, the components of the eye and their parts and functions, the accommodation power of the eye along with eye and lens disorders are discussed to help people with eye defects, both myopia and hypermetropia [21]. Based on the results of the analysis that has been carried out on students' perceptions of the characteristics of the material in the optics course, it was concluded that some materials such as in module 3 in KB 2 regarding the eye optics system are still difficult to understand, and require visualization to understand the material, namely AR media. Referring to the analysis of the results of the student material understanding test on the concept of the eye optics system, it was found that the average score of students was 53.3. If converted into the final assessment, the average grade of the grade is at an unsatisfactory level. Following up on these findings, suggestions and input from students in the optics course are as follows: It is necessary to add visualizations to clarify the understanding of material concepts; it takes AR media to make the eye system material more concrete.

The application of Augmented Reality is considered more practical so that students are more enthusiastic about reading the subject matter [22]. There are three characteristics that state a technology applies the concept of AR: 1. Being able to combine the real world and the virtual world. 2. Able to provide information interactively and in real time. 3. Able to display in three-dimensional form. AR can be used to help visualize abstract concepts for the understanding and structure of an object model [23]. The eye system material also contains abstract concepts as an example of the components of the eye and their functions. With the advantages of AR media that can modify and change the appearance of 2D to 3D so that it is considered suitable as a learning medium on the material of the eye system.

Augmented Reality (AR) aims to simplify things for users by bringing virtual information into the user's environment [24]. In AR technology, users can see the real world around them with the addition of virtual objects generated by the computer. Therefore, AR media is needed in lectures on eye system materials. With the use of AR media will increase user perception and interaction with the real world.

32 Eye Optics System AR Media Design

AR technology is widely developed in the creation of multimedia learning presentations as a tool for teachers in the learning process in the classroom, and does not replace the teacher as a whole [25]. With the use of AR media, the teaching atmosphere in the classroom becomes more active and fun because students become more interactive in responding to the material provided by the teacher in the classroom. In line with the opinion of Khoirudin [26] the application of media with Augmented Reality for education is used in helping the process of self-learning. Optimization of Augmented Reality needs to be done because it has an entertainment aspect that can increase students' interest in learning and play and project it in a real way and involve the interaction of all five senses [26] The excitement of learning not only increases students' interest, but can also motivate them to be better so as to produce good learning achievements. The same thing is also expressed by the opinion of Rahmatullah, et al. (2021) where the application of AR applications can make learning more interesting and help students in improving learning efficiency and knowledge retention related to the subject matter taught [27].

The following is presented the design of ar media for the eye system material:

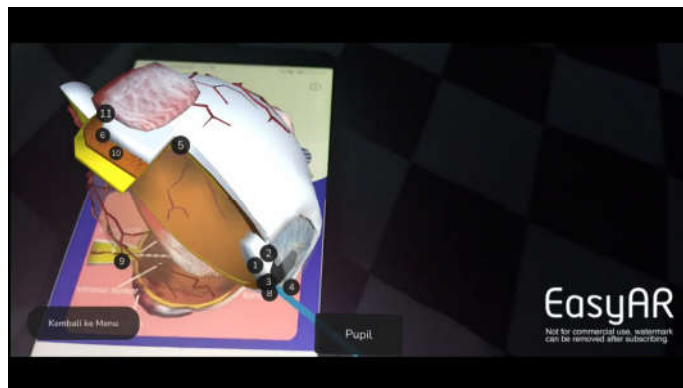


Figure 1. Eye System Parts presented in AR Media

To present the real concept of the eye system, AR media comes with the best visualization. As observed in the picture above, the parts of the eye are presented in detail and resemble their original shape. This is one of the advantages of AR media because it can present duplicates that resemble the original shape of the eye. In the appearance of the eye system, explanatory information for each part of the eye is also presented equipped with a voice that helps users to more easily understand the material.

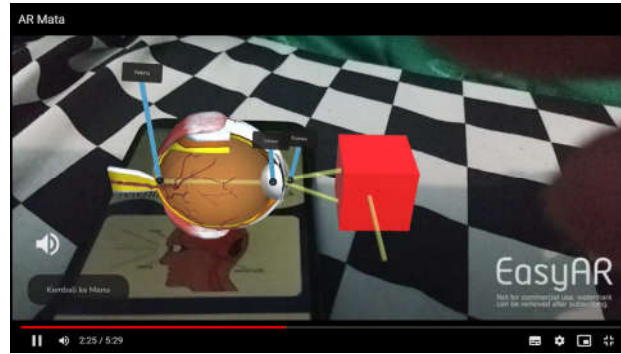


Figure 2. A Display That Shows The Eye Can See Objects

The process of the eye can see objects visualized interestingly in the picture above. It begins with the process of the object being exposed to light and is continued towards the pupil and cornea so that in the end the shadow falls right on the retina. All these processes are well presented using AR media.

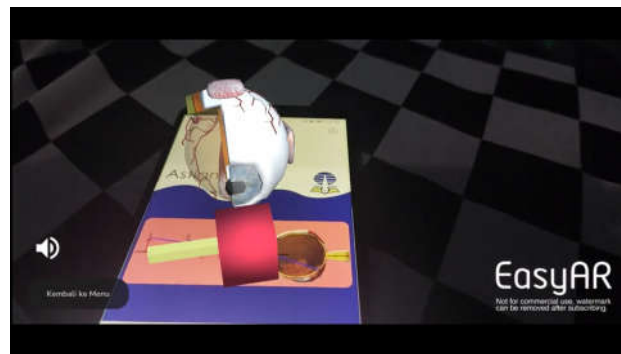


Figure 3. Rotation display when the Eye Process can see objects

The process of the eye being able to see objects can also be observed from different sides. The designed AR media display allows users to rotate 3D animations in various positions making it easier to observe and deepen the material. AR can provide information that can be more easily understood by the user[28]. Because of its advantages, AR can be used to create learning applications that can support the teaching and learning process[29]. Augmented Reality (AR) has been used in a variety of contexts in recent years to improve the user experience on mobile devices. Various studies have shown the usefulness of AR, especially in the field of education, where there is an increase in learning outcomes. Learning systems using AR are suitable for distance learning and promote self-study [30].

4 CONCLUSION

The results of the data analysis showed that 90% of students experienced misconceptions about the material of the eye optic system. Further analysis was carried out on several aspects, including as many as 69% of students agreed that the material of the eye optics system could not be studied without visualization media; as many as 67% of students think that the material of the optical system of the eye is complex and challenging to understand. Based on these findings, as many as 81% of students agree and need AR technology to support the improvement of understanding of eye optic system material. Therefore, AR-based learning media developed with unity technology is designed and equipped with visualizations that can help the advancement of student material understanding of the eye optics system material.

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