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UTILIZATION OF AUGMENTED REALITY IN DEVELOPING LEARNING MEDIA ON OPTICAL MATERIAL

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Abstract

Industrial revolution-based learning media 4.0 is urgently needed when it is in accordance with technological developments. The purpose of this research is to see the effectiveness of learning media based on Augmented Reality in learning. The research subjects were computer science study program students in the General Physics course, the type of research used was Research and Development (R&D) by applying the 4D model. The data collection technique used in this study was an assessment instrument with a questionnaire. Data analysis techniques were carried out to obtain good quality products that meet the aspects of validity, practicality and effectiveness. Based on the results of the study, it was obtained that AR-based learning media on material with special lens rays was valid, practical and effective so that it was concluded that it was feasible to use in learning.

Keywords: Augmented Reality, Learning Media, Optical Material.

Introduction

In this era of globalization, the development of information technology is growing. In the world of Developmental Education Science and technology to the learning process is enriched learning resources and learning media (Suputra et al., 2016). Learning media as one of the components in the system has a function as a means of non-verbal communication which means that the media must exist or must be used in every lesson. (Magdalena et al., 2021).

Hamalik argued that the use of teaching media in the teaching and learning process can generate new desires and interests, generate motivation and stimulate learning activities, and even bring psychological influences on students. (Hamalik, 1994). The role of learning media is very necessary in a teaching and learning activity. Through learning media abstract things can become more concrete, media can overcome the limitations of experience that students have, media can overcome classroom boundaries, simplify an object that is too complex (Junal, 2016). It was concluded that learning media has an important role in increasing student motivation and interest in learning because learning media can overcome the limitations of student experience.

Based on the experience of teaching General Physics courses in the Computer Science Study Program (Prodi), it has its own challenges to apply learning media in accordance with students' IT skills. At the first and second meetings in lectures, students looked bored and rarely paid attention to explanations using Power Point media, videos and pictures. The material that is most difficult for students to understand is the special rays of the lens. Students find it difficult to project special rays on the lens, namely only 37% of the number of students are able to project correctly and precisely.

Based on the problems experienced, a learning media is needed that can visualize the special rays of the lens so that students are able to understand them. The learning media that is applied is learning media based on Augmented Reality Technology (AR).

Augmented reality is a technology that incorporates two-dimensional virtual objects into a real environment, then projects these virtual objects in real time. (Yuliono et al., 2018). The principle of AR is applying computer-generated virtual information, such as text, images, 3D models, music, and videos (Chen et al., 2019). AR systems are combined as between real world and virtual objects that can interact in real time and have three-dimensional virtual object registration (Kaji et al., 2018). The nature of AR technology is that it promises a new teaching model that better meets the needs of students in the 21st century(Elmqaddem, 2019). The real world and virtual information are synchronized thanks to geolocalization and sensors that place the user in relation to their environment (Chou & ChanLin, 2012).

AR technology-assisted learning media can be applied to special lens ray physics material, because this AR-assisted learning media is interactive and also innovative. (Rohmah et al., 2017). AR technology is designed to provide more interesting and detailed information for students from a real object (Pramono & Setiawan, 2019). Availability and development of technology, the application of AR is an alternative (Kurniawan & Kesuma, 2019). The concept of AR on special lens rays material, produces learning media that can directly provide learning anywhere and anytime to students, because students really need an introduction to lens special rays in a more real and complete manner with detailed information. (Pramono & Setiawan, 2019).

Research Method

This research was conducted in the Physics Education Study Program Class, UNIMED in general physics courses. The development model that will be used in this study is the 4-D development model proposed by Thiagarajan and Semmel in 1974 (Eveline et al., 2019) with the stages of its implementation consisting of : *Define,, Design, Development, and Dissemination*) (Gorbi Irawan et al., 2018).

The data collection technique used in this study was an assessment instrument using a questionnaire. There will be 4 questionnaire assessment instruments, namely material validation questionnaires, media validation questionnaires, question validation questionnaires, and student response questionnaires.

Data analysis techniques are carried out to obtain good quality products that meet the aspects of validity, practicality and effectiveness. Data obtained through expert validation sheets, student response questionnaires, and test sheets for the effectiveness of learning media with AR technology or applications.

Results and Discussion

SILAR is a mobile application that can be used as a special lens learning media for students. This application uses Android-based AR technology. The process of developing this application goes through several stages, namely the definition stage, the planning stage, the development stage, the dissemination stage.

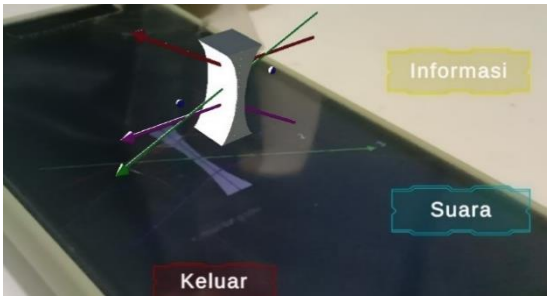
The defining stage is the stage of gathering information related to the product to be developed and identifying problems in learning that underlie the importance of developing the SILAR application. The defining stage consists of the initial and final stages which are carried out by exploring and gathering important information related to problems that occur in student physics learning in general physics courses, especially the Lens sub-matter, the student analysis stage which is carried out to determine student characteristics in the learning process, the concept analysis stage is the discovery of the problems to be faced relate to the special lens material, the task analysis stage, namely students are directed to work independently on the problems being faced, so that they can solve problems individually assisted by learning media that are already available, and finally the goal analysis stage learning, namely for reference in developing android-based learning media with AR technology.

The planning stage (design) is the stage for designing learning tools and research instruments. There are three stages in the design stage, namely media selection, format selection, and initial design. The media selection stage is carried out by observing and interviewing for the selection of appropriate learning media, can be developed, and can be used for learning. The learning media developed is android-based learning media with AR technology, then the format selection stage is adjusted to the needs of android-based learning media, namely the apk format. The developed learning media requires smartphone specifications with the Android operating system with a minimum Android 4.1 Jelly Bean type.

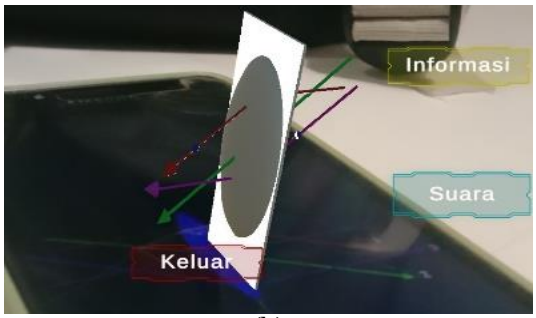
Then the design stage is designing the user interface and user experience, the user interface design is prepared using storyboards while the user experience is made using UML. In addition, the design of SILAR learning media with AR technology from the selection of hardware and software, namely the hardware needed is (a) Personal computer or laptop with Webcam, and (b) Android Smartphone. While the software needed is; (a) Unity 3D, (b) Blender, (c) Adobe Illustrator, (d) Android Development Tools, and (e) Vuforia SDK. Then create 3D objects. In making 3D objects, software called Blender is used with version 2.79b. The 3D objects that were used in the research included (1) special rays of a concave lens, and (2) special rays of a convex lens, then database creation was carried out using tools from the Vuforia SDK which were run through the Vuforia SDK website. The database in question is the marker database which will later be included in Unity 3D during application development, the next is scene or page creation for the process under development in Unity 3D, and the last is application design which is the implementation process of the design that has been made in the storyboard. This design process was carried out using Adobe Illustrator software, the designs made included backgrounds, buttons and also 2 markers.

The development stage consists of two parts, namely validation and development testing. The validation stage is to obtain

product validity data from the validation results of material experts, media experts and product evaluation experts. Product validity in terms of media consisted of 20 statement items, 20 statement items in terms of material, and 10 statement items in terms of item assessment, material expert validation was carried out by two validators with the first validator's assessment of 87% in the very valid category and the validator second with a value of 90% included in the very valid category. Meanwhile, product validity in terms of the media was carried out by two validators with the first validator assessing 89% of the maximum value of 100% in the very valid category and the second validator assessing 91% of the maximum value of 100% and included in the very valid category, and validity in terms of assessment questions carried out by two validators with the first validator assessing 93% and included in the very valid category, then the second validator rated 86% and included in the very valid category. Based on the results of validation in terms of media, material and assessment of questions, the product developed is said to be valid and suitable for use in the learning process.



(a)



(b)

Figure 1. (a) Concave Mirror using AR; (b) Convex Mirror using AR

Development tests were carried out to assess student responses to the products developed and to assess the effectiveness of the SILAR application learning media on student learning outcomes with a pre-test and post-test. From the results of the development test conducted to assess the practicality of a product that has been developed and has been responded to by 20 respondents with 20 statement items in the student response questionnaire, the results of respondents with the highest respondent score are 92 out of a maximum value of 100% and are included in the very practical category, and the lowest score given by respondents is 75 of the maximum value of 100% and in the practical category. If you look at the results of the calculations given by the respondents, the SILAR application is practical to use in learning activities outside and in the classroom independently, because the SILAR application can already be installed on an Android smartphone. Development test to assess the effectiveness of products that have been developed on the ability to understand physics concepts is carried out by looking at student learning outcomes before and after using applications in learning. If student learning outcomes increase after using the application, then the SILAR application media is said to be effective in improving student learning outcomes. Based on the data obtained, the average score of the pre-test of student learning outcomes is 40.1 and the average value of the post-test of student learning outcomes is 71.3. In other words, the development of android-based learning media with AR technology on understanding the concept of special lens ray physics is effective in improving student learning outcomes.

The last is the dissemination stage, this stage is carried out after the product being developed is complete and finished, ready to be assessed for validity, practicality, and also effectiveness. In terms of the validation carried out for media validation, material validation and also validation of questions on the product being developed, the results of media validation carried out by two media expert validators were assessed in the very valid category, material validation was validated by two validators in the very valid

category , then the validation of the questions was carried out by two validators with very valid categories. The practicality test was carried out by 20 respondents in the very practical category, and the last one was to assess the effectiveness of the product that had been developed. The effectiveness results were obtained from the pre-test and post-test scores on the understanding of physics concepts with 20 students as respondents and the average score the results of the pre-test and post-test in the "very practical" category, it can be concluded that android-based learning media with AR technology for understanding physics concepts in special lens light material can be said to be valid, practical, and also effective based on the results of the media validation assessment, material questions, student responses, pre-test and post-test scores.

Conclusion

The conclusion of the research implementation is according to the results of the validation carried out on Android-based learning media with the help of AR technology on Sinar Special material, namely the material validation questionnaire whose results are in the good category (89%), the media validation questionnaire with an average of 90% (good), the questionnaire validation of questions in the good category (89.5%). After practicality and effectiveness tests were carried out, it was concluded that Android-based AR learning media was practical and effective in learning.

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