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Development Of 3-Dimension-Based Physics Learning Media Using Assemblr Edu Assisted Smartphones On Optical Device Material

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1. Abstract

Misconceptions still occur in learning physics in high school, this is due to the limitations of the media used and the low enthusiasm of students in participating in learning because the media used is considered old-fashioned and does not follow the development of science and technology. Writing this physics laboratory paper aims to: (1) Create smartphone-based 3D physics learning media assisted by Assemblr Edu on Optical Instruments material for high school physics learning, (2) Determine the results of validation of smartphone-based 3D physics learning media products assisted by Assemblr Edu on Optical Instrument material. Assemblr Edu is an application that can be used to share activities in the form of presentations, projects, and quizzes in 3 dimensions. The process of making this learning media includes (1) the preparation stage, namely identifying problems, compiling indicators and learning objectives, concept maps, materials, practice questions and evaluation questions related to Optical Instruments material. (2) The creation stage is the stage for creating learning media using the Canva application and supported by other applications such as Assemblr edu, Chrome, Youtube, Google Form, and Sketchfab. (3) The completion stage is the last stage, namely the validation process carried out by an expert validator. This study uses the Research and Development methodology. Based on the assessment by the expert validator, in terms of material, media, and language, this media obtained a validation score of 108 out of an ideal maximum score of 112 with very good criteria and still pays attention to suggestions, input and notes from the expert validator on the validation sheet.

Keywords: *learning media, scientific learning, validation, optical, assemblr edu*

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2. Introduction

Education is an important aspect of one's life, as every human being has the right to obtain and develop through education. According to Law Number 20 of 2003 concerning the National Education System, education is defined as a conscious and planned effort to create a conducive learning atmosphere and learning process. Its purpose is to enable students to actively develop their potential and acquire spiritual, religious, self-control, personality, intelligence, noble character, as well as the skills required for themselves, society, nation, and state. The learning process aims to make individuals independent and improve their lives.. The educational process includes teaching and learning activities, where the teaching and learning process is a change in behavior resulting from the interaction of teachers and students with certain material (Rahayu, 2016). Changes in behavior will be achieved when learning is carried out in a meaningful way, namely continuous learning, which can be exemplified by the use of learning media to clarify the material presented. Implementation in the field, in the learning process there are not a few students who experience difficulties in the process of understanding learning material, one of the subjects that is considered difficult is Physics.

Physics is a part of Natural Sciences (IPA) which has abstract and concrete material characteristics and studies natural phenomena and their physical events (Satria & Handhika, 2015). Physics studies almost every aspect of our lives, one of which is optical matter. According to Parmono, 2020 optical instrument material is contextual material that often occurs in everyday life, to analyze this material requires very complicated mathematical skills so that many students have difficulty understanding the material. Misconceptions about optical instrument material are found in the indicators of determining shadows on the eye, magnification of shadows on the loop and the nature of the shadow on the loop (Suniati et

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al., 2013) Optical Instrument material often makes students experience confusion and difficulties in understanding the topic of light and optical devices (Doctor & Mestre, 2014). Misconceptions can occur because the LKS books used by students are incomplete, resulting in students not being optimal in obtaining information and too teacher-centered learning causing monotonous learning and making students less active and interested in participating in learning (Ardini, 2022). In fact, worksheets and books are not the main learning resources in learning physics. It is essential to have a laboratory to support physics learning, as it goes beyond merely memorizing theories. The laboratory environment allows students to understand concepts and apply them in real-life situations through practical experiments or practicum. This hands-on approach enables students to gain a deeper understanding of the subject matter and fosters a more engaging and interactive learning experience (Purwaningtyas & Putra, 2020). Optical Equipment material also requires the existence of an adequate laboratory and a complete inventory of goods. According to Ekosari et al., 2018 several laboratories in schools whose use is still ineffective due to the inadequate availability of facilities and infrastructure and not in accordance with the material being taught. One solution to the problem above is to use learning media that is able to meet the needs of students.

Learning media in general can be interpreted as a tool that helps the teaching and learning process so that it is able to stimulate the thinking process, attention, feelings, abilities and skills of students so as to create an effective learning process (Rachmadtullah et al., 2021). The development of science and technology (IPTEK) also plays a role in the development of learning media used, one of the most widely used technological developments is using a mobile basis. Intermediaries that are widely used in mobile learning are smartphones (Aripin Ipin, 2018). The smartphone system also facilitates the creation of

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3-dimensional (3D) learning media so that students are able to see images from all directions. One of the 3D creation applications that makes its products easy to use and able to compete in the technology industry is Assemblr Edu.

Previous research was conducted by Akhmad (2022), he used Assemblr Edu as an augmented reality medium in order to increase understanding of the concept of blood circulation. In addition, assemblr edu has also been used in mathematics learning (Putu, et al., 2022). In Dinda and Ika's research (2023), assemblr edu is also used in learning the basics of electronic engineering, they use the augmented reality features that exist in this media. Based on previous research, there has been no research using assemblr edu in learning physics, especially optical material, so in this study researchers tried to develop 3-dimensional physics learning media based on smartphones assisted by Assemblr Edu on optical equipment material and to find out the validation results of these learning media products.

3. Methods

3.1. Participants and context

This study is a type of research and development (R&D). Research and development is a research method used to produce certain products and test the effectiveness of these products. The product developed in this study is a physics teaching material in the form of learning media for optical instrument material with the help of 3 dimensions and augmented reality.

The research subjects are lecturers from the Physics Department of FKIP UNS who serve as validators to provide validation on the aspects of content, media, and language in the physics teaching module for the topic of optical instruments for grade XI MIPA students in high schools following the 2013 curriculum.

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This research was conducted at senior high school Negeri 7 Surakarta in three classes of grade XI MIPA. This school is equipped with facilities and infrastructure that support data collection and research analysis. Data collection was carried out for two months from June to July 2023.

3.2. Material

Making 3-dimensional physics learning media using Assemblr Edu software, and Acer Aspire 5 laptop devices and several applications such as Assemblr edu, Chrome, Youtube, Google Form, and Sketchfab. The instrument used in making this media is a questionnaire. Validation of learning media uses a rating scale with 4 categories as shown in table 1.

Table 1. Validation rating scale

Number	Category	Score
1.	Strongly agree	4
2.	Agree	3
3.	Don't agree	2
4.	Totally disagree	1

The validation instrument consists of three aspects, namely the media validation questionnaire from the material aspect, the media validation questionnaire from the media aspect and the media validation questionnaire from the language aspect. In the validation questionnaire, the material aspect consists of 11 indicators and is categorized into 2 sub-aspects, namely content standards and learning. Media validation of the media aspect consists of 12 indicators which are divided into three sub-aspects, namely presentation techniques, media display design and visual communication, while the validation of the

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language aspect consists of 5 indicators. The validation results in the form of numbers are analyzed. Data in the form of numbers or quantitative data. Data quantization is used by adding up the total score as a whole. These scores are categorized into five criteria contained in table 2.

Table 2. Categories of assessment results

Number	Range	Categori
1.	$M_i + 1{,}5\ Sb_i \leq x$	Very good
2.	$M_i + 0{,}5\ Sb_i \leq x < M_i + 1{,}5\ Sb_i$	Good
3.	$M_i - 0{,}5\ Sb_i \leq x < M_i + 1{,}5\ Sb_i$	Pretty good
4.	$M_i - 1{,}5\ Sb_i \leq x < M_i - 1{,}5\ Sb_i$	Not good
5.	$x < M_i - 1{,}5\ Sb_i$	Very not good

3.3. Data Collection and analysis

The purpose of this research is to create a smartphone-based 3-dimensional physics learning media with the help of Assemblr Edu on Optical Instruments material and to find out the validation results of the learning media product.

This study uses a research and development design (R&D). Data collection was carried out by distributing needs analysis questionnaires to students at senior high school 7

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Surakarta in the form of digital forms which were distributed to the three XI MIPA classes. Based on the results of the questionnaire survey analyzing student needs, learning media were created that were able to meet student needs which were then validated by a validator, namely the Physics Education lecturer at Sebelas Maret University.

After the data is obtained, then a validity test is carried out to test the feasibility of the product from the aspects of material, language and media which are analyzed qualitatively and quantitatively.

3.4. Ethical Considerations

The study had limitations such as a relatively small number of participants, comprising 101 students from three classes of grade XI MIPA at senior high school 7 Surakarta. Additionally, there was only one validator, a lecturer in Physics Education at Sebelas Maret University.

Another constraint was the time limitation, as the research was conducted after the students received the Optical Instruments material, potentially affecting the study's scope and depth.

Furthermore, the research was restricted to the Optical Instruments material, without exploring other physics topics. Also, the study focused solely on the 2013 curriculum, which may limit the generalizability of the findings to other curriculum settings.

Acknowledging these limitations is vital, as they could influence the applicability and generalizability of the study's results. To enhance future research, considering a larger participant pool, extending the research timeline, and exploring various physics topics and curriculum settings would lead to a more comprehensive understanding of the subject matter.

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4. Results and Discussion

3D based physics learning media using a smartphone assisted by Assemblr Edu on Optical Equipment material can be used on smartphones both Android and iOS and can also be accessed using a laptop. Before accessing the link, students are expected to download the Canva and Assemblr Edu applications, both applications can be downloaded on smartphones, both Android and iOS. To access the Optical Instruments learning media, you can go through the link https://bit.ly/ModulAlatOptik . The module has an attractive visual appearance, is easy to understand and easy to use. The module is equipped with a Quick Response Code (QR code) and a link that makes it easy to access 3-dimensional animation and Augmented Reality (AR) as well as access questions and evaluation exercises.

The results of making 3-dimensional physics-based learning media using smartphones assisted by Assemblr Edu on Optical Instruments material are Optical Instruments learning modules consisting of introductory words, instructions for use, concept maps, introductions, learning activities consisting of material descriptions, sample questions, and exercises questions, there are evaluations, glossaries and summaries that can help students to understand the material. When the learning process is carried out, the teacher gives the Optical Instruments learning module to students. Students are directed to read the instructions for use then observe the available video and write down what they think after watching the video. Furthermore, students are directed to form groups and discuss the topics that have been provided and present the results of their group discussions. Students can also work on existing practice questions, practice questions are made after students study at each meeting, while for evaluation students do it at the end of learning to find out the extent to which students' abilities in learning the material that has been taught.

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The validation results obtained from the testers obtained a score of validation results on material aspects of 43 out of an ideal maximum score of 44 indicators which still do not have a maximum score, namely the indicator "there are questions that encourage students to think" so that for further research it is expected to include questions that encourage students to think critically, the validation result score for the media aspect is 48 out of the ideal maximum score of 48, and the validation result score for the language aspect is 18 out of the ideal maximum score of 20 indicators that still don't have a maximum score, namely the "sentence effectiveness" indicator and "the accuracy of sentence structure" so that it is hoped that further research will use sentences that are effective and more precise in constructing sentence structures. Overall, the total product validation result score is 109 out of the ideal maximum score of 112. This assessment gets very good criteria.

5. Conclusion

Based on the results of the research that has been done, it has succeeded in creating 3-dimensional physics-based learning media using a smartphone assisted by Assemblr Edu on Optical Instruments material. The learning media created are in very good criteria based on the validation of material, media, and language experts so that they can be used for physics learning in schools. This research can also be developed for further research on other physics materials and by using an independent curriculum.

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