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Physics Education (PhyEdu): Mechanical wave media for physics learning

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Abstract. This study aims to develop and test the feasibility of learning media in the form of Android-based Physics Education to improve students' critical thinking skills in mechanical wave material. This research belongs to the research by design using a 4D model consisting of define, design, develop and disseminate. Validation is carried out at the develop stage by involving media experts and material experts. The study produced physics learning media in the form of Android-based Physics Education (PhyEdu) with the results of validation obtained from media experts, material experts, physics teachers and yields limited test with good criteria used in physics learning and very feasible to be tested but need improvement in the appearance of the media.

6

1. Introduction

The development of technology and information in the 21st century is very influential on life in all circles, both the general public and students. This is indicated by many students who use smartphones to play games and social media. The effects of using this smartphone will disrupt students' learning and their concentration will decrease even they will be addicted to games on smartphones [1]. The misuse of smartphones among students such as chatting, video, and games tends to make students unaware of the use of smartphones in learning, which is making it easier for them to understand and master and improve skills in physics learning [2].

Android learning has been done on learning in Indonesia [3,4]. The android operating system makes it easy for students to access various applications that support the learning process. The use of android-based learning media allows students to learn unlimitedly to space and time so that it has the potential to improve academic performance and student motivation [5]. The purpose of using smartphones as a learning tool for students with independent learning patterns outside school hours and very practical is not bound by place and time (portable) [6,7]. Learning media in smartphones will be more effective and efficient compared to books because in a smartphone visual media can be created that can explain the concepts of the learning. Physics learning using android-based media can improve learning outcomes and students' critical thinking skills [8].

Critical thinking is a way of thinking about topics, content and problems by improving the quality of thinking skillfully according to intellectual standards. In physics learning, critical thinking skills can be



demonstrated by students being able to solve problems in daily life, able to make the right decisions and have a scientific attitude in solving problems [9,10].

In the world of education, advances in technology and information must also be integrated with the curriculum used at school. Scientific approach is an approach used in the curriculum by training students to observe, analyze and solve problems, able to communicate in writing and verbally with the help of technology [11]. In addition, students are also required to be skilled in reasoning, processing and presenting effectively, collaboratively and communicatively.

Physics subjects are subjects grouped in the branch of Science. Physics is defined as science which studies natural phenomena and their interactions [12]. Symptoms of nature both living and non-living in the sphere of time and space can be studied with physics [13]. Mechanical wave material is considered as one of the material in abstract physics. For example, when students demonstrate a transverse wave using a rope, there will be no waves if there is no rope, when students observe sea waves then what is actually observed is changes in sea level [14].

The use of instructional media in Indonesian schools tends to only use powerpoint media, picture media, video media and student physics books. The use of instructional media makes students less interested in learning interest so students become lazy and get bored quickly to take part in the learning process that takes place [7]. Psychologically, learning media can bring out a concern, feeling, perception, thinking power, imagination and motivation of students towards the material and the learning process [15].

Physics Education is an android based physics learning media. This media is made to maximize the learning process in the classroom. In addition, it also maximizes the use of learning media available around us. With the creation of this media, it is expected to be able to improve students' thinking skills both in thinking science processes or critical thinking. This media is also equipped with multiple choice quizzes that can foster the spirit of playing while learning and can be used to measure critical thinking skills in physics learning.

2. Methods

This research belongs to research by design, which is a research method to produce a product and test the effectiveness and feasibility of the product. The research design used is 4-D stages consisting of define, design, develop and disseminate stages [16,17]. Define stage consists of teacher analysis, student analysis, concept analysis and designing the learning process. The design stage consists of data collection instruments, media design and format selection. The develop stage includes the development and testing and improvement of the media that has been made. The disseminate stage includes the dissemination of media that has been created and revised.

The media is designed to determine the suitability and purpose and how the learning media works. The media design illustrated on the Flowchart can be seen in figure 1.

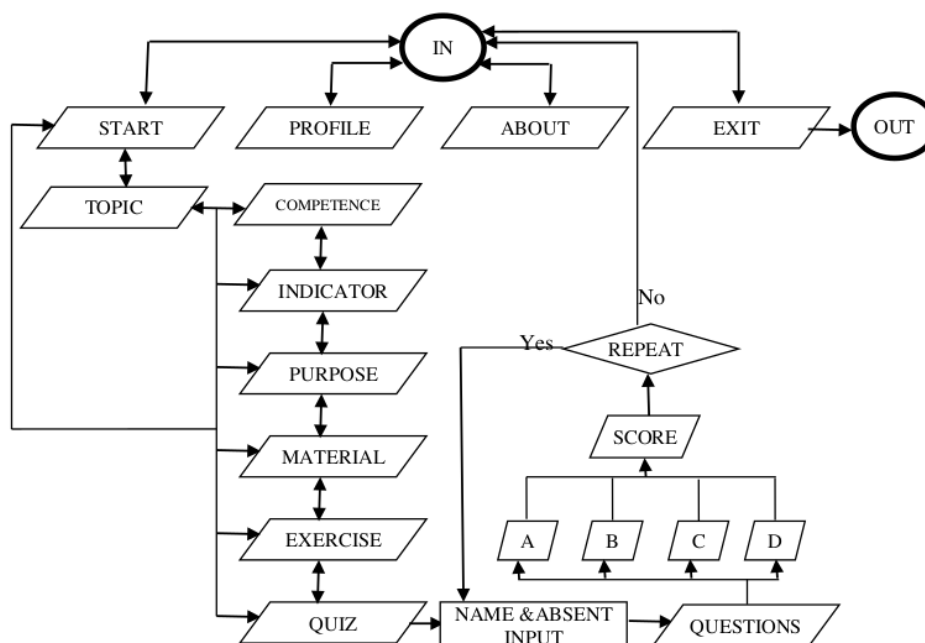


Figure 1. Media plan flowchart.

Tests carried out by material expert examiners, examiners of media experts, teachers and limited test. The media expert test was conducted by one of the media expert lecturers at Universitas Kanjuruhan Malang. The material expert test was conducted by one of the material lecturers at Universitas Kanjuruhan, Malang. Media and material testing was also carried out by physics teachers from research schools. The limited test is carried out by high school students in Malang with a total of 20 students. The study was conducted on February 25, March 16, 2019.

The instruments used was questionnaire. This questionnaire is used to measure the quality of media used both the quality of media specifications and the quality of the material contained in the learning media. The instrument of quantitative data collection using a Likert scale with 4 alternative answers can be seen in table 1.

Table 1. Likert scale with 4 alternative answers.

Alternative Answers	Score
Very Good	4
Good	3
Bad	2
Very Bad	1

Qualitative data collection instruments are obtained from comments and suggestions given by examiners through available columns on instruments. Quantitative data is calculated by calculating the number of scores obtained divided by the ideal score

To find out the feasibility of the media that has been developed, then using the eligibility criteria can be seen in table 2.

Table 2. Feasibility criteria.

Criteria	Assessment Percentage
Very Feasible	76 – 100%
Feasible	51 – 75%
Not Feasible	26 – 50%
Very Not Feasible	1 – 25%

4. Results and discussion

This study produced a medium in the form of an Android-based learning media called Physics Education (PhyEdu) and tested the feasibility of media Physics Education (PhyEdu).

3.1. Android-based Physics Education (PhyEdu) product

This research develops products in the form of android-based learning media called Physics Education (PhyEdu). The specifications that have been developed are as follows: (1) Media is an application (software) that can be installed on a smartphone with an Android operating system. Media can also be installed on computers or laptops via the Android Emulator (Bluestacks, NOX, etc.). (2) Making media is done using the Adobe Flash CS 5.5 application with ActionScript 3.0. with the results of the media can be run in offline mode so that users do not need an internet connection. (3) In the media there are KDs, Indicators, Objectives, Materials, Practice Questions and Quiz Games. (4) Material in the media is loaded in the form of text, images and animations so that it can facilitate students in understanding the material presented. (5) In the media there are games in the form of quiz with a total of 20 questions. Before starting the quiz, students are expected to log in first by filling in the name and absent number.

3.2. Assessment result of Android-based Physics Education (PhyEdu) media

Product testing in the form of PhyEdu media is carried out by 3 limited validators and tests. Validators include media experts, material experts, physics teachers and limited tests conducted on students with a total of 20 students in class XI MIPA senior high school in Malang City with the following results:

3.2.1. *Validation result of material expert.* Material validation was conducted by Universitas Kanjuruhan Malang Lecturers as material experts. Aspects that will be assessed include the relevance aspects of the material which getting a score of 16 from the ideal score of 20 so that the percentage is 80% with good and very feasible criteria, the presentation aspect of the material scores 17 from the ideal score 20 so the percentage is 85% with very good and very feasible criteria, the evaluation aspect gets a score of 12 from the ideal score of 16 so the percentage is 75% with the criteria of good and very feasible. The results of the material validation on the PhyEdu media obtained the total score of 45 out of 56 with a percentage of 80% that have good and very feasible criteria.

3.2.2. *Validation result of media expert.* Media validation was carried out by Universitas Kanjuruhan Malang Lecturer as a media expert. The aspects that will be assessed include the visual aspect of obtaining a score of 21 from the ideal score of 24 so that the percentage is 88% with very good and very feasible criteria, the software engineering aspect scores 18.5 from the ideal score of 20 so that the percentage is 93% with very good and very feasible criteria, the aspects of implementation get a score of 21 from the ideal score 24 so that the percentage is 88% with very good and very feasible criteria, aspects of language get a score of 14 from the ideal score 16 so the percentage is 88 with very good and very feasible criteria. Validation of material produces quantitative data in the form of a total of 74.5 out of 84 with a percentage of 89% that have very good and very feasible criteria.

3.2.3. *Validation result of physics teacher.* Physics teacher validation is done by one of the physics teachers at senior high school in Malang City. The aspects that are assessed include the relevance aspects of the material obtaining a score of 13 from the ideal score of 20 so that the percentage is 65% with good and feasible criteria, the presentation aspect of the material scores 11 from the ideal score 16 so

the percentage is 69% with good and feasible criteria, evaluation aspects get a score of 11 from the ideal score of 16 so that the percentage of 69% with the criteria of good and feasible, visual appearance aspects get a score of 16 from the ideal score 24 so that the percentage is 67% with good and feasible criteria, aspects of software engineering score 16 from the score ideal 20 so that the percentage of 80% with the good and very feasible criteria, aspects of implementation get a score of 16 from the ideal score 24 so that the percentage is 67% with good and feasible criteria, aspects of language score 12 from the ideal score 16 so the percentage is 75% with good and feasible criteria. Overall the material validation produced quantitative data in the form of the total number of scores 97 out of 140 with a percentage of 69% that has good and feasible criteria.

3.2.4. Result of limited test. The limited test is carried out by high school students in Malang in class XI MIPA with total respondents of 20 students. The results of the acquisition of each indicator obtained the total number of an average of 65.25 with an average of 3.1 and a percentage of 77.6% so that the PhyEdu media has good criteria used in learning physics. Furthermore, the data seen from the limited test results of each respondent, the results were that the acquisition for all respondents was 1305 from 1680 with an average of 65.25 of 84 that has a percentage of 78%. This shows that the PhyEdu media that has been made and tested on 20 respondents has good criteria so that PhyEdu media is well used in physics learning. This limited feasibility test is very effective if the media will be tested in general [3,6].

4. Conclusion

The conclusions that can be drawn from this research and development are as follows: (1) This research is a Research and Development (R & D) study with a research design using a 4-L model consisting of define, design, develop and disseminate stages. The media is created using the Adobe Flash CS 5.5 application with ActionScript 3.0. (2) The study produced physics learning media in the form of Android-based Physics Education (PhyEdu) with the results of the average validation obtained is 79% with criteria both used in physics learning and very feasible to be tested but need improvement in the appearance of the media.

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