

EDUCATION GAME DEVELOPMENT AS AN ALTERNATIVE MEDIA TO LEARN PHYSICS FOR JUNIOR HIGH SCHOOL GRADE 7 IN JUNIOR HIGH SCHOOL JATINANGOR

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ABSTRACT

This study aims to build a physics education game to increase students' interest and understanding in learning physics material. The flow of research used in this study first collected data, after that analyzed the problems that occurred at Jatinangor 1 Junior High School. After being analyzed, a solution was obtained in the form of making a physics education game. After the application is built, a test is carried out for students. Respondents were divided into two classes: control class and experimental class. Before using the physics education game application, students must first answer 10 pretest questions. After that students are given time to learn physics material in the physics education game application that was built. After students use the application, students are required to answer posttest questions which also number 10 questions. The test results in the control class and experimental class show improvement in terms of students' values and understanding. To find out the student's response to the application, students were distributed a questionnaire. From the results of the questionnaire, obtained results of more than 80% of respondents agreed that this application increases students' interest and understanding in learning physics. Thus, it can be concluded that the purpose of this study is to increase students' understanding and interest in learning physics material.

Keywords: Educational Physics Game, Learning Methods, GDLC, Adventure, Puzzle, Android

1. PREMILINARY

Physics is the science that tries to understand the rules and can be described mathematically neatly. The aim of learning physics material is to improve students' thinking skills so that students are able to support thinking in a systematic, objective and creative way [1]. A good learning

method is a method that is able to arouse the desire and interest in learning children or students especially in learning physics. There are several factors that influence interest, namely motives, as well as learning material and teacher attitudes [2]. The first is the motive. Motives will give birth to a certain motivation and marked by the emergence of a reaction to achieve a goal. When students have a concern and motivation in a lesson, the students' interest will be high to learn the lesson. The second is the subject matter and the teacher's attitude. If the learning material is not suitable or does not match the student's interest, then the student will not study optimally. Likewise also with the teacher who is one of the objects that can stimulate students' interest in learning [3]. Along with the development of its special technology on Android smartphones which are now widely favored by various circles because it can be used anywhere. Easy access is also an advantage for technology on Android smartphones because it is equipped with various multimedia features [4]. In this increasingly sophisticated era, the use of smartphones among the community, especially children, is also slowly changing functions as a means of entertainment or just to play games. One of the modern learning methods that can be used as an alternative to learning is games. According to research conducted by Amami, Subali, and Syaefullah, games can be an alternative learning that uses multimedia and interactive technology as their intermediate media, so it can be concluded that educational games are games that aim to provoke children's learning interest while playing [5]. Especially after being analyzed, it turned out that 94.76% of students at Jatinangor 1 Junior High School had Android-type smartphones that could also be used as educational tools. Based on observations of 210 students, 127 students did not like physics, and only about 4.29% of students often studied physics. This is caused by learning methods that are still conventional and also students consider physics as one of the difficult material.

Based on the background of the problem that has been described there is a problem, namely.

1. Low student interest in learning physics material.
2. Lack of students' understanding in studying physics material, especially in calculations.

So based on the problems described above, the purpose of this study is to build a physics education game for grade 7 at Jatinangor 1 Junior High School.

The objectives to be achieved in this study are:

1. Increasing students' interest in learning physics.
2. Increasing students' understanding in learning physics material.

1.1 Science (IPA)

According to Tritanto, Natural Sciences (IPA) is a knowledge that learns about natural phenomena, both living and non-living, which includes three basic fields of science, namely Biology, Physics and Chemistry. Essentially the IPA is built on the basis of scientific products, scientific processes and scientific attitudes [6]. While Physics is a science that tries to understand the rules neatly and can be described mathematically [1].

1.2 Game

Game is an interactive form and entertainment. Watching television, reading, and other related things are all forms of passive entertainment. Whereas when someone plays a game, they are entertained by actively participating and able to visualize something that is usually rarely done. Games are placed in an artificial world that is governed by rules [7].

1.3 Education Game

Educational games are games that have been specifically designed to teach students a particular learning, develop concepts and understandings and guide them in training their abilities, as well as motivating students to play them. The application of games for educational media or what is called education game stems from the rapid development of video games and makes it an alternative medium for learning activities [8].

1.4 Game Development Life Cycle

Software development or application development used in the construction of this physics education game uses GDLC (Game Development Life Cycle). According to Blitz Game Studio, the game development method consists of six stages, namely pitch, pre-

production, main production, alpha, beta, and master [9]. The following is a stage drawing on GDLC.

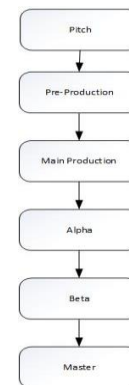


Figure 1 Game Development Life Cycle

The explanation of the GDLC modeling stage is as follows:

- a. Pitch
In this process is the initial concept and data collection, in the physics education game design that will be built.
- b. Pre-production
In the pre-production process involves the design process or the design stage of game design that involves several components such as the game genre, Storyboard, and Storyline.
- c. Main Production
It is a core process where it has begun to process asset creation, the coding process in the construction of its application. The Game Engine used is Unity and must refer to the storyline and storyboard in its creation.
- d. Alpha
Alpha is the initial testing phase of the game to assess and ensure that the function of the physics education game goes well before being distributed. Alpha can also be called a system test.
- e. Beta
Is a trial phase to the user after alpha testing.
- f. Master
The Master is the final stage in the construction of this physics education game. After all tests have been carried out, the application is ready to be released to the public [9].

2. CONTENTS OF RESEARCH

2.1 Problem Analysis

Analysis of the problems obtained for the construction of this application are as follows.

1. Many students don't like physics.
2. There are still many students who are still having difficulties and not understanding the material presented.

2.2 Material Analysis

The physics material that will be displayed in the physics education game is sourced from the book of Natural Sciences Class 7 Middle School, and can be seen in the table as follows.

Table 1 Material Analysis

Chapter 1	
Chapter Title	IPA Object and Observation
Basic Competencies	1. Understanding Knowledge based on curiosity.
	2. Applying the concept of measuring various quantities with standard units
Chapter 4 4	
Chapter Title	Temperature and Change
Basic Competencies	1. Analyzing the concepts of temperature, expansion, heat, heat transfer, and its application in daily life including the mechanism to maintain body temperature stability in humans and animals

2.3 Material Collecting

Some components in the development of physics education games can be seen in the following table.

Table 2 Material Collecting

No.	Komponen	Source
1	Emblem School SMPN 1 Jatinangor	School SMPN 1 Jatinangor
2	Main Character (Beni)	Made using the fuse application
3	NPC1 (Pak Budi)	Made using the fuse application
4	NPC2 (Bu Anna)	Made using the fuse application
5	NPC3 (Andien)	Made using the fuse application
6	NPC4 (Rudi)	Made using the fuse application
7	Animation Main Character (Beni)	Made using the Mixamo

No.	Komponen	Source
8	Animation NPC1 (Pak Budi)	Made using the Mixamo
8	Animation NPC2 (Bu Anna)	Made using the Mixamo
10	Animation NPC3 (Andien)	Made using the Mixamo
11	Animation NPC4 (Rudi)	Made using the fuse application
12	Asset Package	Made using the fuse application
13	Physics Material	Made using the fuse application

2.4 Game Concept

Here is the physics education game concept that will be built, which can be seen as follows.



Figure 2 Game Concept

1. The target is 7th grade junior high school students.
2. Games that are built have two types of genres namely Adventure and Puzzle.
3. The material used is a book in Class 7 Natural Sciences with 2013 Curriculum.
4. Games are built with 3D display.
5. Games built will be based on a village and also a farm.
6. The game can be run using Virtual Analog as a controller to move the main character.
7. The game runs in a single player and is based on Android.
8. There will be three stages in the game and each stage has different maps and obstacles.
9. In the game, you will be provided with an NPC that can be invited to interact to start the mission.
10. The purpose of this game is to increase student interest and improve student understanding, in learning physics.

2.5 Gameplay






This educational physics game runs on an android platform and is single player and does not require an internet connection in playing it or offline. Here is the gameplay and overview of physics education game:

1. First of all, the character will be placed in a village before starting the mission.
2. The mission will be given by the NPC in the village, the NPC will ask the main character whether to help or not. If the player receives a mission, it will be directed to the next scene and map. If the player rejects the mission, the character will remain in the village.
3. The first mission is the main character (Beni) will be asked for help by the NPC (Pak Budi) to calculate the length of wood that will be used to build the crossing bridge. Before the mission is complete, the player will be given an obstacle in the form of a question that must be filled in to complete the mission. If the question is answered correctly, a bridge will appear that can be used across the river.
4. The second mission is the main character (Beni) will be asked for help by the NPC (Mrs. Anna) to measure the temperature of the eggs that are on a farm which was originally a Kelvin degree must be converted into degrees Celsius.
5. Third Mission is the main character will be asked for assistance by NPC3 to build and calculate the amount of sand needed. In this mission, the material used is about the conversion of mass objects.
6. When the main character answers the question from the NPC correctly, it will get items from the NPC that must be collected in the form of F - I - S - I - K - A. In each mission or map each will get 2 alphabets if the answer is correct.
7. When the character answers the wrong question from the NPC, it will automatically Game Over and the game must be repeated from the beginning.
8. Missions will vary depending on the chapter of the material and the stage of the game.
9. Material information can be accessed through the manual button.
10. The game will be finished after all the NPC missions are done.

2.6 Character Analysis

As for some characters used in the construction of physics education games are as follows:

Table 3 Character Analysis

No	Character	Description
1		Name: Beni. Age: 17 years old. Role: Main Character. Description: Beni is the main character who likes adventure.
2		Name: Mr. Budi. Age: 40 years old. Role: (NPC). Description: Brother is the one who will give the first mission in the game.
3		Name: Mrs. Anna. Age: 32 years old. Role: (NPC). Description: A housewife who is assigned to monitor the lungs in order to complete each mission given.
4		Name: Andien Age: 16 years old Role: (NPC) Description: Dear friend in the village, Andien will participate in giving the mission in the game.
5		Name: Rudi Age: 15 years old Role: (NPC) Description: Andien's sister who likes to learn the martial arts movement.

2.7 Hardware Needs Analysis

The following are hardware specifications used in the construction of physics education games, which can be seen in the following table:

Table 4 Hardware Needs Analysis

NO	Hardware	Spesification
1	Processor	Intel Core i3-3217U, 1.8Ghz
2	RAM	4 GB
3	Harddisk	500GB
4	VGA	2GB
5	Monitor	14 inch, resolution 1366x768 pixel
6	Other	Mouse, Keyboard, Speaker

2.8 Software Needs Analysis

The following are the software specifications used in the construction of physics education games, which can be seen in the following table:

Table 5 Software Need Analysis

NO	Software	Description
1	Operating system	Windows 10
2	Unity	Game engine used to make games.
3	Fuse	To create characters in the game.
4	Mixamo	For 3D object animation.
5	Photoscape	To create 2D objects.

2.9 User Needs Analysis

User needs analysis is grouped into two categories as follows:

1. Knowledge and User Experience

Expected user knowledge and experience can be seen in the table description as follows.

Table 6 Knowledge and User Experience

Knowledge and User Experience	
Android knowledge	Can operate the basic basis of using Android.
Application experience	Can use applications that are common on Android.
Education	Middle School (Junior High School)
Reading Ability	Can read well and correctly

Counting Ability	Understand the basics of physics concepts such as calculations and formulas
Language skill	Indonesia

2. User Characteristic

The expected user characteristics can be seen in the table description as follows.

Table 7 User Characteristic

Karakteristik Pengguna	
Umur	12 tahun keatas
Jenis Kelamin	Laki-laki dan
Penggunaan Tangan	Kondisi baik
Disabilitas	Tidak

2.10 System planning

System Design aims to design a system of physics education games built. The following is the menu structure of the physics education game design which can be seen in the following figure.

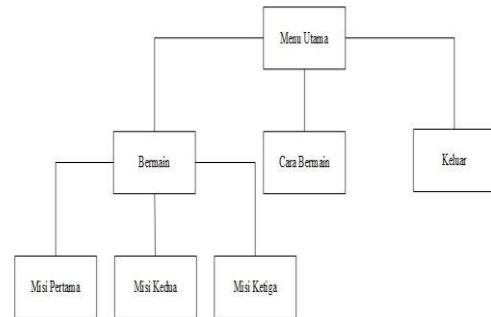


Figure 3 Menu Structure

2.11 System Implementation

System Implementation aims to implement the results of system analysis and design processes that have been carried out, so that system users can provide input to the system developer. The hardware and software expected for the implementation of this physics education game are as follows.

Table 8 Implementation of Hardware Needs

No.	Hardware	Spesification
1.	Processor	Dual Core 1,2GHz
2.	RAM	1 GB
3.	Storage	1 GB

Tabel 9 Implementation of Software Needs

No.	Perangkat Luna	Spesification
1.	Operating System	Android OS, 4.1 (Jelly Bean)

2.12 System Testing

System testing or also called alpha testing that aims to test the functionality of the application, whether the application that is built goes well or not. In this alpha test using blackbox testing [9].

2.12.1 Alpha Testing Scenario

The following is an alpha testing scenario based on a system that explains the things tested in physics education game testing. The test scenario is as follows.

Table 10 Alpha Testing Scenario

No.	Komponen Yang Diuji	Metode Pengujian
1.	Showing Starting Games	<i>Black Box</i>
2.	Showing How to Play	<i>Black Box</i>
3.	Control Characters	<i>Black Box</i>
4.	Interact with NPCs	<i>Black Box</i>
5.	Doing Mission	<i>Black Box</i>
6.	See the Guidebook	<i>Black Box</i>
7.	Exit	<i>Black Box</i>

2.12.2 Alpha Testing Results

The results of testing Displaying Starting a Game and Displaying the Play Method can be seen in the table as follows.

Table 11 Testing Displays How to Start

Action	Expectation	Observation	Conclusions
Pressing the button starts playing	Display the initial view of the village	Display the initial view of the village	Be Accepted

Table 12 Testing Displays How to Play

Action	Expectation	Observation	Conclusions
Pressing the button How to Play	Display the menu Way play	Display the menu Way play	Be Accepted

2.12.3 Conclusion Alpha Testing

Based on the results of the alpha testing that has been carried out, it can be concluded that in the development of physics education game applications functionally run as expected.

2.13 Conclusion of Application User Responses

From the distribution of questionnaires conducted on respondents, then obtained some conclusions, namely:

1. The results of the questionnaire indicate the average response of students giving an assessment of the range strongly agree and agree that the application has reached its goal.
2. After the results of the questionnaire were obtained, it was concluded that on average more than 80% of students agreed to each statement given on the questionnaire.

2.14 Testing

At the next stage, testing is conducted which aims to determine the level of students' understanding by conducting pretest and posttest tests. To test the hypothesis, n-Gain testing was carried out in two class categories, namely the control class and the experimental class.

In testing the hypothesis there are several things that must be passed, the procedure in testing the hypothesis is as follows [10].

- a. Statistical tests include normality test and homogeneity test. The data normality test used is the Kolmogorov-Smirnov statistical test.
- b. Determine the Hypothesis Formulation (H0 and H1).
- c. Determine the test criteria, ie if the significant value is greater than 0.05, H0 is accepted, and if the significant value is less than 0.05, H0 is rejected. The data normality test used is a statistical test of kolmogorv-smirnov [10].

The results of the normality test for n-Gain data are as follows.

Table 13 Normality Test Results

Tests of Normality							
	Kelas	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Nilai	Kelas Kontrol	.222	31	.000	.869	31	.001
	Kelas Eksperimen	.223	31	.000	.872	31	.002

a. Lilliefors Significance Correction

Based on the test results above, if the sig value of n-gain is <0.05 , it can be concluded that the data is not normally distributed. If the data is not normally distributed, the test will continue with the Mann-Whitney U test. Mann-Whitney U test results can be seen in the following table.

Test Statistics^a

	Nilai
Mann-Whitney U	255.500
Wilcoxon W	751.500
Z	-3.247
Asymp. Sig. (2-tailed)	.001

a. Grouping Variable: Kelas

Figure 4 Mann-Whitney U Testing Result

Based on the Mann-Whitney U Test value, it can be seen in the results of "Test Statistica" where the results of the sig value. (2tailed) is $0.01 < 0.05$. So from the results it can be concluded that H_0 is rejected. So that the average of the normalized gain value of the experimental group (μ_2) is more than the average control normalized gain score (μ_1). So it can be seen that there is an increase in students' interest and understanding after using physics education games.

3. CLOSING

3.1 Conclusion

Based on the results of testing of research conducted in the preparation of a thesis that refers to the purpose of the study, it can be concluded

that the application of physics education games can increase students' interest in learning physics, as well as improving students' understanding in studying physics material. Thus, the purpose of this research has been achieved.

3.2 Suggestion

In the construction of educational game applications There are still many shortcomings in physics, so it is necessary to do some development to make this application better. In this physics education game application, the author applies three stages and only includes one to two variants of practice questions on each stage which according to the students are still felt short in completing the game, as well as lack of education that is only through the Guidebook and also practice questions in the game his. Therefore, in order for this application to be better the author suggests adding a stage, and the questions at each stage are given a varied or random question. As well as in the education section the authors suggest adding some animations or videos so that the delivery of education is more optimal.

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