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The Development of Learning Media for 6th Grade Elementary School Solar System Courses-based on Android with Virtual Reality Technology

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Article Info	ABSTRACT
  Corresponding Author: Aditya Nugraha Pradana, Departement of Informatics Education, Sebelas Maret University, Jl Ahmad Yani, no 200, Pabelan, Kartasura, Surakarta, Jawa Tengah, 57169, Indonesia. Email: adityabjo@student.uns.ac.id	This study aims to: (1) create learning media for android-based solar system subjects with virtual reality technology (2) determine the feasibility of learning media for android-based 6th grade solar system subjects with virtual reality technology. Solar system learning media for Android-based 6th grade elementary school with virtual reality technology which was developed using the luther method through 6 stages, namely concept, design, material collection, manufacture, testing and distribution. At the concept stage, determine the objectives, materials, and content of the learning media that will be developed. At the design stage, determine the material and storyboard. At the material collection stage, including determining learning materials, Unity 3D assets, images, audio and others that support the learning media. At the stage of making learning media in accordance with the predetermined design and storyboard. At the testing stage, researchers tested media experts, material experts, and users. At the distribution stage, it produces media in the form of *.apk which is uploaded to Google Drive. The validation of learning media is seen from the assessment of media experts, material expert assessments, and user assessments. Ratings obtained from all these aspects are 91.9% from media experts, 88.3% from material, and 71% from users. The results of the three assessments have an average of 83.7%. From these results it can be concluded that this learning media is very feasible to be used as a learning medium. **Keywords:** Learning Media,Solar System, Unity, Virtual Reality

1. INTRODUCTION

In the world of education, students' interest in learning is decreasing due to the development of entertainment technology which is increasingly presenting things interesting and interactive, such as cartoons and three-dimensional (3D) animation, while the learning media currently used are still dominated by a book containing text and pictures only. Use of still images that available in textbooks makes students tend to be passive and less interactive because they are unable to provide a reciprocal response, are less visible, and less attractive to students. An easy way for students to understand the lesson well and quickly is to make the lesson interesting in the eyes of students not forcing children to memorize the subject matter.

In Supriyono's [1] research, there are three basic reasons for the need to use media in the learning process in the classroom, especially for elementary school students, namely because, first, elementary school students tend to still think concretely, so that abstract subject matter needs to be visualized so that it becomes more realistic. In fact, both the use of media in the learning process can generate interest and motivation in student learning, reduce or avoid the occurrence of verbalism, generate regular, systematic reasoning, and to foster understanding and develop values in students. Third, learning using media can also provide meaningful experiences for students because with the use of media students can witness firsthand the things that are happening around them.

The learning methods applied today are mostly still conventional, one of which is material about the solar system and everything that is incorporated in it. The presentation still uses conventional media such as blackboards and pictures in books while the material for the solar system is very difficult to find in everyday

life, it takes a tool to find out its existence in the form of telescopes, making it difficult for students to understand the material. and imagine the existence of the solar system being studied and finally students get bored quickly in teaching and learning activities. This can be related to the conclusion of Nursyam's [2] research that learning using information technology-based media can increase student interest in learning.

Virtual Reality (VR) is a collection of hardware such as PCs or mobiles, head mounted displays (HMDs) and tracking sensors, and software to deliver immersive experiences [3]. The concept of VR refers to the whole simulated reality, which is built with a computer system using a digital format. Building and visualizing these alternate realities requires hardware and software powerful enough to create realistic immersive experiences [4]. Currently, VR implementation continues to be present in many fields ranging from tourism to education. VR implementations can be found in tourist destination advertisements, presentations of historical elements or in the entertainment sector [5].

With this Virtual Reality technology, it really helps humans feel in a real place as a whole and makes it easier to know what objects are there in detail. The information presented is also more and more interactive for users compared to similar technologies.

2. RESEARCH METHOD

The type of research used is research and development. That is a research method that aims to produce certain products and test the effectiveness of these products [6]. Research and development is carried out to produce new products or the development of existing products. As for this research, which is developed is a learning media for solar system subjects. The development model carried out is the Luther development model which consists of 6 stages, namely concept, design, material collection, development, testing and distribution. The explanation of some of these stages is as follows:

1. Concept

    The concept stage is the initial stage of developing learning media. At this stage the determination of the initial concept of the learning media that will be developed through observation activities and looking for references on the subject taken. Activities at this stage include determining the objectives, materials, and content of the learning media that will be developed

2. Design

    At this stage, the design of learning media is carried out which includes making materials from learning media and create a storyboard to describe the description of each scene

3. Material Collection

    At this stage, the collection of materials in accordance with the needs of the developed learning media is carried out. These materials include learning materials, Unity 3D assets, images, audio and others that support the learning media.

4. Development

    The development is the stage where learning materials, Unity 3D assets, images, audio and previously collected materials are used as learning media. Development of learning media using Unity 3D. The development is carried out based on the navigation and storyboard designs that have been made in the previous stage. Interactive aspects are added to the learning media through Unity 3D features.

5. Testing

    The testing phase is carried out after the learning media has been created to find out the shortcomings of the media. The test is divided into four stages, namely product functional test, product non-functional test, expert feasibility test, and user trial. Product functional test aims to test whether the learning media that has been made is in accordance with the results of the analysis and design. Functional tests are carried out by developers to test the functionality of the learning media. Non-functional product testing is carried out by developers by testing the product using several devices that have different specifications Expert due diligence includes research by media experts and materials experts. After the expert feasibility test phase is carried out, data will be obtained in the form of suggestions and assessments that are used as material for revising the learning media. User trials include trials to learning media users. From user trials, data will be obtained to determine the feasibility of learning media

6. Distribution

    At this stage, the learning media storage process is carried out to Google Drive in the form of *.apk. Learning media is then distributed to teachers to be used as a tool in the learning process.

The subjects of this research are media expert that is someone who has expertise in the field of learning media., theory expert that is someone who masters the theory of the solar system as well as a class teacher, and user that is a 6th grade elementary school student

Data collection in this study will use 2 techniques, namely observation and questionnaires. Observations in this study are to find out the weaknesses of learning media about the solar system for the current 6th grade elementary school and questionnaire is a research instrument that contains a series of questions or statements to collect data or information that must be answered by the respondent freely according to his opinion. Below are the details statement for media expert validation questionnaire :

Table 1 Details Statement For Media Expert Validation Questionnaire

No	Indicator
	Usability
A.	Learnability Aspect
1.	Learning media can be used easily
2.	Learning media can be used for independent study
3.	The choice of words can be understood easily
4.	The description of the material is presented clearly
5.	Learning media helps to be more effective in learning
B.	Operability Aspect
6.	Navigation buttons work fine.
7.	Selection of assets and buttons according to their function
8.	Proportionate and easy to read letters
9.	Learning media has a design that is not confusing
C.	Attractiveness Aspect
10.	Learning media is quite interesting
11.	Use of appropriate and interesting animation
12.	The assets used do not interfere
13.	The color composition is good and attractive
14.	Interesting and unobtrusive background selection
15.	Proportionate and attractive layout design
	Portability
16.	Learning media can provide displays in various layer resolutions
17.	Learning media can be accessed from various Android operating systems
18.	Learning media does not take up a lot of storage size

Below are the details statement for theory expert validation questionnaire:

Table 2 Details Statement For Theory Expert Validation Questionnaire

No	Indicator
A	Accuracy and Suitability
1.	The theory on the learning media is in accordance with the learning objectives
2.	The theory on the learning media is in accordance with the aspects being taught
3.	Selection of the type of learning media according to user needs
4.	Vocabulary selection according to user
B	Interest
5.	Learning media increases user interest in learning
6.	The display of learning media is attractive to users
C	Usefulness
7.	Learning media is useful for students
8.	Learning media is useful for teachers
9.	Learning media can be used as a learning companion for users
10.	Learning media can be used as a source of independent learning for students

Below are the details statement for user validation questionnaire:

Table 3 Details Statement User Validation Questionnaire

No	Indicator
A.	Usefulness
1.	This learning media helps me more effectively in understanding the solar system

No	Indicator
2.	This learning media helps me to be more active in learning the solar system
3.	This learning media is useful in understanding the material of the solar system
4.	This learning media has a big impact on the learning activities that I go through
5.	This learning media makes it easier for me to solve a solar system learning problem
6.	This learning media saves my time to study
7.	This learning media suits my needs
8.	The learning media is as I expected
B	Ease of Use
9.	Learning media is easy to use
10.	Practical learning media to use
11.	Learning media is easy to understand
12.	The steps for using learning media are very easy and efficient
13.	This learning media can be adapted to my needs
14.	I have no trouble using this learning media
15.	I can use learning media without written guidance
No	Indicator
16.	I didn't find any inconsistencies while using this app
17.	Users who rarely or regularly use it will like this application.
18.	Whenever I make a mistake I can come back quickly and easily
19.	I can use it well every time.
C	Ease of Learning
20.	I understand the use of this learning media quickly
21.	I can easily remember how to use this learning media
22.	I find it easy to understand how to use this learning media
23.	I am fast and proficient in using this learning media
D	Satisfaction
24.	I am satisfied with the performance of this learning media
25.	I will recommend this learning media to my friends
26.	The use of this learning media is fun
27.	This learning media works like what I want
28.	This learning media is very good
29.	I feel I have to have this learning media
30.	This learning media is convenient to use

The response data from the questionnaire by media experts, theory experts, and users on the solar system learning media were then measured using a Likert scale as shown in below:

Table 4. Likert Scale

Assessment criteria	Score for statement	
	Positive	Negative
Very suitable	5	1
Suitable	4	2
Sufficient	3	3
Not suitable	2	4
Very unsuitable	1	5

The data from the media expert, theory expert, and user questionnaire will be converted into a percentage with the following calculations:

Percentage (%) = F/B×100

Description =

F = The results of the assessment obtained

B = Total number of assessments

The final value is then formed a criterion as shown in below:

Table 5. Assessment Criteria

Assessment criteria	Percentage
Very worth	81%-100%
Worthy	61%-80%
Not worthy	41%-60%
Not feasible	21%-40%
Very unworthy	0%-20%

3. RESULT AND ANALYSIS

The results of the research will be described according to the stages of the Luther development model, namely:

1. Concept

    Before starting the development of instructional media, the objectives of the research were determined, including identification of potential users, types of learning media, objectives of learning media, and general specifications.

    a. The purpose of learning media

        Learning media is intended for grade 6 elementary school students. This learning media aims to help the learning process for users. Media will be developed with the Unity 3D application.

    b. Learning material concept

        The learning material taken is to explain the planets in the solar system. The concept of presenting the material to be displayed includes an explanation of the material in the form of text, images and videos.

2. Design

    The process carried out at the design stage is material design and storyboarding.

    a. Theory

        The design of the material in this learning media was made based on an analysis of the material on the sematic class 6 student book theme 9 exploring outer space. Jakarta: Ministry of Education and Culture.

    b. Storyboards

        Storyboards are made after confirming the design of the content in each part of the learning media. Storyboard serves to describe the description of each scene, by listing all the multimedia objects and links to other scenes.

3. Material Collection

    At this stage, the collection of materials to be used in learning media is carried out. The results obtained for holding the material collection are as follows:

    a. Learning materials

    b. Supporting assets as objects in learning media as well as explanations in the material section.

    c. Audio as background music in learning media.

    d. Video as a complement to the material.

4. Development

    At this stage, the process of making learning media is carried out according to the storyboard that was made before. Broadly speaking, this learning media consists of materials, quizzes, and video players. Making this learning media begins with designing display by display Unity. After all the designs have been made, then a script is given so that the learning media can run as expected and can support the functionality and interactivity of the media. Following are the results of making solar system learning media as follows:

    a. Gameplay scenes

        The gameplay scene is divided into 4 parts:

        1) Main view

There are 3 buttons and 1 panel that contains an explanation, as shown in Figure 1.

Figure 1 Main View

2) Material view

There are assets, 2 navigation buttons, and 1 to 2 explanatory material panels, as shown in Figure 2.
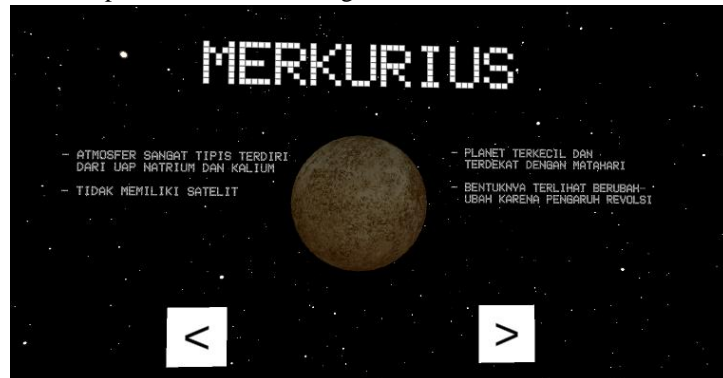

Figure 2 Material View

3) Quiz view

There are 4 answer buttons and 1 question panel, as shown in Figure 3.

Figure 3 Quiz View

b. 360viewer scenes

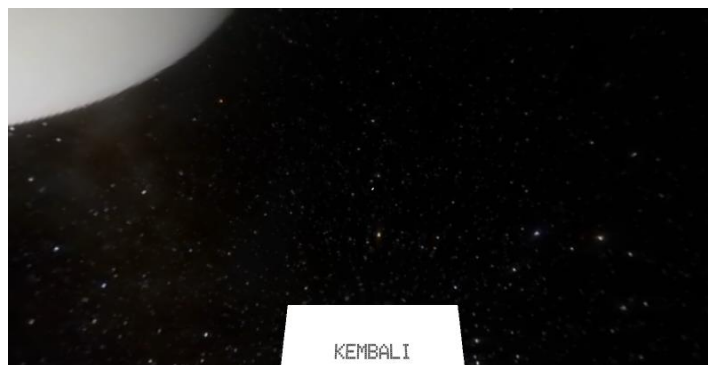There is a 360º video and 1 navigation button to return to the main, as shown in Figure 4.

Figure 4 360viewer Scenes

5. Testing

The testing phase is carried out after completing the manufacturing stage by running the learning media and seeing whether there are errors or not in the learning media. Testing includes:

a. Testing by media experts

The learning media was tested by lecturers from the Education Technology and Informatics Study Program, Sebelas Maret University. Testing includes usability aspects which are divided into learnability, operability and attractiveness as well as portability aspects. Media experts also advise to put space between the buttons in the quiz section. The results of the assessment of the above aspects can be seen in Table 6 and Figure 5.

Table 6 Feasibility Test Result By Media Experts

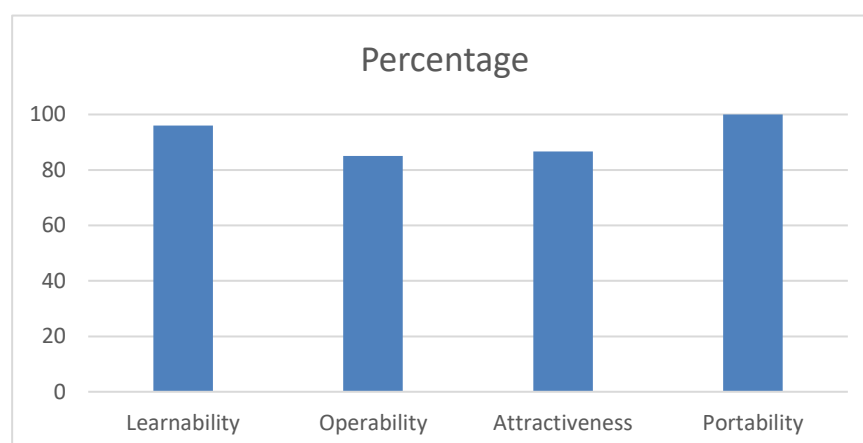| Assessment criteria	Score
Learnability	96%
Operability	85%
Attractiveness	86,7%
Portability	100%
Median	91.9%

Figure 5 Feasibility Test Result By Media Experts

If the learning media is said to be feasible, it will be continued with testing by material experts.

b. Testing by material experts

The learning media was tested by sixth grade teachers from Kanisius Keprabon 02 Elementary School Surakarta. Testing includes aspects of accuracy, suitability, interest, and

usefulness. The results of the assessment of the above aspects can be seen in Table 7 and Figure 6.

Table 7 Feasibility Test Result By Material Experts

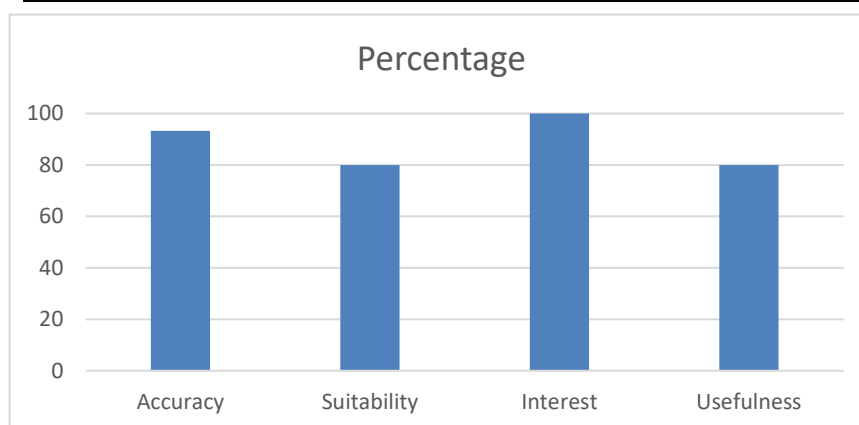| Assessment criteria	Score
Accuracy	93,3%
Suitability	80%
Interest	100%
Usefulness	80%
Median	88.3%

Figure 6 Feasibility Test Result By Material Experts

c.   User testing

The learning media was tested by sixth grade students at Kanisius Keprabon 02 Elementary School Surakarta. Testing includes aspects of Usefulness, Ease of Use, Ease of Learning, and Satisfaction. The results of the assessment of the above aspects can be seen in Table 8 and Figure 7.

Table 8 Feasibility Test Result By User

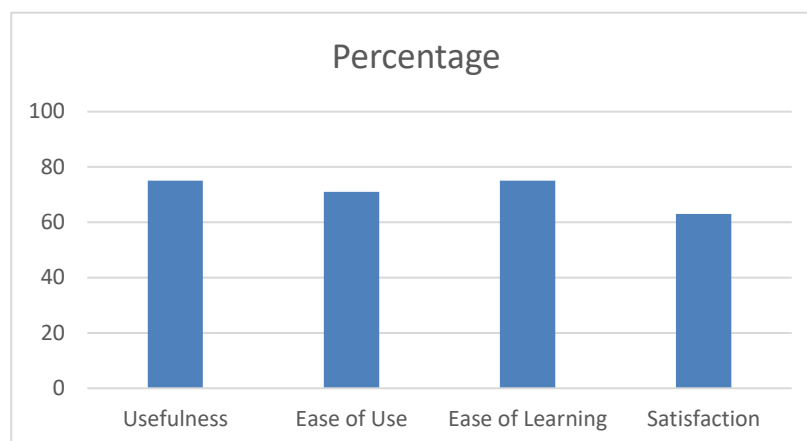| Assessment criteria	Score
Usefulness	75%
Ease of Use	71%
Ease of Learning	75%
Satisfaction	63%
Median	71%

Figure 7 Feasibility Test Result By User

6. Distribution

The process carried out in the distribution stage is uploading media to Google Drive in the form of *.apk which will then be distributed to teachers.

The feasibility of information systems is assessed from several aspects, namely learnability, operability, attractiveness, portability, accuracy, suitability, interest, usefulness, Usefulness, Ease of Use, Ease of Learning, and Satisfaction. This assessment is carried out on an assessment instrument sheet. This assessment is useful as input for system developers in developing the system that is created.

The results in Table 6 for each aspect are explained as follows:

a. Learnability gets a score of 96%. This value is in the range of 81% -100%. These results indicate that learning media can be used and understood very easily.

b. Operability gets a value of 85%. This value is in the range of 81% -100%. These results indicate that learning media is very functional with what is desired.

c. Attractiveness gets a value of 86.7%. This value is in the range of 81% -100%. These results indicate that learning media is very interesting to use.

d. Portability scores 100%. This value is in the range of 81% -100%. These results indicate that learning media is very adaptable to various Android operating systems.

The results in Table 7 for each aspect are explained as follows:

a. Accuracy obtained a value of 93.3%. This value is in the range of 81% -100%. These results indicate that the learning media material is appropriate for the purpose.

b. Interest gets 80% value. This value is in the range of 61% -80%. These results indicate that learning media material can increase user interest.

c. Compliance gets a value of 100%. This value is in the range of 81% -100%. These results indicate that the type of learning media is in accordance with what is needed.

d. Usefulness gets a value of 80%. This value is in the range of 61% -80%. These results indicate that learning media material is useful for users.

The results in Table 8 for each aspect are explained as follows:

a. Usefulness gets a value of 75%. This value is in the range of 61% -80%. These results indicate that learning media is said to be feasible in terms of its usefulness.

b. Ease of Use gets a value of 71%. This value is in the range of 61% -80%. These results indicate that learning media is easy to use.

c. Ease of Learning gets a score of 75%. This value is in the range of 61% -80%. These results indicate that learning media is easy to learn.

d. Satisfaction gets a score of 63%. This value is in the range of 61% -80%. These results indicate that the learning media material is satisfactory.

The results of the media expert, material expert, and user tests are calculated to get the average value. The average value is used as the final value in the due diligence test. The average value obtained is 91.9% for media experts (Table 6). The average value obtained is 88.3% for material experts (Table 7). The average value

obtained is 71% for users (Table 8). Then the average result of media experts, content experts and users is 83.7%. The results of this assessment show that the average result is in the range of 81% -100%%. According to the percentage scale proposed by Riduwan[7], this attendance system is in the very proper category.

4.   CONCLUSION

Solar system learning media for grade 6 SD based on Android with virtual reality technology was developed through 6 stages, namely concept, design, collection of materials, manufacturing, testing and distribution. At the concept stage determine the objectives, materials, and content of the learning media that will be developed. At the design stage determine the material and storyboard. At the material collection stage, including determining learning materials, Unity 3D assets, images, audio and others that support the learning media. At the manufacturing stage produce learning media in accordance with predetermined designs and storyboards. At the testing stage, the researcher tested the media experts and material experts. And at the distribution stage it produces media in the form of *.apk which is uploaded to Google Drive.

This system has been tested to measure the feasibility level. For the eligibility given, the aspects tested consist of learnability, operability, attractiveness, portability, accuracy, suitability, interest, usefulness, usefulness, ease of use, ease of learning, and satisfaction. The percentage obtained from all these aspects has an average of 83.7%. From these results it can be concluded that this learning media is very feasible to be used as a learning medium.

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