Design and Development of Physics Learning Media of Three Dimensional Animation Using Blender Applications on Atomic Core Material

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Abstract. The Aims of this study is to design and build a three dimensional animated physics learning media on the atomic core material using blender application for High School Physics learning media for atomic core material is already exist but still in the form of two dimensions, so it less of visualize actual concept. This research used three-stage of development research. The first stage is the design stage of the media by using instructional design model type ADDIE. The second stage is the stage of media development using the blender application. The third stage is the stage of validation and reliability. Respondents amounted to 54 people consisting of 5 experts (Expert), 11 teachers (user experts), 20 teachers (users) and 18 students (users). Aspects assessed are pedagogic, content and technical. Data collection technique is questionnaire. The results showed the validity score of experts 4.515 which means the learning media is valid with very high category. The Cronbach alpha value of the teacher as user is 0.950 and from student as user is 0.889. it indicated that the media is reliable.

Keyword: *ADDIE, Blender Application, Three Dimensional Animation*

1. Introduction

When the Education problem changed, then the solution also changed Sahin (2009). Education is always adjusting dynamically base on what skills students should possess. According to Mervi, Hirvonen (2010) the development of this learning process requires the ability of teachers in delivering the material, so that the teachers emphasize the knowledge related to daily teaching practices. Science education is education that based on natural phenomena. Chiappetta (1994) said that the essence of science is as a way of thinking, a way of investigating and body of knowledge. Based on the size of the object of science study is divided into two groups, micro sciences and macro science. Micro sciences will be dominated by physicists

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and computers, which will examine the contents of atoms and atomic nuclei that were originally believed to be the smallest part of matter.

The Redish statement in Kabil (2015) states that the problem in physics learning is that learners have difficulty in knowing the meaning of symbols that arise from an equation. Compared to other subjects, physics emphasizes conceptual teaching. Activity thinking takes priority in understanding the concept of physics perfectly. Poor mastery of physics concepts makes Physics seem difficult, Hardiyanto (2012). According to Nasir (2017), Ardhianto (2012) one of the causes of physics is less desirable, in the material of physics there are many concepts that are abstract so it's difficult to imagine.

To be able to teach concepts in physics learning. Understanding about the object to be discussed is needed. But in the matter of the atomic nucleus object, it cannot be seen because it included to the micro-science group. Because of this it is necessary to have auxiliary media learning that can bring the object of atomic nucleus so that the concept of learning delivered to the learners.

Physics learning media had used today is two-dimensional animation. So the result of movement just fixed on two axis dimensions only. However, three-dimensional animation can provide a different point of view from an animation. Animations that move in three-dimensional space make the object can be built based on the actual thing that makes the animation result becomes more real.

One of software that manipulates the shape and motion in three-dimensional space is the blender application. Blender application is an open source software 3D computer graphics. The results of the program can be used on another computer even if not install the blender application first. Blender is an application that has been published and licensed by the GNU (General Public License). This published license makes the users have the freedom to use the Blender application, free to edit, distribute and even free to sell any work that can be done with Blender application. Type of Blender application used in this research is Blender 2.76 with 32 bit version.

The use of three-dimensional animation in learning has been done before by Maria V, (2002). Maria Virvou has done research on the effectiveness of three-dimensional games in helping the learning process. They claim that the virtual reality edition game that they create (VR-ENGAGE) can be very motivating while improving educative effects on learners. Furthermore, similar development has been done also by Gosalia N (2015). Niyati Gosalia undertook the development of three-dimensional animation based on game E-learning on the subject of mathematics called MathMazing. The

results of his research states that by using MathMazing learning becomes more effective, practical and makes learners easy to remember lessons.

Inspired by those studies and for solving the problem of how to teach physics lessons for abstract material. So using this three-dimensional application Blender as a learning multimedia that able to visualize all the atomic nucleus core is expected to be a solution to the problem. So the authors conducted a study entitled " Design and Development of Physics Learning Media of Three Dimensional Animation Using Blender Application On Atomic Core Material".

The main problem of this research is "How to design a three dimensional animated learning physics media using Blender application on atomic core material for High School?". The purpose of this research is to be able to design, create, and validate physics learning media that capable to displaying three-dimensional animation on atomic nucleus material for High School using Blender application. It is hoped that this research can be used as a solution to face the learning of atomic nucleus, giving input in the selection of instructional media and can be a reference to various parties, especially the teachers in the field of science to be more innovate. So that abstract learning materials can be better modeled and drawings better.

2. Methodology

This research included to R & D (Research and Development) which used ADDIE instructional design model. The design model of ADDIE consists of 5 stages: Analysis, Design, Development, Implementation, and Evaluation Nadiyaha RS, Faaizah S (2015). And N.Azhar, M. Adri. (This approach is based on research objectives, to design, create, and validate physics learning media that capable to displaying three-dimensional animation on atomic nucleus material for High School using Blender application.

Evaluation can be done if the implementation phase has been completed. From this step will showed the results whether the media produced is proper to use or not. The research instrument used is the questionnaire and animation program. The design of three-dimensional animation program with blender application designed with ADDIE modeling can be seen in the figure 1.

The data required to test the animation obtained by evaluating it by the validator. This data will showed content validity and construct validity. Validator in this study consists of five people, of which two of them are experts in the field of programming, and the rest is an expert in the field of education. Categorization of validity in each aspect can be seen in Table 1:

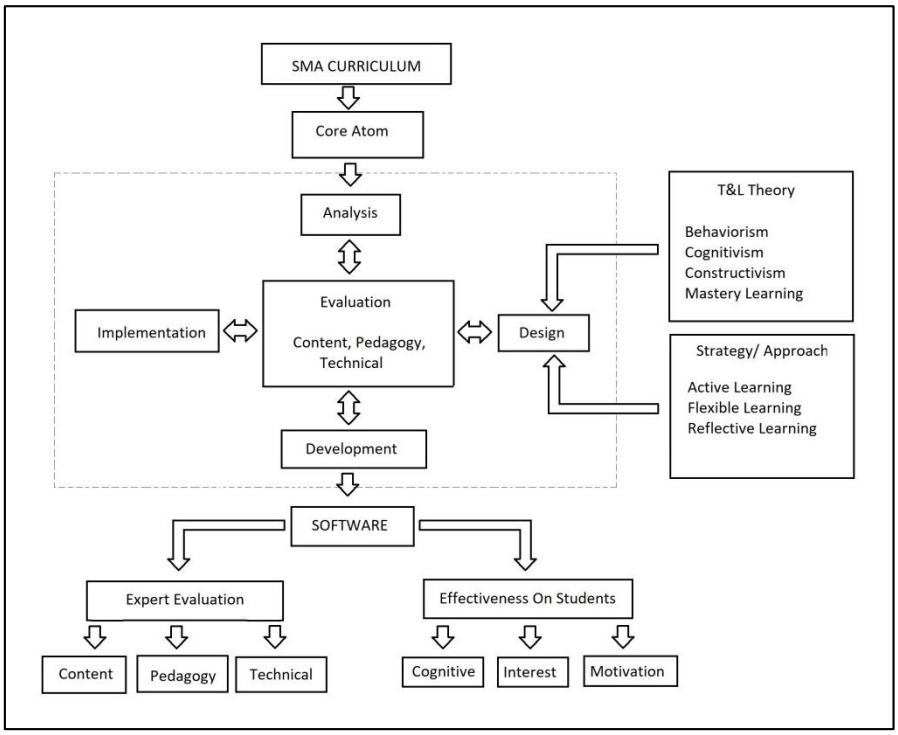

Figure 1 Step of using ADDIE (Adaptation from Jasmi, 2014)

Table 1 Instrument Evaluation Category (Nasir 2016)

Average Score Interval	Category
4,2≤ Average ≤ 5	Very High
3,4≤ Average < 4,2	High
2,6≤ Average < 3,4	Medium
1,8≤ Average ≤ 2,6	Low
1≤ Average < 1,8	Very Low

The 3 dimensional animation of atomic core learning material with Blender application in this research is valid if it has above average score of 2.76 which means it is in medium category, high or very high.

3. Results and Discussion

The design of learning media made based on Indonesian curriculum 2013. Learning media is designed with the basics of learning and learning theory, learning behaviorism, cognitivism and constructivism. The approaches and strategies used are scientific, versatile and active. This approach was chosen in order to assist the teacher in carrying out the learning of atomic nuclear material.

The learning media made using the computer on the minimum specification of the blender application, with dual core processor and 2 GB ram. During the process of media development quite a lot of changes are happening.

Good in terms of shape, or in terms of performance improvement. The result of learning media of three dimensional animation physics Using blender application on atomic core material for high school has been completed. Learning media created provide explanations about the material through animation, writing, sound and video.

This learning media uses mixed navigation. The figure 2 shows In the main menu of the user can freenly choose the desired menu option. Whether you want to get into learning materials, see competence, or evaluation page. When selecting the material menu it will go into the material view. The learning media gives the user choice whether to go to the first material or go to the needed material. When the user starts from the initial meeting, the indicator of material achievement will be displayed in the meeting and will be followed by a video motivation

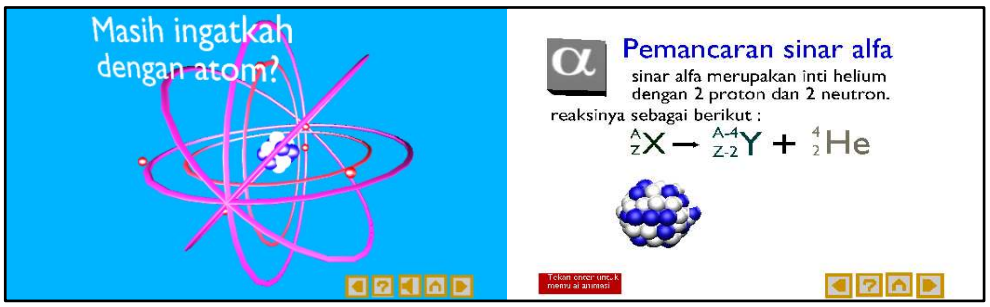

Figure 2. View of Learning Media

Figure 3 shows that this application is also accompanied by game application called Atomic Bear. In this game application the player will move the bear character inside the maze to get the honey. In the effort to get honey bears will get a bee distraction that moves and when bears are hit by a bee then the bear will return to the initial position. In the labyrinth players will meet the barriers that will open when successfully answered the questions on the door. If the answer is wrong then the player will lose, and if its correct then the player will get one point and continue his adventure in the maze until find the honey to win the game. The labyrinth has been designed for players to meet at least 5 doors which means there are 5 questions to be answered to be able

Figure 3. View of Atomic Bear Application

Validity Test by Expert

Respondents are experts who have the ability in this field. The validation of learning media is valid can be seen with the score as giving in the table. 2

Table 2. Expert Validity Score

No	Aspect	Score	Evidence
1	Design Aspect	4.48	Valid
2	Pedagogic Aspect	4.40	Valid
3	Content Aspect	4.72	Valid
4	Technic Aspect	4.46	Valid
	Validity Score	4.515	

The data shows that the highest value is in the content aspect with point 4.72 while the lowest value is in the pedagogic aspect with 4.40 points. With the final score of 4,515 then the three dimensional animated learning physics learning media using blender application on atomic core material for high school is declared to be valid in very high category.

Validity Test by Expert Teacher

From the test of expert test as many as 11 physics teachers who teach above 10 years, obtained the validity test using the average formula shown in Table 3.

Table 3. Expert Teacher Validity Score

No	Aspect	Average	Validity	Category
1	Learning Strategy	4,1	Valid	Tinggi
2	Display Design	4,1	Valid	Tinggi
3	Interaction Design	4,2	Valid	Tinggi
4	Motivation and Interest	4,2	Valid	Tinggi
	Average Score	4,15	Valid	Tinggi

It shows that the learning media is valid with an average of 4.15 and high category. The results of the study are stated to have external validity if the results of the research can be applied to the real world that resembles the place studied Sugiyono. (2014). This means that the learning medium has been known to the level of truth and accuracy of the use of such media to the user (student) Azhar, Adri (2008).

Score of Validity and Reliability Test by Teacher (Expert User)

From 20 teachers as respondents, it can be determined the value of r table for product moment with N = 20 is 0.444. If the value of r counted is greater than the value of r table then it can be categorized as valid Yamin, Kurniawan (2014). From the results of expert user questionnaires (teachers) obtained validity test using SPSS it shown in table 4.

Table 4. Validity Score by Expert User

Questionnaires item	r counted	r table	Category
1	0,500	0,444	Valid
2	0,538	0,444	Valid
3	0,731	0,444	Valid
4	0,745	0,444	Valid
5	0,753	0,444	Valid
6	0,687	0,444	Valid
7	0,851	0,444	Valid
8	0,749	0,444	Valid
9	0,669	0,444	Valid
10	0,714	0,444	Valid
11	0,628	0,444	Valid
12	0,765	0,444	Valid
13	0,807	0,444	Valid
14	0,724	0,444	Valid
15	0,673	0,444	Valid
16	0,777	0,444	Valid
17	0,807	0,444	Valid
18	0,834	0,444	Valid
19	0,824	0,444	Valid
20	0,865	0,444	Valid

In the table 4 we can see that all items have a value of r counted greater than r table (0.444) so that all items are said to be valid. So that learning media is valid. Because of the assessment of the media through the questionnaire items with a given score by expert users (teachers).

The results of the study are stated to have external validity if the results of the research can be applied to the real world that resembles the place studied Sugiyono, (2014). Trial or application of three dimensional animated physics learning media on expert user (teacher) has been declared valid. This means that the learning medium has been known to the correctness and accuracy of the use of the media to the user's expert (teacher) Azhar , Adri. (2008).

Reliability test is done with SPSS. From the results of the expert user questionnaire (teacher) the value of Cronbach's Alpha (α) is 0,950 while N= 20. If the value of Cronbach's Alpha is greater than 0.7 (> 0.7) then it is said to be reliable Yamin, Kurniawan (2014). With the total 20 items α = 0.950 greater than 0.7 so the media is reliable based on the results of the media assessment analysis through the questionnaire item. Its means that learning media of three dimensional animation physics can give the same effect among respondents (teachers) Sugiyono, (2014).

Score of Validity and Reliability Test by Students (User)

From 22 students as user respondents, can be determined r table value for product moment with N = 22 is 0.423. If the value of r counted is greater than the value of r table then it can be categorized as valid Yamin, Kurniawan (2014). From the results of media scoring scores through

questionnaires by users (students) obtained validity test results using SPSS shown in table 6.

Table 5. Validity Score by User

Questionnaires item	r counted	r table	Category
1	0,539	0,423	Valid
2	0,747	0,423	Valid
3	0,560	0,423	Valid
4	0,439	0,423	Valid
5	0,424	0,423	Valid
6	0,785	0,423	Valid
7	0,692	0,423	Valid
8	0,633	0,423	Valid
9	0,566	0,423	Valid
10	0,563	0,423	Valid
11	0,564	0,423	Valid
12	0,677	0,423	Valid
13	0,499	0,423	Valid
14	0,482	0,423	Valid
15	0,646	0,423	Valid
16	0,691	0,423	Valid
17	0,539	0,423	Valid
18	0,670	0,423	Valid

In table 5 we can that all items have r counted greater than r table (0.423) so that media assessment by users (students) through the questionnaire item is valid. If the eighteen items are said to be valid then the learning media is also valid.

The results of the study are stated to have external validity if the results of the research can be applied to the real world that resembles the place studied Sugiyono (2014). Trial or application of three dimensional animated physics learning media on expert user (teacher) has been declared valid. This means that the learning medium has been known to the correctness and accuracy of the use of the media to the user's (students) Azhar, Adri (2008).

Reliability test is done with SPSS. From the results of the user questionnaire (students) the value of Cronbach's Alpha (α) is 0,889 while N = 18 . The value of Cronbach's Alpha can is $\alpha = 0.889$ greater than 0.7 so the learning media is reliable. it means that learning media of three dimensional animation can give the same effect among respondents (students) Sugiyono, (2014). Based on the results and discussion, physics ;earning media of three dimensional animation using Blender application on atomic core material was declared valid by the experts (lecturers and teachers) and reliable by user (user) and user expert (teacher) so there is not much revision of product. Revisions were made based on the suggestions given by the respondents.

4. Conclusion

Physics learning media of three dimensional animation using blender application on atomic core material has valid category very high and reliable. Validation results have shown that this study successfully designed a learning media that capable to show three dimensional animation of atomic core learning materials for High School by using Blender application. This research can be used as an alternative solution in facing the problem in learning atomic core material which is classified as abstract material. This media can be used as an alternative selection of learning media and can be a reference for teachers in the field of science to be more innovative or creative.

This research is expected to be continued again to conduct a wide-scale test and can be modified to Augmented Reality to improve multi representation and visualization of learners. Many other physics teaching materials can explained better by using three dimensional modeling. Such as the material of material physics, earth, modern physics and other materials whose object of study is abstract.

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