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Development of Interactive Media in Learning Science for Elementary School Students

By

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Abstract

This study aims to develop interactive media specifically for 3D animation learning media. This research used research and development (R and D) with stages by stages: needs analysis, design, and expert validation. The data collection instruments included material expert validation sheets, linguist validation sheets, and learning media expert validation and test sheets. The results showed that the average category was very good at 4.52 obtained based on the validation results of material experts, the average category was very good at 4.61 obtained based on the validation results of linguists, and the average category was very good at 4.51. they were based on the validation results of linguists. 3D animation media with an average criterion is excellent, so 3D animation media is suitable for learning science in elementary schools. Analysis of student learning outcomes tests through the t-test for Equality of Means on Sig. (2-tailed) is 0.00001 <0.05. Thus, there is a significant difference in effectiveness between using conventional 3D animation media for students in elementary schools. The Mean N-Gain value obtained on the experimental data is 66.7155 or 66.72% based on the N-Gain interpretation category. The use of 3D animation media is quite effective in the experimental class.

Keywords—learning media, 3D animation, Science Content

Introduction

Learning media is a tool used or utilized to teach properly; the media makes it closer or facilitates the path to the planned goals (Tafonao, Setinawati, & Tari, 2019). Apart from attracting students' interest in learning, the success of the learning process cannot be separated from the support of facilities that support the use of learning media (Coman, Țîru, Meseșan-Schmitz, Stanciu, & Bularca, 2020). Both simple learning and multimedia are essential to implementing education in schools, but the provision of learning media has so far been an obstacle or problem (Mupa & Isaac., 2015). Students need more practical, effective visualization and more optimized learning time (Castro-Alonso, de Koning, Fiorella, & Paas, 2021). The need for visualization can be fulfilled with the help of learning media (Naps, Cooper, Koldehofe, Leska, Rößling, Dann, Korhonen, Malmi, Rantakokko, Ross, Anderson, Fleischer, Kuittinen, & McNally, 2003). The variety of learning media is an example of the development of science and technology in education (Center, 2012).

Technology, Information, and Communication (ICT) rapidly develop in the education sector. Due to these developments, the learning process starts with many fun activities. Consequently, the students from the alpha generation, familiar with advanced technology, will be engaging in the teaching-learning process (Ibrahim, Safitri, Umasih, Marini, Apriwahyudi, 2020; Safitri, Lestari, Maksum, Ibrahim, Marini, Sudrajat, Zahari, & Iskandar, 2022). ICT progress has created many kinds of educational software development (Marini, Nafisah, Sekaringtyas, Safitri, Lestari, Suntari, Umasih, Sudrajat, & Iskandar, 2022). Teachers can use this software to develop fun learning activities. As it is currently famous, interactive media help diminish abstract conception so that they can improve material absorption effectively by the students.

The advances in education greatly depend on the progress of technology (Marini, Safitri, Lestari, Suntari, Nuraini, Nafiah, Saipiatuddin, Ambar Arum, Sudrajat, & Iskandar, 2021; Batubara, Sumantri, & Marini, 2022). Interactive media is a suitable instrument for teachers to attain greater student participation in learning (Sujarwo, Herawati, Sekaringtyas, Safitri, Lestari, Suntari, Umasih, Marini, Iskandar, & Sudrajat, 2022). This way of teaching demonstrates a proper strategy to enhance students' attentiveness in teaching-learning. The forming of interactive learning media makes the learning process effective for student learning (Rihatno, Safitri, Nuraini, Marini, Putra, Wahyudi, 2020; Safitri, Awalia, Sekaringtyas, Nuraini, Lestari, Suntari, Marini, Iskandar, & Sudrajat, 2022; Sarifah, Rohmaniar, Marini, Sagita, Nuraini, Safitri, Maksum, Suntari, & Sudrajat, 2022; Nuraini, Safitri, Rihatno, Marini, Putra, Wahyudi, 2020; Edwita, Safitri, Nuraini, Rihatno, Sudrajat, Marini, Wahyudi, 2020). The consequences of the technological developments require students and teachers to overcome technology underpinning learning systems (Sujarwo, Herawati, Sekaringtyas, Safitri, Lestari, Suntari, Umasih, Marini, Iskandar, & Sudrajat, 2022).

Learning media are facilities that are used or utilized so that teaching can take place well; media approach or facilitate the path to the planned goals (Marini, Safitri, Nuraini, Rihatno, Satibi, Wahyudi, 2020). Besides being able to attract students' interest in learning, the success of the learning process cannot be independent of the support of facilities that support the use of learning media (Umasih, Safitri, Nuraini, Rihatno, Maksum, Marini, Wahyudi, 2020). Both simple learning and multimedia are essential to implementing education in schools, but the provision of learning media has been an obstacle or problematic. Learners need more practical and effective visualization and optimized learning time. Learning media can meet visualization needs. The variety of learning media is one example of the development of science and technology in education. The type of learning media is one example of the development of science and technology in education.

The need to use it in the learning process can be an effective solution by engineering learning conditions to be more accurate. Teachers can use many learning media, both simply through teaching aids and multimedia-based, known as interactive learning media (Hadi, Yuksafa, Yarmi, Safitri, Lestari, Suntari, Umasih, Marini, Sudrajat, & Iskandar, 2022). However, the interviews with students revealed that students found it challenging to absorb the learning materials presented, the teaching materials used in learning used 2013 curriculum textbooks, and the media used by teachers to support learning were pictures and power points that were less attractive to students. The results of interviews with teachers revealed that in delivering material, teachers used 2013 curriculum textbooks, and media development was mainly in the form of pictures and materials in the form of power points. Therefore, we need the help of learning media designed to provide concrete examples, such as animations, photos, images, Etc.

The position of science content in education is critical (Susanto, Dwiyanti, Marini, Sagita, Safitri, & Soraya, 2022). Science content is one of the subjects at every level of education. The elementary level is the basis for studying science content. Another reason is that science sharpens students to think, analyze, and design to create a finding. Therefore, this subject is not merely memorization but can potentially shape students' personalities. Lack of media use in the learning process can reduce high-level thinking; students will tend to feel bored with learning that only uses improvised media, especially for elementary school students because elementary school students' learning must use media concrete and varied. With the help of exciting media, students will find it easy to understand the subject matter, which positively impacts student learning outcomes.

Using media in the learning process can be an effective solution by manipulating learning conditions to become more accurate. Teachers can use many learning media, simple ones through teaching aids and multimedia-based interactive learning media (Sujarwo, Herawati, Sekaringtyas, Safitri, Lestari, Suntari, Umasih, Marini, Iskandar, & Sudrajat, 2022).

The results of interviews with students revealed that students had difficulty absorbing the learning material presented, the teaching materials used in learning using the 2013 curriculum textbooks, the media used by the teacher to support learning in the form of pictures, and power points which were less attractive to students.

The results of interviews with teachers revealed that in delivering material, teachers used 2013 curriculum textbooks, and media development was mainly in the form of pictures and material in the form of power points. So it needs the help of learning media designed to provide concrete examples, such as animations, photos, pictures, etc.

This condition should not be expected to occur; the position of science content in education is crucial (Idris, Hassan, Ya'acob, Gill, & Awal, 2012). Science content is one of the subjects at every level of education (Margot & Kettler, 2019). Where the elementary school level is the basis for studying science content, another reason is that science hones students to think, analyze, and design to create findings. Therefore, this subject is not merely rote but has the potential to shape the personality of students as a whole.

The lack of use of media in the learning process can reduce high-level thinking, and students will tend to feel bored with learning that only uses makeshift media (Sherman, 2013), especially for Elementary School students because Elementary School students learning must use media concrete, and varied (Puspitarini et al., 2019). With the help of exciting media, it will be easy for students to understand the subject matter, which is thought to positively impact student learning outcomes (Kamamia, Ngugi, & Thinguri, 2014).

Very few elementary school teachers currently use 3D animation as a learning medium (Facione, 2016). The transformation in designing 2D to 3D animation requires solid technological capabilities so that the resulting learning media can be enjoyed by students (Milner-Bolotin & Nashon, 2012). Audio-visual-based media is used in the learning process by involving sight and hearing, one of which is animation. Animation is a series of images that form a movement that has advantages over other media, such as static images or text (Korakakis, Pavlatou, Palyvos, & Spyrellis, 2009). Animation is usually in moving text or pictures to attract students' attention and strengthen motivation (Bhatti, Abro, & Karbasi, 2017). In addition, the animation is one multimedia object that provides an understanding of the material provided to students (Adamo-Villani, Doublestein, & Martin, 2005).

3D animation is a type of animation, which has a 3D appearance and the entire manufacturing process uses computer assistance (Bhatti, Mahesar, Bhutto, & Chandio, 2017). 3D animation is the result of the development of 2D animation, which makes it possible to see from various perspectives and make objects look more natural, closer to their original form (Zakir et al., 2021).

Based on the description above, in this study, the researcher intends to develop 3D animation learning media on science content in elementary schools.

Research methods

This research used Research and Development. This type of development research was used to produce learning media products in this study. The learning media developed is in the form of 3D animation media on natural science content.

Data collection techniques in this study (1) need analysis of data related to the development of 3D animation media for elementary school students, (2) the results of the feasibility test on the developed media, and (3) Evaluation of student learning outcomes tests.

The instruments used in this study consisted of (1) 3D animation-based interactive media development needs questionnaire sheets and (2) product validation sheets for media experts, material experts, and linguists. In addition, these instruments were used to obtain data about the assessment of the quality of the products produced and (3) the Student learning outcomes test sheet.

Data analysis in this study used qualitative and quantitative data analysis. Qualitative data were analyzed in a qualitative descriptive manner based on input, responses, criticisms, and suggestions for improvement contained in questionnaires, discussions, and the results of interviews with experts (expert review)—quantitative data obtained from the test scores of learning outcomes.

Result

Preliminary Stage

The preliminary analysis results were carried out through literature and field studies by collecting, analyzing, and interpreting the data obtained through surveys, interviews, questionnaires, and documentation. Science content material is memorized, teaching materials used in learning use the 2013 curriculum textbook, and media used by teachers to support learning in the form of pictures, and power points are less attractive to students. Regarding smartphone ownership, 85% of students have smartphones and 15% use smartphones belonging to relatives or parents to support learning.

Needs analysis stage

The results of interviews with teachers revealed that in delivering material, teachers used 2013 curriculum textbooks, media to support learning in schools was limited, media development was mainly in the form of pictures, and material in the form of power points. So it needs the help of learning media designed to provide concrete examples, such as animations, photos, pictures, etc.

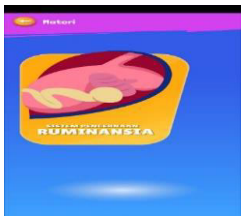
After preliminary studies, the next step is to develop 3D animation media. The first step is compiling flowcharts and storyboards as the initial stages in creating interactive media

programs. The program was developed on a computer-based basis, packaged in an attractive Adobe Flash program, and then an application was created that could be installed on Android phones. The development stages in this phase consist of making basic programming applications, making graphics, making animations, making narratives, designs, and content (content) from prototypes of interactive media that will be developed.

Media Development Stage

The resulting interactive media products are arranged with an arrangement of components including (1) competency maps those outline core competencies, essential competencies, indicators, and learning objectives, (2) presentation of learning materials, (3) exercises in the form of quizzes and evaluations, and (4) bibliography. In addition, the following displays interactive media based on 3D animation.

Initial View



Display Before entering the material

3D animation material display

Figure 1. *3D Animation Media*

Expert Validation Stage

The draft that has been developed is validated and evaluated by educational technology experts as media experts, science material experts, and linguists to obtain input and suggestions to produce media that are effective and suitable for use. The results of the first validation, namely product validation by educational technology experts aim to obtain information related to the quality of the 3D animation media developed, from the average validation of media experts obtained 4.52 in the outstanding category. The second is the validation of natural science material. This stage attempts to obtain information about the feasibility of the developed media related to the material content of the product developed from the three material expert validations; an average of 4.61 is obtained in the perfect category. The third validation, namely product validation by linguists, aims to obtain information related to the readability quality of the product being developed. From the validation of the three linguists, an average of 4.51 is obtained in the excellent category. From the expert validation activities, interactive media based on 3D animation is feasible to use. The need for using media in the learning process can be an effective solution by manipulating learning conditions to become more accurate. Many learning media can be used by teachers, both simple ones through teaching aids and multimedia-based, known as interactive learning media (Jasuli & Fitriani, 2018). Learning media is vital because it improves the quality of learning and student understanding. This study revealed that the application of 3D cartoon media to fourth-grade elementary school students increased the learning process. It shows that animated videos can increase student motivation in class IV science lessons.

Evaluation Stage

This evaluation phase was carried out on 23 students in the experimental class and 23 students in the control class. The field trial was intended to test the effectiveness of the 3D animation learning media developed to improve student learning outcomes. During the field trial, learning activities were performed by comparing the experimental class using interactive multimedia-based science teaching materials and the control class using

PowerPoint presentation media. Field trials were conducted through Quasi-Experimental Design to measure learning science results for fifth-grade elementary school students. Analysis of pretest and post-test results using the independent t-test and N-Gain

A descriptive data analysis was conducted to show an overview of the research data mapping between the experimental and control classes. The N-Gain value based on the descriptive can be seen in the mean of the data being tested (Wahyuni, Indrawati, Sudarti, & Suana, 2017).

Table 1 *Group Statistics*

	Class	N	Mean	Std. Deviation	Std. Error Mean
N-Gain	Experiment	23	66.7155	6.10063	1.27207
	Control	23	48.1402	6.74167	1.40574

The mean N-Gain value obtained from experimental data is 66.7155 or 66.72% based on the N-Gain interpretation category (Ridha et al., 2018). Therefore, 3D animation media is quite effective in the experimental class. Furthermore, it is known that the Mean N-Gain value for the control class is 48.1402 or 48.14% which can be interpreted that conventional learning being applied less effectively in the control class. So statistically descriptive, there are differences in the effectiveness of learning methods with conventional 3D animation media.

Next, to determine if there is a meaningful difference in the effectiveness of the two methods, it can be done by testing through the Independent Samples Test. Requirements in the test, where the data must be normally distributed and homogeneous. For data in the experimental class using 3D animation media and control class data using conventional learning. The two data were tested for normality with the aim of normally distributed data.

Table 2 *Tests of Normality*

	Class	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
N-Gain	Experiment	.101	23	.200	.969	23	.662
	Control	.161	23	.127	.955	23	.371

The test results presented in Table 1, Tests of Normality, show that the normality test uses the Shapiro-Wilk. This is because the number of samples used is less than 50, so the normality test is with Shapiro-Wilk (Potochnik, Colombo, Wright, Potochnik, Colombo, & Wright, 2018). It can be seen to show that the data is typically distributed based on the significant value of Shapiro-Wilk, provided that the significant value above 0.05 is customarily distributed (Delİce, 2001). It is obtained that a significance of 0.662 in the experimental class and 0.371 in the control class is more significant than 0.05. Therefore, it can be stated that both data are typically distributed.

To strengthen the findings in Table 1, the Independent Samples Test was carried out to indicate significant differences in the effectiveness of learning methods.

Table 3 *Independent Samples Test*

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)

N-Gain	Equal variances assumed	.000	.983	9.798	44	.000
	Equal variances not assumed			9.798	43.568	.000

Other findings are presented in Table 3, namely the homogeneity test with Levene's Test for equality of variances. This is done to show that the data have the same variance. The significance value of the variance is 0.983, which refers to Equal variances assumed. It means that a significant variance is assumed to be greater than 0.05 so the data has a homogeneous variance (Amo-Salas, Arroyo-Jimenez, Bustos-Escribano, Fairén-Jiménez, & López-Fidalgo, 2014).

Overall, the prerequisites for data analysis have been met, and then the significance test is that there is a difference in effectiveness between the two learning methods through the t-test for Equality of Means on Sig. (2-tailed) is 0.00001 < 0.05. Thus, it can be concluded that there is a significant difference in effectiveness between using conventional and 3D animation media for students in elementary schools.

Advantages of 3D Animation Media

Animation media on digestive system material in animals has advantages, including;

a. The product developed consists of a 3D media animation application, a user manual, and a material book.
b. The application of 3D animation media can be used in learning science content for fifth-grade students at Elementary School because it includes analysis and description of competencies, materials, examples, and evaluations that can help students learn more activities such as building new knowledge, thinking critically, thus forming learning competencies. In full.
c. 3D animation media applications can be used either individually and independently or in groups according to the conditions of facilities and infrastructure.
d. Products are developed using scientific learning steps according to the objectives of the 2013 curriculum, accompanied by concrete and contextual examples of each material.
e. Anyone can use 3D animation media applications without entering a password and user name, making it easier to install and use.

Weaknesses of 3D Animation Media

Besides having several advantages, this 3D animation media also has several disadvantages, as follows:

1. The program can only be used on cell phones with a minimum storage capacity of 3 GB
2. The material being developed does not cover the entire contents of the subject matter but is only limited to the material on animal digestive system. However, the material or material being developed can be a reference for the development of other materials.
3. The effectiveness of the developed teaching material products only measures the cognitive domain related to learning outcomes.

However, after several improvements and revisions were made, it was possible to minimize the deficiencies found in the product.

Factors supporting and inhibiting research

Several supporting and inhibiting factors in this research and development process are as follows:

a. Supporting factors

Factors that support the success of this research and development include: 1) good cooperation from the school, 2) students' willingness to bring handphones when learning in class, and 3) high student motivation to be actively involved in research activities, especially at the trial stage small group and field tests.

b. Obstacle factor

The inhibiting factors in this research and development are as follows: 1) This application requires the use of proper digital devices and adequate internet access, 2) information literacy skills related to the use of internet technology are still low, and 3) some parents do not allow mobile phones to be brought to school.

Conclusion

Based on the research results and discussion related to the development of 3D animation-based interactive media, this study produced a product consisting of android-based 3D animation media applications and 3D animation-based interactive media user books. The feasibility of the product developed was obtained based on the validation results of material experts, linguists, and learning media experts. Based on the validation results of material experts, an average of 4.52 was obtained in the outstanding category, the validation results of language experts obtained an average of 4.61 in the excellent category, and the validation results of media experts obtained an average of 4.51 in the perfect category. It is said that interactive media based on 3D animation is feasible to use. Analysis of student learning outcomes tests through the t-test for Equality of Means on Sig. (2-tailed) is 0.00001 <0.05. Thus, it can be concluded that there is a significant difference in effectiveness between using conventional 3D animation media for students in elementary schools. The mean N-Gain value obtained on the experimental data is 66.7155 or 66.72% based on the N-Gain interpretation category. The use of 3D animation media is quite effective in the experimental class.

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