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Interactive Multimedia Development Based on STEM in Improving Science Learning Outcomes

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ABSTRACT

This study aims to improve science learning outcomes by using interactive multimedia based on STEM. This research is a research and development research that refers to the Addie development model which consists of 5 stages, namely the Analysis, Design, Development, Implementation, and Evaluation. The Subject. This study was a grade student of SD Negeri 104197 Klambir village during the field trial of the research subject of 30 students. The research design used design one group pretest- posttest. The research instruments used in data collection are observation, interviews, validation questionnaires and tests. Based on the results of research, interactive multimedia based on STEM developed. The results of the field trial phase The effectiveness criteria are achieved with the number of students reaching 28 people in the post-test or around 93,33% with the results of the gain score classified in the "medium" effectiveness criteria with a score of 0.54 so that interactive multimedia based on STEM is effective for use.

KEYWORDS

Interactive multimedia; human digestive system; STEM

INTRODUCTION

Learning media can be grouped into four groups, namely: (1) Media The results of printed technology such as text, photos, and books, (2) media of audio-visual technology such as film projector machines, (3) media results of technology based on computers generally Known as a computer-assisted instruction (learning with the help of computers), (4) media results of print and computer technology, such as multimedia (Arsyad, 2020). Audio, video, and image animation creates an exciting classroom atmosphere, presents interesting teaching content, and stimulates students' interest (Luo, X, 2020). The use of media is adjusted by the teacher to the needs of students and supporting facilities. Based on the four media groups that have been mentioned, innovative media variations can be developed by the teacher.

Learning in elementary schools, especially in learning science requires learning media in its implementation. The presence of learning media has an important meaning for teachers and students during learning. At present learning in elementary schools in accordance with the 2013 curriculum implements thematic learning which also contains science content. According to Prastowo (2019) states that so that learning in SD/MI can be effective and efficient, then learning media and learning resources are needed, multimedia, and multisensory. The multimedia field is one of the learning media that is widely developed as a learning media because it combines computers with video.

The learning process should be able to attract students' attention and interest so that the learning objectives can be achieved optimally (Marhayani, D. A., & Wulandari, F, 2020).

Learning less attractive will make students feel bored in learning so that it affects student learning outcomes. Designing innovative learning becomes a difficult challenge to be realized by the teacher, so that the learning design that is not appropriate has an impact on the achievement of student learning outcomes. Paying attention to the problems that occur, it is appropriate in learning an innovation is carried out. Learning media can also be developed by teachers in conjunction with technology that is able to create a pleasant and enthusiastic atmosphere of students in learning to form.

Based on the results of direct observations and interviews conducted at SD Negeri 104197 Klambir Village on July 28, 2022, focusing on 30 fifth grade students of the 2022/2023 school year. The state of the learning process when making observations is seen the teacher focuses on books and explains with the lecture system, as well as the lack of supporting media in learning makes it difficult for students to learn with focus. The enthusiasm of students becomes invisible because of the absence of innovative learning media. Students do not pay too much attention to the learning material in the book because they feel the pictures in the book are not attractive. That makes students' understanding of the material also low, especially in the content of science. The media image of the human digestive system used in the classroom is still difficult for students to understand. Student activities have not been seen in the learning process because learning media that do not support the development of knowledge that students have in the digestive system material.

The results of observations and further interviews were conducted on October 26, 2022, it was known that there were a number of grade students of SD Negeri 104197 Klambir Village who were lacking in learning the material of the human digestive system on the theme of healthy food caused by several factors from teachers and students. Based on information obtained from the principal there are several factors from the teacher is (1) the teacher is still lacking in mastering the digestive system material in humans, so that learning does not go well. (2) The teacher is less creative in teaching the material of the human digestive system. (3) Learning Activities Human digestive system material in the classroom is still centered on the teacher, so students tend to be passive. Based on information obtained from the teacher there are several factors from students are (1) student learning outcomes of the material of the human digestive system are still lacking. (2) Students find learning difficulties in the material of the human digestive system. (3) Students are less active in receiving learning.

The results of observations that researchers made were also focused on learning the content of natural food themes in class V SD Negeri 104197 Klambir Village which was known to have facilities supporting the teaching and learning process such as library rooms, infocus, laptops and learning media such as Human Torso. But in reality that in learning the facility has not been used optimally, so students tend to feel bored in the learning process. The teacher prefers to use other more practical media such as the pictures printed by the teacher. Lack of innovation in developing learning media makes students feel bored and influence the low learning outcomes of science in grade V students of SD Negeri 104197 Klambir Village. This is reinforced by the acquisition of data on low learning outcomes.

Data was obtained through the daily value of the Healthy Food Theme Subtema 1 with the focus of the content of the Science of Class V Students SDN 104197 Klambir Village Academic Year 2021/2022, the results of the daily value data of students totaling 27 people on the content of the Science theme of Healthy Food, each greater than complete. This shows that students still do not meet the achievement of the Minimum Completeness Criteria (KKM). In the science content of the theme of Healthy Food Subthema 1 consists of 3 learning, with each data on the percentage of daily values in learning I which has not

been completed at 62.96%, learning II is 66.67%, and learning III of 55.55%shows the percentage of numbers which is greater than students who are complete. The learning process should be able to provide a good understanding so that the achievement of all students can meet the criteria by creating meaningful and fun learning.

Through this observation and interview activities the most dominant problem is the absence of students' activities and enthusiasm in the learning process with the percentage of student learning outcomes that have not been completed are still greater because there is no innovation in the form of technological assisted learning media (interactive multimedia) that can be used by Teacher. Teachers only use the media provided by the school and the education office and tend to use makeshift media more often such as books. In addition, the success of learning is also influenced by the learning approach used by the teacher. It is known from the results of observations and interviews, a scientific approach is the dominant approach used in learning. To help improve science learning outcomes with interactive multimedia development requires a STEM approach.

STEM stands for Science, Technology, Engineering, and Mathematics. The STEM approach is proven to be able to improve student learning outcomes (Hutapea & Silitonga, 2020: 219). In the STEM analysis as follows, students are guided to observe and study the material of natural sciences about the human digestive system. Technology, students are guided in using intercative multimedia to study the material of the human digestive system. Engineering, students are guided in operating interactive multimedia directly with digestive system material and questions that have been presented in the media. Mathematics, students are guided in observing a data about the disorder of the human digestive system and the order in the process of human digestive systems. According to Prieffer (2013: 10) states that in learning STEM, students use skills and knowledge simultaneously. STEM learning is also able to increase the soft skills of students, namely starting from patience, teamwork, and various mental expertise that can be applied in personalities and daily life. In addition, STEM learning makes students a problem solvement, inventor, innovator, independent, logical thinkers, technology literacy, able to connect their culture and history with education, and the world work.

According to Kristianto, et al (2021) the average media used in the learning process is still in the form of silent images, so students are less active and interested in participating in learning. Based on the problems obtained from the questionnaire of teacher and student analysis, it is necessary to have research related to learning media in accordance with the characteristics of students to increase student interest in the digestive system of healthy food themes, the sub-theme of how the body processes food, it is necessary to have learning media can foster the interest of students to be enthusiastic in undergoing the learning process. One way to increase the interests and learning of students is to use creative, and fun media. Students will be directly involved in the learning process with the existence of learning media. In line with Ulfa's research, et al (2022: 486) that the teacher gives an overview of implementing the 2013 curriculum in learning theme 3 Healthy Food Subthema 1, but in its application it is still less than optimal because the teacher and students must adjust both in the model, media, device, and material content learning. Teacher difficulties in thematic learning are the scope of material in the book lack and students cannot learn independently or look for learning resources independently so that students still need guidance from the teacher.

Dominating factors affect learning difficulties are found in internal factors of health indicators and external factors in media indicators. Broadly speaking, the difficulties experienced by students in the content of the science material of the human organs are explaining the understanding of the organs of the body and students cannot rewrite the

organs that play a role in the digestive system. This is because 1). Students do not like science subjects, 2). Students do not hear the teacher's explanation, 3). Students are tired of hearing the teacher's explanation, 4). The teacher explains very quickly, 5). The teacher explains not with a strong and firm voice, 6). The teacher does not give students the opportunity to ask questions so students are not active, 7). The teacher does not use the media when giving material, 8). Teachers only focus on books when explaining (Sari, et al, 2022: 4).

Based on the various problems that have been described above and the results of observations and interviews that show the low learning outcomes of class V students can be concluded that learning media is very necessary to create students' activities and enthusiasm in the learning process and understand the material delivered by the teacher. One of the learning media that can be utilized is the use of STEM-based Interactive Multimedia on the theme of healthy food in improving the learning outcomes of the Science of Class V Students of SD Negeri 104197 Klambir Village. The selection of this media is because almost everyone can use technology like a laptop whose operation is considered easy to use so that it helps teachers in the learning process and can also provide new experiences to students in learning.

RESEARCH METHODS

The type of research used is Research and Development (R&D) or commonly referred to as research and development. The selection of research methodology, in addition to considering the previous methodology used in similar research, will also be greatly influenced by the resources possessed by researchers. Through the statement above it can be concluded that research and development (R&D) is a study that develops a product through planning and production and then evaluates the validity of the product that has been produced.

The development design in this study uses the Analysis Design Development Implementation Evaluation (ADDIE) model by Robert Maribe Brach. As the name implies, the Addie model consists of five stages, namely analysis, design, development, implementation, and evaluation. This development research is oriented to product development where the development process is described carefully. Product development in this study is in the form of learning media with the help of technology in the form of interactive multimedia with the concept of STEM (Science, Technology, Engineering, and Mathematic).

The research design used design one group pretest- posttest which meant that the researcher observed a main group and intervened therein throughout the study. First measured before the experiment (O1), then given a treatment (X) for a certain period of time, then measured the second time (O2). This design can be described as follows:

O_1 X O_2

Information:

O_1 = pretest value
X = Treatment
O_2 = posttest value

To find out the difference between the pre-test and post-test scores, it is calculated using the gain score technique. After the completeness of student learning outcomes is classically analyzed to see the improvement and effectiveness of STEM-based interactive multimedia between before and after using the media developed in the learning process then the pre-testand post-test results are calculated using the normalized gain score formula (N-Gain) :

$$g = \frac{Post\ test\ Score - Pre\ test\ Score}{Maximum\ Score - Pre\ test\ Score}$$

Students can be said to have increased learning outcomes if the score ≥ 0.30. After the N-gaintest, the pre-test and post-test value data are analyzed to find out whether the increase is significant or not.

This research was conducted at SD Negeri 104197 Klambir Village which is located at Jalan Perintis Kemerdekaan No.4, Klambir, Hamparan Perak District, Deli Serdang Regency, North Sumatra. This study was conducted starting from January 2023. The subject in this study was a class V-C SD Negeri 104197 Klambir T.A 2022/2023 Village totaling 30 people. Male students numbered 16 people and female students numbered 14 people. The object in this study is the development of an interactive multimedia based on STEM.

RESULTS AND DISCUSSION

The field trial stage is carried out after the interactive multimedia based on STEM is completed based on the assessment of small group trials. The purpose of the field trial is to determine the effectiveness of the media in student learning outcomes. The field trial was conducted in the V-C class SD Negeri 104197 Klambir Village with 30 students present.

This field trial began on April 15, 2023 at 08.00 WIB until 10.00 WIB. In this trial, students and teachers are asked to use STEM-based interactive multimedia from beginning to end in the learning process with a reference to the Learning Implementation Plan (RPP). In this field trial, students will be given pre-test and post-test questions to determine the improvement of student learning outcomes after using this STEM-based interactive multimedia media. In the teaching and learning process students are put together in the seats to form groups. The teacher forms students in 5 large groups, each consisting of 6 students.

Students are given a pre-test by the teacher before using an interactive multimedia based on STEM with the contents of the problem in the form of material that has been previously studied, namely the animal digestive system in accordance with the indicators that have been formulated in the previous lesson plan. After students work on pre-test questions, the teacher continues learning the next material, namely the human digestive system with the media from the initial material to the end according to the steps in the RPP which is then closed with students working on post-test questions so that the researcher can find differences in learning outcomes from pre-test and post-test.

Based on the results of the data above, it can be concluded that the results of the pre-test and post-test above that the learning outcomes of the field trials have increased. The value of KKM of Natural Sciences in the V-C Class of SD Negeri 104197 Klambir Village is 72. The value included in the complete category based on KKM is from the value of 72 to 100. The results of student learning outcomes tests in the field trial are summarized as follows:

Table 1. Statistics The value of learning outcomes in the field trial

Variable	Value	
	Pre-test	***Post-test***
Research subject	30	30
Ideal value	100	100
Average	71,66	87,16
Maximum value	85	100
Minimum value	50	70
The number of students is complete	19	28
The number of students who are not complete	11	2

Based on the results in the table it can be seen that the learning outcomes of the student class of V-C SD Negeri 104197 Klambir Village on the theme of Healthy Food Subthema 1 Learning 2 Learning Science before learning using Interactive Multimedia Based on STEM Obtained an average score of 71.66 from the ideal score of 100, with a value The maximum obtained by students is 85 and the minimum value obtained by students is 50. While the learning outcomes after learning using STEM-based interactive multimedia obtained an average score of 87.16 from the ideal score of 100, with the maximum value obtained by students which is 100 and the minimum value obtained by students is 70. This shows that student learning outcomes in field trials increase.

Furthermore, the completeness of student learning outcomes before and after learning using interactive multimedia based on STEM. The percentage of completed student results based on the pre-test score is as follows:

$$\text{Percentage of students who are complete} = \frac{\textit{Many students are complete}}{\textit{many students in the whole}} \times 100\%$$
$$= \frac{19}{30} \times 100\%$$
$$= 63,33\%$$

The percentage of completed student results based on post-test values is also calculated as follows:

$$\text{Percentage of students who are complete} = \frac{\textit{Many students are complete}}{\textit{many students in the whole}} \times 100\%$$
$$= \frac{28}{30} \times 100\%$$
$$= 93,33\%$$

Data on the results of the completeness of student learning outcomes more clearly can be seen in the table below:

Table 2. Completeness of student learning outcomes in the field trial

Value	Category	*Pre-test*		*Post-test*	
		Frequency	**Percentage**	**Frequency**	**Percentage**
72-100	Complete	19	63,33%	28	93,33%
0-71	Incomplete	11	36,67%	2	6,67%

The table above shows that of the 30 students who participated in the pre-test of learning outcomes, there were 63.33% of students who were complete and 36.67% of students were incomplete. Furthermore, the results of post-test learning outcomes after learning using interactive multimedia based on STEM are 93.33% of students who are complete and 6.67% of students who are not complete.

Based on the table above shows that the completeness of the classroom after learning using an interactive multimedia based on STEM increases rather than when pre-test. An increase in learning outcomes by 30%. Based on the completeness criteria described by Nurhayati in his journal, the completeness of the learning outcomes of students of V-C Class SD Negeri 104197 Klambir Village in the field trial of 93.33%, which means that it has met the classical completeness standards and entered into the "Very Good" category.

Interactive multimedia based on STEM is said to be effective if it provides good changes to the achievement of learning objectives. Improved learning outcomes can be seen through the difference in pre-test and post-test values calculated using the gain score technique. After the completeness of students' learning outcomes classically analyzed to

see the improvement and effectiveness of interactive multimedia-based multimedia between before and after using the media developed in the learning process then the pre-test and post-test results are calculated with the normalized gain score formula (n-gain). The pretest and posttest results are presented as follows:

$$g = \frac{Post\ test\ Score - Pre\ test\ Score}{Maximum\ Score - Pre\ test\ Score}$$

$$g = \frac{87{,}16 - 71{,}66}{100 - 71{,}66}$$

$$g = \frac{15{,}50}{28{,}40}$$

$$g = 0{,}54$$

Based on the results of the gain score obtained that STEM-based interactive multimedia is classified in the "medium" effectiveness criteria. V-C class students already have increased learning outcomes with gain scores of ≥ 0.30 which is 0.54 so that it can be concluded that the media developed has been effective for use in learning the human digestive system. From the difference between the average student and posttest values of students can be declared significantly increased with a difference of 30%.

The effectiveness of the use of STEM-based interactive multimedia

The effectiveness of interactive multimedia -based multimedia is known through product trials, the product trials carried out are field trials. At this stage the researcher measures the effectiveness of the use of media in learning using learning outcomes tests. Valuation and a test is very influential on student learning test results. For example, if the test is included in the valid category it will produce positive learning outcomes, and vice versa if the test is invalid it will have a negative effect on the results of student test assessment. Therefore the test validity test is first. The validity of the test is presented in the appendix.

Before the product trial was carried out, the researcher conducted a pre-test to students to test the level of student knowledge with previous material taught without using learning media. Furthermore, in the product trial, learning activities are carried out such as daily learning activities with RPP references that will be delivered directly by class teachers. In explaining the teacher's material will use learning media as a learning support tool. After finishing using STEM-based interactive multimedia, students are distributed post-test to see learning outcomes after using learning media.

The field trial phase was carried out in the V-C class SD Negeri 104197 Klambir Village with a total of 30 students. The effectiveness criteria are met or said to be good if students who reach completeness are greater or equal to 85% (Nurhayati, 2016: 4).

Based on the field trials that have been carried out, the effectiveness criteria are achieved by the number of students reaching 28 people in the post-test or around 93.33%. Whereas at the time of pre-test students who reached completeness of 19 people out of 30 students or around 63.33%. It also shows that the completeness of the classroom after learning using interactive multimedia increases rather than when the pre-test is an increase of 30%, which means that it has met the classical completeness standards and is included in the "very good" category. The results of the gain score obtained that STEM-based interactive multimedia is classified in the "moderate" effectiveness criteria in accordance with the criteria table (Oktaviani, et al: 2019: 598). V-C class students already have increased learning outcomes with gain scores of ≥ 0.30 which is 0.54 so that it can be concluded that the media developed has been effective for use in learning the human digestive system.

The results of the post-test implementation are obtained that the average student learning outcomes, the value is above the KKM ≥ 72. It can be concluded that learning using an interactive multimedia based on STEM that has been developed can improve student learning outcomes.

CONCLUSION

The effectiveness of interactive multimedia -based multimedia is developed and measured through learning outcome test instruments. Obtain an increase in learning outcomes by 30% in field trials. The gain score results obtained are 0,54 that interactive multimedia based on STEM is classified in the "medium" effectiveness criteria. Then the level of effectiveness of interactive multimedia -based multimedia is included in the effective category used in the learning process.

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