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DEVELOPMENT OF STEAM-BASED INTERACTIVE LEARNING MEDIA ON ENERGY SOURCES AND ITS UTILIZATION IN CLASS IV ELEMENARY SCHOOL, TILAMUTA DISTRICT

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ABSTRACT

This research was conducted to create and develop STEAM-based interactive learning media in class IV science content with the material Sources of Energy and Its Utilization. This interactive learning media is made by combining several multimedia objects such as text, images, animation, audio, video and interactive buttons, besides that it is also used to determine the feasibility and practicality of interactive media and the effectiveness of learning media in grade IV elementary schools. The method used in this research is Research and Development (R&D) with the development stages of the Four-D model (Define, Design, Develop, Disseminate). Data collection techniques in this study used a questionnaire instrument to validate material experts and media experts, interactive media practicality assessment questionnaires by students, and tests. The developed media was tested in three elementary schools in Tilamuta District, namely SDN 05, SDN 10 and SDN 10. Interactive learning media was designed using Articulate Storyline 3 software. The validation results for each expert were material experts with an average score 88.13% and media experts 96.10%. From the validation results of the two experts, it shows that interactive media gets the category "very feasible". While the practical test results of this interactive learning media obtained an average score of 92.47% in the "very practical" category. The average student learning outcomes showed an increase after the pre-test, as seen from the classical completeness which reached 100% at SDN 05 and SDN 14 Tilamuta, while 94.12% at SDN 10 Tilamuta. The average achievement of learning outcomes in trials is 98.04%. Based on the results of validation tests, practical tests, and student learning outcomes, it can be concluded that STEAM-based interactive learning media is feasible, practical, and effective for use as learning media in class IV Elementary Schools.

Keywords: Interactive learning media, STEAM, Energy Sources and Their Utilization

INTRODUCTION

The results of direct observations and interviews with the teachers of class IV SDN 10 Tilamuta on the science learning outcomes of students in class IV SDN 10 Tilamuta show that, there are still many students who score below the minimum completeness criterion of 70, the percentage of students who have not achieved completeness still reaches 67 % with the average acquisition value of knowledge is 50.6 and the average value of skills is 56.25. While the percentage of students who have achieved the minimum completeness criteria of 70 is 33% with an average knowledge score of 76.64 and an average skill score of 78. This certainly requires more attention from the teacher, especially how to improve learning outcomes students in the science content. The accumulated values that have the lowest KKM achievement level are in theme 2 "always save energy", sub theme 1 "energy sources and their utilization". After conducting a review of basic competencies and core competencies in the odd semester IV class syllabus, it is known that basic competencies that have a low presentation are basic competencies of 3.5 "identifying various sources of energy, changes in energy forms, and alternative energy sources (wind, water, solar, geothermal , organic and nuclear fuels in everyday life

(class IV syllabus Semester 1).

The material "Energy Sources and Its Use is one of the important study materials to be taught to students because in this energy source material students can develop knowledge, ideas, and concepts about energy sources that are close to students' lives. In line with Suyitno's opinion (Herlinawati 2022: 7) that in principle, studying science is a way of finding out and how to do or do and help students to understand the natural surroundings in more depth. Through this learning it is hoped that students will be able to recognize energy sources and their uses for life and conserve energy sources, know their rights and obligations in using and preserving energy sources so that their availability on earth does not run out. This lesson also teaches students to be more grateful for the abundance of blessings that God has created for humans on earth, and it is the duty of students as humans to preserve these natural resources.

After observing the results of documents in the form of learning tools, namely the learning syllabus, the reasons for the high percentage of student learning outcomes obtained under the minimum completeness criteria (KKM) in these basic competencies include several factors, namely; first, in the learning process the teacher is still monotonous in the lecture, discussion, question and answer method; second, in the daily learning process the learning resources used are limited to textbooks and textbooks provided by the government; third, in the learning process the teacher only uses makeshift media and is limited to the environment around students.

Starting from the results of observation and analysis of the study of the learning tool documents mentioned above, it is necessary to improve in terms of the learning process, especially in the delivery of learning material to students. This is very necessary considering that the 2013 curriculum focuses on cognitive, affective and no less important is the mastery of skills in students.

One of the teacher's efforts to further clarify the delivery of material to students is to use tools or in the world of education known as learning media. Meanwhile Arsyad (2016: 3) says learning media are humans, material, or an event that builds conditions and can enable students to acquire knowledge, skills or attitudes. Media serves to connect information from one party to another. Meanwhile, in the world of education, the word media is called learning media. Learning media includes physical tools and everything that can be used to convey messages or information in a teaching and learning process so that it can help children to stimulate students' attention to learn.

In the 21st century, the media is more developed and varied. One of them is media technology. Understanding of technology must be instilled early on in students, this can provide provisions for children to compete with the rapid development of technology. In the future, technology will play a very vital role in the development of the world. Whether we realize it or not, technology facilitates human activities in fulfilling human life.

Today's technological media are increasingly diverse and innovative, ranging from animated videos to interactive visual media. Many applications utilize technology to assist teaching and learning activities including Geoggebra, Microsoft PowerPoint, Adobe flash, Macromedia flash, articulate storylines, smart apps creators and many other types of technological media that can be developed for teaching materials.

Learning media by utilizing computer media can accommodate students who are slow in receiving lessons, because this media can provide a more effective climate that makes students not easily forget. The tendency for a monotonous learning model every day makes students pay less attention to the teacher's explanation. They need a new atmosphere that can generate interest in learning, for example interesting learning media such as computers or gadgets.

The existence of gadgets that have become a primary need for students why is it not used by teachers to be used as media for their materials to access learning information. Therefore, researchers are interested in

utilizing these applications to be used as media materials in learning so that students are more interested in the material presented. The software chosen by the researcher is Articulate Storyline. The selection of this software is expected to be able to attract students' interest by presenting images, animations and accompanied by clear and attractive sounds.

This STEAM-based interactive media was created by utilizing Articulate Storyline 3 Software. This application is used by researchers in concocting interactive learning media content in this case the media will be used as teaching materials that can provide a new climate for classroom learning. This application is a software that combines video, animation, image and sound elements that are packaged into one application that can be tweaked by students so as to increase students' curiosity and interest in learning.

The use of interactive media in learning makes it easy for teachers to explain subject matter, as well as providing a new learning atmosphere for students, increasing student activity in the classroom, in this way students can easily remember the material being studied, then they will answer questions. presented in the application and you can immediately see the score obtained after carrying out the learning. The use of technology in education and learning can be conceptualized as an application of ideas from theoretical concepts to solve concrete problems in the field of education and learning (Amiruddin, 2016: 82-83)

In its application, interactive media will be combined with STEAM. STEAM is an acronym for Science, Technology, Engineering, Arts and Mathematics. STEAM is a learning model that combines science or science, use of technology, (Engineering) or the skills of assembling or operating something that has benefits or use value, art or solving a problem in a creative way, and thinking rationally and with careful consideration. STEAM-based learning is a 21st century skills development need for students. Through the STEAM approach presented in interactive media articulate storyline 3 it is hoped that it can improve students' critical thinking, creativity, collaboration and communication skills.

This research will be developed using a research and development (R&B) model by adopting the four-D theory put forward by Thiagarajan and the Semmel brothers in 1974. The research phase begins with fact-finding in the field, determining what problems will be developed, what should be developed in solving the problem. in the field, then the second stage is designing products that will be used in solving problems in the first stage in this case is interactive learning media, the third stage is followed by the development stage of interactive learning media, and the fourth stage is disseminate or dissemination, namely product testing activities in the form of media learning outcomes development in schools.

RESEARCH METHODS

This research was conducted in 3 schools in the Tilamuta sub-district, Boalemo Regency, namely SDN 5 Tilamuta, SDN 10 Tilamuta and SDN 14 Tilamuta, which in this study was carried out from August to November 2022. The activities to be carried out are in accordance with the stages of the activity, namely begins with observing the problems encountered, compiling research development proposals, conducting research and ending with compiling a research report. This research was conducted using the development research method or better known as Research and Development.

RESEARCH RESULT

The process of developing interactive learning media is carried out by adopting the Four-D model developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I Semmel (1974). As the name implies, the Four-D model consists of four main stages, namely Define, Design, Develop, and Disseminate.

Results of the Defining Stage (Define)

The analysis stage carried out by the researcher is by analyzing several things such as initial - final analysis, student analysis, analysis of teaching materials, teaching materials, use of student worksheets, learning media used by teachers to preparation of lesson plans that contain learning objectives to be achieved.

Results of the Design Stage (Design)

The design process (design) is the stage of preparing ideas, which are outlined in the form of a prototype which aims to direct the preparation of interactive learning media. At this stage the researcher designs the initial form of the learning media that will be developed. Preparation based on analysis of media needs will then be processed using software, namely articulate storyline 3.

Results of the Develop Stage (Development)

The learning media development stage is needed to produce good quality learning media before being disseminated for use by users of learning media or students. The development stage is carried out through validation involving experts in their fields. The expert validators needed in this development are material expert validators and media design experts.

These two things are necessary to validate learning media before it is ready to be tested and get feedback from users. Design maturity, the use of material outlined in learning media needs to be strengthened so that it is more optimal in its application later in schools. Assessment or validation is determined by the eligibility criteria obtained from the mean score of the respondents. The average value is then converted according to the eligibility conversion table to determine the feasibility level of STEAM-based interactive learning media according to respondents.

Results of the Stages of Dissemination (Dissemination)

The process of carrying out the trial of this learning media product begins with giving pretest questions to each student, this aims to measure students' initial abilities on the material to be studied before carrying out learning using STEAM-based interactive learning media. After learning using STEAM-based interactive learning media, students will be given posttest questions again. Giving a posttest at the end of learning also serves as a final evaluation in learning and to measure the achievement of learning objectives and to find out the increase in students' cognitive learning outcomes. At the end of the meeting, students were distributed questionnaires containing student assessments of STEAM-based interactive learning media that had been used by students in the learning process. This aims to explore opinions and obtain an assessment of interactive learning media from students.

Data on student learning outcomes were collected from two evaluation activities, namely the pretest and posttest. In addition to written evaluations, students can also access questions in the form of quizzes on interactive learning media as learning evaluations when operating the media. The results of the evaluation of student learning are presented in table 1.

Table 1 Recapitulation of the average student learning outcomes

School name	Number of Respondents	Average		Individual Percentage Average >70%	
		Pretest	Post Test	Pretest	Post Test
Public Elementary School 05 Tilamuta	15	5,07	8,67	50,67	86,67
Public Elementary School 15 Tilamuta	17	4,82	8,53	48	84,67
Public Elementary School 14 Tilamuta	10	4,93	8,53	49,33	85,33
Achievement Average					**85,56**

(Source: Processed personal data)

Based on the data presented in table 4.4 above, it can be seen that the average percentage of student learning outcomes in the pretest is below the minimum completeness criterion of 70%. The average learning outcomes of students at SDN 05 Tilamuta are only at 50.67%, SDN 10 Tilamuta is at 48%, and SDN 14 Tilamuta is at 49.33%. It can be concluded that the initial cognitive potential of students on energy sources and their utilization has not reached the minimum completeness criteria or has not been completed.

Learning Media Practicality Test Results

Based on the analysis of the data obtained from the distribution of questionnaires to students in each school where the disseminate or trial was conducted, the data were obtained as presented in table 2 below:

Table 2 Results of Student Questionnaire Assessment Recapitulation Against Learning Media

No	School name	Assessment Aspects	Total Value	Percentage	Information
1	Public Elementary School 05 TILAMUTA (15 Learners)	Software	336	89,60%	**Very Practical**
		Learning Design	354	94,40%	
		Evaluation Aspects	352	93,52%	
		Audio Visual Aspect	505	96,19%	
2	Public Elementary School 10 TILAMUTA (17 Learners)	Software	400	94,12%	**Very Practical**
		Learning Design	383	90,12%	
		Evaluation Aspects	398	94%	
		Audio Visual Aspect	578	97,14%	
3	Public Elementary School 14 TILAMUTA (10 Learners)	Software	222	88,80%	**Very Practical**
		Learning Design	225	90,00%	
		Evaluation Aspects	226	90,86%	
		Audio Visual Aspect	318	90,86%	

(Source: Processed primary data)

Based on the data presented in table 4.5 regarding the recapitulation of students' assessment of STEAM-based interactive learning media, it can be seen that the percentage of scores given by students to the learning media

that has been used is in the very feasible category with the acquisition of the value of each aspect, namely; (1) software aspects with an average value of 90.84%; (2) learning design with an average score of 91.51%; (3) Evaluation aspects with an average value of 92.79%; (4) Audio Visual Aspect with an average of 94.73%.
Thus it can be concluded that the average acquisition of questionnaire results for the practicality of interactive media is at 92.47%, when viewed from the practicality criteria, the average acquisition value lies in the "very decent" criteria. It can be concluded that STEAM-based interactive learning media with energy source materials and their utilization is "very practical", where interactive learning media developed by researchers are able to increase students' learning interest, learning media packaged in the form of applications installed on cellphones make learning media easy to be carried and studied by students anywhere without using internet access.

The Effectiveness of Interactive Learning Media

Data on student learning outcomes were collected from two evaluation activities, namely the pretest and posttest. In addition to written evaluations, students can also access questions in the form of quizzes on interactive learning media as learning evaluations when operating the media.
Learning media can be said to be effective if it meets the requirements for effective learning including (1) Students feel happy in undergoing learning as outlined in the questionnaire response in the attachment; (2) student activity increases, for example in operating interactive learning media; (3) increased student learning outcomes of at least 70% of the total value of 100; (4) classical completeness is achieved at least 80% of the average number of students who take part in learning. The learning outcomes of students can be seen in the following table 3:

Table 3 Student Learning Outcomes

No Responden	Which school are you from					
	Public Elementary School 05 Tilamuta	Info	Public Elementary School 10 Tilamuta	Info	Public Elementary School 14 Tilamuta	Info
1	90	complete	60	Not complete	80	comp
2	80	complete	90	complete	90	comp
3	90	complete	100	complete	60	comp
4	80	complete	80	complete	100	comp
5	80	complete	80	complete	70	comp
6	90	complete	80	complete	100	comp
7	90	complete	80	complete	100	comp
8	90	complete	100	complete	100	comp
9	70	complete	80	complete	70	comp
10	100	complete	70	complete	80	comp
11	100	complete	90	complete	_	_
12	80	complete	100	complete	_	_
13	100	complete	90	complete	_	_
14	80	complete	80	complete	_	_
15	80	complete	100	complete	_	_
16	_	_	90	complete	_	_
17	_	_	100	complete	_	_
Grade Average	**86,67**		**86,47**		**85**	
Compelete Percentage	**100%**		**94,12%**		**100%**	

Source: Processed Primary Data

Based on the criteria for the effectiveness of learning media, this STEAM-based interactive learning media is classified as effective for use in learning. This is illustrated by the increased activity of students after the evaluation was carried out, the completeness of learning of students exceeded the minimum completeness criteria of 70 in each school. Meanwhile, classical completeness reached 100% at SDN 05 and SDN 14 Tilamuta, while 94.12% at SDN 10 Tilamuta. The average achievement of learning outcomes in this trial is 98.04%.

DISCUSSION OF RESEARCH RESULTS

This research and development was carried out in class IV of an elementary school in the Tilamuta District with an interval from July to November 2022. The target of this research was fourth-grade students who were spread across several schools in the Tilamuta sub-district. As a sample of this study were several schools representing each cluster in the Tilamuta subdistrict, namely group one with a sample of SDN 05 Tilamuta, group two with a sample of SDN 14 Tilamuta, and group three with a sample of SDN 10 Tilamuta.

Research and development carried out by researchers produces products in the form of interactive learning media using the articulate storyline 3 software and contains material reviews about energy sources and their utilization. So that the media can be used by students for learning activities, the product is packaged in the form of html software and applications. This application has a small file size so it is easy to install or install on a cellphone or laptop device. This makes it easier for students to access STEAM-based interactive learning media easily even outside of learning hours (at home) and can be used offline or without using an internet network.

This research is more focused on the development of learning media as learning materials for students. This learning media was developed through articulate storyline 3 by pouring material on energy sources and their utilization. The objectives of developing this learning media are, (1) to find out the practicality of STEAM-based interactive learning media for class IV SD Tilamuta District, (2) to determine the feasibility of STEAM-based interactive learning media based on the assessment of media experts and the response to the assessment of students of class IV SD Kecamatan Tilamuta, (3) To find out the practicality of STEAM-based interactive learning media in elementary schools in Tilamuta District.

The product resulting from this development research is in the form of an interactive learning media which contains class IV science material, namely "Energy Sources and Their Utilization". An interactive learning media developed utilizing articulate storyline 3 type software technology. Articulate Storiline 3 is software used to design learning media supported by a lot of interesting content such as text, images, audio and video that can be adapted to content needs and learning objectives. Likewise, the product design process for STEAM-based interactive learning media with the material "sources of energy and their utilization" which is the output of this development research, is designed using articulate storyline 3 software.

The product form is packaged in HTML form and an application form that can be easily installed onto gadget devices owned by users/students. Applications are facilitated with simple buttons that can be accessed by users/students in the learning process. The presentation of the material is packaged briefly and easily understood by students as well as evaluation in the form of quizzes that students can do independently and find out their level of ability after carrying out the learning outcomes.

The main target users of this STEAM-based interactive learning media are fourth grade elementary school students in Tilamuta District. The reason for choosing this target was based on the background of the problems encountered by researchers in the field, namely the achievement of basic competencies in science content in energy sources and their utilization which was still below average and the availability of facilities such as

chrombook devices but not functioning properly, and the absence of interactive learning media. used in the learning process in class IV. The material outlined in the interactive learning media is adapted to the curriculum used by the educational unit where the researcher made observations, namely SDN 10 Tilamuta, namely the 2013 curriculum. The material developed comes from the 2013 curriculum thematic book for class IV SD/MI theme 2.

The process of developing this interactive learning media was carried out by adopting the type of research and development with the 4D model developed by 3 experts namely S. Thiagarajan, Dorothy S. Semmel, and Melvin I. Semmel (1974). This research model consists of four stages, namely the Define stage, the Design stage, Develop, Disseminate. This process aims to produce products in the form of good and quality interactive learning media.

This STEAM-based interactive learning media design is produced with learning content that has been adjusted to the characteristics of students, choosing fonts and readability of text, colors in text, image packaging, and the use of audio and video backgrounds that are able to attract students' interest to deepen learning. The material that is poured into the learning media is also adapted to the student books that are used at school.

The first step in producing learning media is making the opening and the main page of interactive learning media. followed by creating a guide menu and main menu that presents competency icons, materials, performance, evaluation, and developer profiles. Next, create a material menu by adding images and videos that match the material content. Next, add interactivity in the form of an evaluation in the form of a quiz. Interactivity which is packaged in the form of quizzes in interactive learning media aims to invite students to be more active in learning activities as well as self-simulation material. This is in line with Daryanto (2019) who describes the characteristics of multimedia learning as follows; (1) having more than one convergent media, for example combining audio and visual elements; (2) is interactive, in the sense that it has the ability to accommodate user responses; (3) is independent, namely providing convenience and completeness of the content in such a way that users can use it without guidance from others.

The suitability of the interactive learning media developed with the characteristics of multimedia learning is strengthened by assessments and opinions by material and media experts. This is shown by the results of the validation of material experts with an assessment percentage of 88.13%, while the media expert's assessment percentage was 96.10%, as well as the validation results of linguists with an assessment percentage of 85%. The validation results show that this STEAM-based interactive learning media is considered valid so that it is said to be suitable for use in trials in learning activities in the classroom.

At the implementation stage the learning media that has been developed are then disseminated or tested on educational units, namely elementary schools that are the target of the research, namely SDN 05, SDN 10, and SDN 14 Tilamuta. The purpose of implementation is to obtain user/student responses to the use of interactive learning media. Based on the calculation of the students' questionnaire assessment results obtained; (1) software aspects with an average value of 90.84%; (2) learning design with an average score of 90.98%; (3) aspects of visual communication with an average value of 95.12%. Thus it can be concluded that STEAM-based interactive learning media with material on energy sources and their utilization is "very feasible". Based on the results of the validation from the validator and the responses of class IV students who are the target of implementation, it can be concluded that STEAM-based interactive learning media with energy sources and their utilization is suitable for use/implementation in class IV elementary schools.

In the process of producing and implementing STEAM-based learning media, of course researchers encountered obstacles, but thanks to effort, hard work and patience researchers were able to overcome the obstacles encountered: The obstacles encountered in the process of developing and implementing STEAM-

based learning media products are as follows:

1. Researchers lack knowledge about multimedia
2. Researchers have not mastered image design techniques using Photoshop
3. In the process of dissemination or dissemination/implementation, they do not understand the characteristics of students in other schools so that they are a little overwhelmed in learning activities
4. The solutions to overcome the problems that arise include:
5. Looking for as much information about multimedia as possible to design interactive learning media
6. Ask for assistance from multimedia experts in designing interactive learning media to make it easier for researchers in the process of producing interactive learning media.
7. Prepare simple packages to be distributed to students who have participated in the dissemination/implementation of STEAM-based interactive learning media products with the material of energy sources and their use in class IV elementary schools.

CONCLUSION

Based on the discussion of the research results that have been described, it can be concluded that at the development stage of interactive learning media, media and material validation must be carried out before entering the product deployment/testing stage. Material validation obtained an average score for each aspect of 4.35 with a percentage of 88.13%, while the validation assessment for the media obtained a score for each aspect, namely 4.6 with a percentage of 96.10%, while the validation assessment for language obtained a score for each aspects, namely 4.25 with a percentage of 85%. Based on the results of validation by experts, the average percentage value when viewed from the media feasibility parameter is in very good criteria, it can be concluded that STEAM-based interactive learning media is "very feasible" to be tested in learning in class IV SD.

The product developed is STEAM-based interactive learning media. This learning media can improve student learning outcomes. This can be seen from the acquisition of initial test scores (pretest) before being given treatment and final test scores (posttest) after treatment. The average learning of students achieves completeness of 85.56%. So it can be said that this STEAM-based interactive learning media is "Very Practical", whereas based on a review of the effectiveness of learning media through student learning outcomes, it is obtained that the average student learning outcomes show an increase after pre-test, as seen from classical completeness reaching 100% at SDN 05 and SDN 14 Tilamuta, while 94.12% at SDN 10 Tilamuta. The average achievement of learning outcomes in trials is 98.04%. Based on the results of validation tests, practical tests, and the effectiveness of learning media through student learning outcomes, it can be concluded that STEAM-based interactive learning media is feasible, practical, and effective for use as learning media in class IV Elementary Schools. used to improve student learning outcomes in the content of natural science lessons on energy sources and their utilization.

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