Uricet Line Equation

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Student Learning Outcomes in Learning Straight Line Equations Using Web-Based Interactive Media

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***Abstract*—Learning media has an important role in helping teachers to achieve learning objectives. This study aims to develop web-based interactive learning media on the material of Straight Line Equations and analyze student learning outcomes who learn to use this interactive media. This research is an ADDIE model development research. Learning media trials were conducted using a quasi-experimental method at SMPN 13 Banjarmasin, South Kalimantan, Indonesia. Sampling was carried out using purposive and random sampling techniques. Data obtained through documentation, tests and non-tests. The data analysis technique used is descriptive statistics and inferential statistics. The results of the development are web-based interactive learning media on Straight Line Equations, which are developed using HTML, CSS, JavaScript, JSON, Mathjax, firebase, Netlify, and Geogebra technologies, and are supported by visual studio code, google chrome, and Live Server software. The validation results from two media experts, two material experts and one practitioner, show very high validation. There is a significant difference in learning outcomes between students who take part in learning mathematics with the aid of web-based interactive learning media and students who take part in learning mathematics without web-based interactive learning media, where the average student learning outcomes in learning mathematics with the aid of web-based interactive learning media are higher. Students and teachers also gave a positive response to the use of web-based interactive learning media on Straight Line Equations. Thus, web-based interactive learning media on Straight Line Equation material is suitable for use as a medium for learning mathematics in SMP/MTs.**

Keywords*—*web-based interactive media, straight line equations

I. INTRODUCTION

The Covid-19 pandemic that hit the world, caused governments to implement rules, study at home. Not only in Indonesia, distance learning policies are implemented in almost all countries [1]. However, in its implementation, there are many obstacles that must be faced by teachers and students. In addition to the problem of facilities and infrastructure, specifically for learning mathematics, according to the results of a survey conducted by [2], it was found that 82.25% of students had difficulties in understanding mathematics lessons through online learning. Likewise, the results of research [3] and [4] which show that in blended learning students still need help to achieve the expected learning outcomes. Therefore, teachers need to find strategies to help students in dealing with these difficulties. One of them is by utilizing the use of web-based interactive learning media.

Web-based interactive learning media is a computer-based learning media, which is designed to be able to respond to user activities directly, so that two-way communication occurs and can be accessed via the internet. In web-based interactive learning media, presentation of material is usually presented in written form, which is equipped with moving images, animations, videos, audios, or video games. So that web-based interactive learning media is also known as web-based interactive multimedia. The development of web-based interactive learning media aims to assist the teaching and learning process carried out by teachers in the classroom. In addition, it can also be used by students as a means of supporting independent learning. As explained by [5] that the advantages of using multimedia in the learning process are not limited to space-time so that it allows students to study alone anytime and anywhere.

The use of web-based interactive learning media in learning can help deliver information in a more interesting way and make it easier for students to obtain this information, so that it has an effect on improving student achievement [6]. As revealed by [7] and [8] interactive web-based media can help students improve their learning outcomes. Meanwhile in learning mathematics, [9] revealed that interactive learning media is an important aspect of the teaching and learning process. The use of interactive learning media is an addition to traditional learning methods. With this it is hoped that students will have a better understanding of many mathematical problems and experiment with them.

One of the mathematics learning materials for eighth graders is Straight Line Equations. This material, in addition to containing text descriptions of the material, also contains many mathematical symbols and pictures. Visualization is needed to help students understand the concept of gradient

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on a straight line, as well as the relationship or position between two lines. This study aims to develop web-based interactive learning media on the material of Straight Line Equations and analyze student learning outcomes who learn to use this interactive media. The results of this study are expected to assist teachers in providing learning media on the material of Straight Line Equations that can encourage students to actively learn.

II. RESEARCH METHODS

A. Research design

The design of this research is development research using the ADDIE model which consists of four stages: analysis, design, development, and implementation. At the end of each activity, before entering the next stage, an evaluation is carried out [10].

B. Media Eligibility

This media is declared suitable for use if it can meet three components, namely valid, practical and effective [11]. Validity includes the validity of materials and media. If both requirements are met, then this media is said to be valid. Material validation was carried out by three material experts from the Mathematics Education Study Program, Faculty of Teacher Training and Education, Lambung Mangkurat University (ULM), and a mathematics teacher at a junior high school. Media validation was carried out by three media experts from the Computer Education Study Program, Faculty of Teacher Training and Education (FKIP) ULM.

Practicality is measured based on responses from users, namely one teacher and 24 students. If the users perceive the developed media to be usable and easy for them to use in a way that is mostly in accordance with the developer's intent, then the media is said to be practical.

The developed media is said to be effective if it has obtained the desired results, in this case the achievement of learning outcomes. To measure the effectiveness of the media, a trial of the use of media was conducted on eighth grade students of SMPN 13 Banjarmasin. The trial was carried out with a quasi-experimental design. In this design, there is an experimental group that gets learning treatment with the help of web-based interactive learning media, while the control group gets learning treatment without web-based interactive learning media. The research sample was selected using purposive and random sampling techniques. The developed media is said to be effective, if the learning outcomes of students using web-based interactive media differ significantly from the learning outcomes of students who study without web-based interactive media, where student learning outcomes using web-based interactive media are higher.

C. Research instrument

The instrument used in this study consisted of a questionnaire and a test sheet. The questionnaire consisted of a material validation questionnaire, a media validation questionnaire, a teacher response questionnaire, and a student response questionnaire. The material validation instrument used is an adaptation of the instrument developed by the Indonesian National Education Standards Agency [12]. This questionnaire contains 15 aspects of assessing the validity of the material. While the media validation instrument used is an adaptation of [13], which consists of 16 assessment aspects. The assessment of the validation instrument uses a Likert scale. Practical instruments were prepared by the research team based on indicators from [11]. This instrument contains 15 statements that are assessed using a Likert scale. To measure learning outcomes after learning, a learning outcome test is carried out. The test instrument is in the form of four description questions on the material of Straight Line Equations. The logical validity test of the learning outcomes instrument was carried out by four Mathematics Education experts, FKIP ULM and one mathematics teacher. After being declared valid, the test instrument was tested on eighth grade students at SMP IT Al Asmaul Husna Banjarmasin. The test results show that all questions are valid, while the results of the reliability test using Cronbach's Alpha obtained a reliability coefficient of 0.643 which means it is included in the medium category [14].

D. Data analysis technique

The data analysis technique used is descriptive statistics and inferential statistics. In this study, the Shapiro Wilk test was used for normality test, Levene test for homogeneity was used, and t-test was used for the difference test.

III. RESEARCH RESULT

A. Result

The research has been well done. The interactive media developed has Straight Line Equation content for eighth graders. This material consists of a discussion of the equation of a straight line, the slope of a line, the equation of a line through a point and parallel to another line, the equation of a line through a point and perpendicular to another line, and the equation of a line through two known points. The content presented in the developed learning media consists of components of images, mathematical symbols, text, and tables. The presentation of the material is designed with a question and answer session between the media and the user. In addition to the material description, there are many practice questions and evaluation questions. These questions are designed to be displayed randomly, so that each student will get a different question each time they work on practice questions or evaluation questions. The developed media is designed to be accessible to users using a computer or smartphone. Based on the results of this analysis, the technology used in media development can be seen in Table I.

TABLE I. TECHNOLOGY AND SOFTWARE USED

Utilization	Technology and Software
Organize and design the appearance of text and images	HTML, CSS
Display math symbols	MathJax
Store data collection of questions, user answers and scores	JSON, Firebase
Manage the interaction between the application and the user	JavaScript, Bootstrap
Drawing graphics	Geogebra
Write code	Visual Studio Code
Hosting media to internet	Netlify

Before the media is developed, the teaching materials that will be the content of the media are prepared first. The teaching materials describe learning objectives, material descriptions and sample questions, as well as practice and

evaluation questions, including the completion of each question. After the teaching materials are arranged, then validation is carried out by material experts. Several suggestions for improvement were obtained from the validator, especially to improve the sentence structure in the description of the material and questions. After being corrected according to the suggestions, all aspects assessed showed very high validity. The results of material validation can be seen in Table II.

TABLE II. CONTENT VALIDITY

Aspect	Achievement Percentage	Validity
Content Eligibility	80.95	Very high
Serving Eligibility	81.25	Very high
Language Eligibility	83.33	Very high
Contextual	83.33	Very high
Total Achievement	82.22	Very high

The results of material expert validation show that the material is valid so that it can be used as the content of the developed application. After the media design was agreed upon by all members of the research team, then a web-based interactive media was developed on the material of Straight Line Equations. The results of the development have been validated by three media experts from the Computer Education Study Program, FKIP ULM. The results of media validation can be seen in Table III.

TABLE III. MEDIA VALIDITY

Aspect	Achievement Percentage	Validity
Ease of use and navigation	95.00	Very high
Aesthetics	87.50	Very high
Contents and Information	84.38	Very high
Overall Function	84.38	Very high
Total Achievement	88.60	Very high

In Table III, it can be seen that all aspects that are considered to have very high validity. There are several things that must be improved, especially with regard to navigation, and layout. After being corrected according to suggestions from the validator, the developed media can be used for trials in learning. This application can be accessed via a computer or mobile phone. Fig. 1 shows the initial page view of the developed media. This page was developed using HTML and CSS technology. On this page, three main menu buttons are presented, namely the KIKD menu, the material menu and the information menu. These three buttons are active, and are used to move to the desired page. The KIKD page contains an explanation of basic competencies, learning objectives to be achieved, as well as indicators of learning success.

Fig. 1. Home page view

The material page contains a description of the material equipped with examples of questions. To make it easier for students to study the material, the material page display is divided into three columns. The first column is navigation for the table of contents, while the second column is for content. The second and third columns are for material exposure, sample questions and discussion. Fig. 2 shows an example of what the first column of a content page looks like. From this page the user can go to the next page according to the selected sub material.

Fig. 2. Example of the first column display on the material page

The presentation of each sub material always begins with the learning objectives. The presentation of the material is presented by the question and answer method. Fig. 3 shows an example of the second column display in the sub material exposure. In observation activities, students are given questions to direct their observations to the material to be studied, in this case it is about determining the gradient of a line that passes through the points (0,0) and (x, y). Students can check whether the answers given are correct or not by

pressing the Check answer button. If the answer is wrong, students can try to answer again

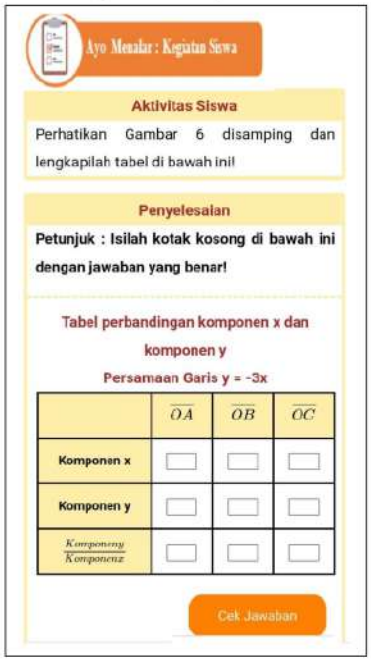

Fig. 3. An example of the display of the presentation of the sub material

The third column of the content page can contain places to draw using Geogebra, images that users must observe, or sample questions. Fig. 4 shows an example of the appearance of the second and third columns in the final discussion of determining the gradient of a line that passes through the points (0,0) and (x, y). Users are guided to conclude their observations, so they can rediscover the formula for determining the gradient.

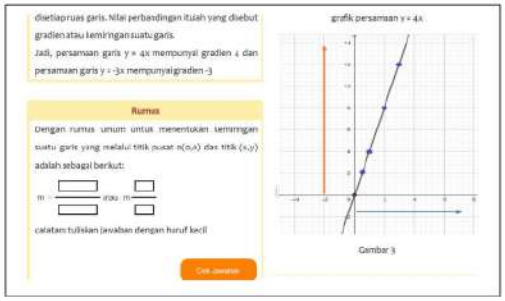

Fig. 4. An example of second and third column display

At the end of each sub-material, practice questions will be presented. The practice questions database contains 50 questions, which are presented randomly every 10 questions. So each practice pack contains 10 questions that the user has to answer. After all the questions are answered, the score obtained will be displayed. To work on another package of questions, users can press the retry button. Fig. 5 shows an example of an exercise page display. From this page the user can return to the previous material or continue to the next material.

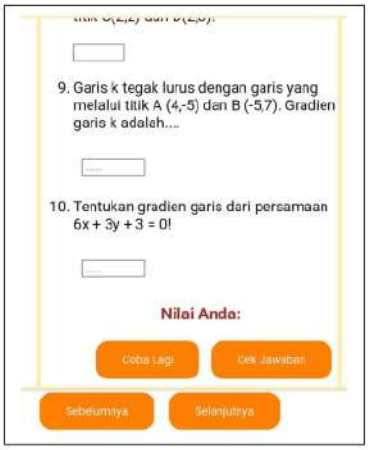

Fig. 5. An example of exercise page view

After completing all the material, the user can work on evaluation questions. Fig. 6 shows an example of an evaluation page display. Questions are displayed randomly, so students do not get the same questions at the same number. If the question has been answered, the question number will change color. To move from one question to another, users can choose through question number navigation, or by pressing the Next button or the Back button. In the last question there is a Done button, if this button is pressed, the application will display the results page. The results page will display the user's personal data, correct answers, incorrect answers, final grades and descriptions of passing or not passing. If they do not pass, the user can rework the evaluation questions by clicking the repeat button. Data such as name, class, and test scores are sent to the Firebase database in real time when the user presses the finish button.

Fig. 6. Evaluation page view

Web-based interactive media on Straight Line Equation material, was tested on eighth grade students of SMPN 13 Banjarmasin. The initial ability of students is seen based on the odd mid-semester test scores in the 2020/2021 school

year. The results of the normality test of students' initial abilities in Table IV show that the significance value of the control class and the experimental class is more than a significance level of 0.05. This means that the initial abilities of the control class and experimental class students are normally distributed.

TABLE IV. NORMALITY TEST RESULTS, OF INITIAL ABILITY

Class	Statistic	df	sig.
Experiment	0.91600	24	0.17394
Control	0.93392	24	0.11402

Table V, shows the results of the initial ability homogeneity test, where the Levene Statistics value is less than Ftable. This shows that the variance of the class pairs is homogeneous. Based on the results of the different test using the t-test, it is known that the control class and the experimental class have a Sig value. (2-tailed) of 0.782 is greater than 0.05. This means that there is no significant difference in the initial abilities of students in the experimental class with those in the control class. With the same initial ability, learning is carried out in the control class and experimental class for five meetings consisting of four teaching and learning activities and one final evaluation.

TABLE V. HOMOGENEITY TEST RESULTS

df1	df2	Levene Stat.	Ftable
1	46	0.60659426	4.051749

Given the COVID-19 pandemic, learning is carried out online, where teachers and researchers are at school while students are at home. Learning is held in five meetings, starting from 7 to 21 November 2020. Communication between teachers and students during learning is done through WhatsApp groups. At the fifth meeting, a learning evaluation was carried out for the experimental class and the control class. The evaluation is carried out online using the help of google forms. The teacher sends the google form link through the WhatsApp group. The teacher reminds students to do the evaluation independently without the help of others. The learning outcomes of students in both classes can be seen in Table VI.

TABLE VI. TABLE TYPE STYLES

Score	Experiment	Control	Qualification
85.01–100.00	33.33	12.50	Very good
70.01–85.00	41.67	29.17	Good
55.01–70.00	25.00	33.33	Sufficient
40.01–55.00	0.00	16.67	Less
00.00-40.00	0.00	8.33	Very less
Sum	100.00	100.00	

From Table VI, it can be seen that in the control class there are still students who get less qualifications, while in the experimental class the learning outcomes achieved by students are the lowest with sufficient qualifications. Based on the results of the normality test, as shown in the Table VII, it is known that the value of learning outcomes in the experimental class and control class both have a significance value of more than 0.05. This means that both learning outcomes are normally distributed.

TABLE VII. NORMALITY TEST RESULTS, OF INITIAL ABILITY

Class	Statistic	df	sig.
Experiment	0.91600	24	0.11397
Control	0.94933	24	0.16904

Furthermore, based on the results of the homogeneity test, it is known that the value of sig. the pair of control class and experimental class is 0.580 more than the 0.05 level of significance. This shows that the variance of the class pairs is homogeneous. Based on the results of the difference test in Table VIII, it is known that the control class and the experimental class have a Sig value. (2-tailed) of 0.003 less than 0.05. Thus, there is a significant difference in learning outcomes between junior high school students who take part in learning mathematics with the aid of web-based interactive learning media and junior high school students who take part in learning mathematics without web-based interactive learning media. From Table VIII, it can be seen that the average learning outcomes in the experimental class are higher than those in the control class. Thus, this learning media has met the requirements of media effectiveness.

TABLE VIII. T-TEST: TWO SAMPLE ASSUMING UNEQUAL VARIANCES

	Experiment	Control
Mean	76.78542	63.69125
Variance	174.1213	248.0794
Observations	24	24
Hypothesized Mean Difference	0	
Df	45	
t Stat	3.121936	
P(T<=t) one-tail	0.001568	
t Critical one-tail	1.679427	
P(T<=t) two-tail	0.003136	
t Critical two-tail	2.014103	

Both teachers and students stated that the web-based interactive media on the Straight Line Equation material was interesting and easy to use. In general, the teacher and students gave a positive response to learning using web-based interactive media, with the mode of agreeing. Student responses to learning using interactive media can be seen in the Table IX. Students gave a positive response to learning using interactive multimedia, with the response mode is agree.

TABLE IX. STUDENT RESPONSE

Statements	Response (%)			
	SDA	DA	A	SA
The display of this learning media is very interesting			61.5	38.5
This learning media makes me excited in learning straight line equation material		3.8	73.1	23.1
This learning media makes it easier for me to learn straight line equation material	3.8	15.4	42.3	38.5
This learning media makes me not bored in learning about straight line equations		7.7	61.5	38.5
This learning media makes me		3.9	61.5	30.8

Statements	Response (%)			
motivated in learning				
The material presented by this learning media is easy to understand	3.8	7.7	57.7	30.8
This learning media encourages to write down the knowledge that has been understood		7.7	69.2	23.1
The exercises given made me understand more about straight line equations		3.8	60.0	34.6
The evaluation given can test how far my understanding of straight line equation material is	3.8	3.8	69.2	23.1
The sentences and paragraphs used in this learning media are clear and easy to understand		7.7	61.5	30.8
The instructions provided are easy to understand		7.7	65.4	26.9
The letters used are easy to read	7.7		46.1	46.1
This learning media is easy to use	7.7	11.5	57.7	23.1
The navigation provided makes it easier for me to learn the material		11.5	65.4	23.1
The display of this learning media is very interesting			61.5	38.5

SD=Strongly Agree; A=Agree; DA= disagree; SDA=strongly disagree

B. *Discussion*

The implementation of learning in the experimental class runs more smoothly. Students independently build their knowledge with the help of web-based interactive learning media. Learning media involves several media components to make learning more interesting and easy to understand by students [6], [15], [16] and [17]. Interactive media make students more active in learning by involving many senses. Students who use interactive media will read, see, hear, and actively manipulate the material. Interactive media acts as a tutor who asks questions that are guiding students to understand concepts. Based on the results of research [18] and [19], the application of the question and answer method can improve student learning outcomes. When students answer a question, interactive media will provide immediate feedback. So that students can change answers every time the application assesses their answer is wrong, until the correct answer is obtained. Thus students become more active in learning, and enthusiastic in completing all the tasks given. While in the control class, even though the teacher has provided opportunities for discussion or provoked students to ask questions. But only a few students were actively involved.

The average learning outcomes in the experimental class are in good qualifications, while those in the control class are in sufficient qualifications. The results of this study are in line with the results of research [20] which states that the learning outcomes of students who receive learning with interactive multimedia are better than the learning outcomes of students who receive learning without interactive multimedia. This shows that the use of web-based interactive media on the Straight Line Equation material can improve student learning outcomes. This is in line with the results of research [21] which found that the use of web-based interactive media can improve the understanding of mathematical concepts of SMK students in Pakanbaru. In line with that, the results of research [6], [22]–[24] also show that the use of web-based interactive media can improve student learning outcomes. Meanwhile [25] found that the use of interactive learning media was effective in improving the learning outcomes of tenth graders at SMKN 8 Malang on Basic Computer Networking material.

The use of web-based interactive media on the Straight Line Equation material received a positive response from both students and teachers. Students stated that the use of this media made them more enthusiastic and motivated to learn. This media makes learning more fun, so the material becomes easier to understand. This is in line with the results of research [6], [26], [27] and research results [28] which found that the use of interactive multimedia made students less bored and more motivated to learn.

IV. SUMMARY

This research has succeeded in developing web-based learning media on the material of Straight Line Equations. The technology used is HTML, CSS, JavaScript, JSON, MathJax, firebase, netlify, and Geogebra, and is supported by visual studio code software, google chrome, and Live Server. The validation results from three media experts, three material experts and one practitioner, show that the developed media is valid in terms of material and media.

The results of the trial of the use of media at SMPN 13 Banjarmasin showed that there were significant differences in learning outcomes between students who took part in learning mathematics using web-based interactive learning media and students who took part in learning mathematics without web-based interactive learning media. The average learning outcomes of students who study using web-based interactive learning media are higher than the average learning outcomes of students who take mathematics lessons without web-based interactive learning media. Students and teachers also gave a positive response to the use of web-based interactive learning media on Straight Line Equations.

Based on the results of the research, web-based interactive learning media on the Straight Line Equation material has met the validity, effectiveness and practicality requirements of a media. Thus, this media is suitable to be used as a medium for learning mathematics in SMP/MTs. So that teachers can use this media as an alternative learning media on the material of Straight Line Equations in the eighth grade, to help create a student-centered learning atmosphere.

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