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Development of Visual Media Uses Geogebra Application on Linear Program Material

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Abstract. *The research is aimed at developing mathematical visual media with the help of the GeoGebra Application on linear program material that tests its validity and practicality. This research uses the development research method with ADDIE design, but developed in this research is the GeoGebra Application to Linear Program Materials. Participants in to see this validation by 2 experts and 32 high school students in Cianjur district. Research procedures include analysis, design, development, implementation and evaluation. The instruments used are validation sheets and practicality. Based on the results of the research showed that the application of GeoGebra on the linear program material of the validator results is good and validated and practical at the time students use it.*

Keywords: *Development Research, Geogebra Application, Visual Media, Linear Program.*

1. INTRODUCTION

Linear program is a part of mathematics that is used to find the maximum and minimum values of a linear inequality. For example, in the business world, an entrepreneur generally wants to get as much profit as possible from the business he is engaged in. For that, the entrepreneur makes a plan to optimize the available resources, raw materials and others.

The problem in linear program material is the solution procedure which usually requires a relatively long processing time if done manually [1]. Then another problem, students also always feel bored and lazy to start solving math problems regarding linear program material because it requires analysis or a long process. Students are not interested in trying to do the work and tend to only want to see the explanation from the teacher directly [2]. Problems that usually arise in linear programs are story problems, story problems are problems that are considered by students to have a higher level of difficulty compared to mathematical problems that display mathematical models directly. In story problems, students are expected to find the problems that must be solved in the problem. Without good reading comprehension skills, it will certainly be very difficult for students to find the answer to the problem. Story problems are also the most representative problems to show the usefulness of mathematics in everyday life because usually the story problems are related to problems that exist in real life. (Trizulfianto, Anggreini, and Waluyo 2017).

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linear program material because it requires analysis or a long process. Students are not interested in trying to do the work and tend to only want to see the explanation from the teacher directly (Sunaryo 2019). Problems that usually arise in linear programs are story problems, story problems are problems that are considered by students to have a higher level of difficulty compared to mathematical problems that display mathematical models directly. In story problems, students are expected to find the problems that must be solved in the problem. Without good reading comprehension skills, it will certainly be very difficult for students to find the answer to the problem. Story problems are also the most representative problems to show the usefulness of mathematics in everyday life because usually the story problems are related to problems that exist in real life [3].

From these various problems using visual media with GeoGebra learning is expected to be able to help students in carrying out mathematics learning activities related to linear program material, this is based on the results of research using visual media as a mathematics learning media has an influence on student learning outcomes [4]. Visual media can help students to build students so that they can visualize the problem of linear equations so that they can see the variables that affect each other, then students can make changes to variables and see the results of the changes they make directly, help students demonstrate or visualize mathematical concepts and as a tool to construct mathematical concepts. Then for teachers, with this Geogebra learning media, learning can be made interactively so that students can interact. This will make students more interested in learning Linear Program material.

The results of research on the use of GeoGebra applications in Linear Program material are found in the use of GeoGebra applications to facilitate learning of Linear Program material [5, 6]. The results of these studies have the same goal. However, the novelty of this research is optimized on visual media by increasing students' cognitive thinking skills and facilitating the learning process, especially in Linear Program material. Linear Program material is material that students are not interested in. This can be seen from the enthusiasm of students in learning linear programs in class is very lacking. In addition, linear program material is considered as abstract material that is very difficult to implement in everyday life [7]. In addition, linear program material is also one of the materials that are difficult for students to understand.

From the description above, the purpose of this development is to design and develop Geogebra applications on Linear Program material as a visual media supporting learning in the classroom that can help students solve problems related to linear programs,

especially in determining maximum and minimum values. And aims to create interactive visual media so that it can make students more interested in learning with Linear Program material.

2. MATERIALS AND METHODS

The research method used in this research is the R&D (Research and Development) method, which is a research method used to research so as to produce new products, and then test the effectiveness of these products [8]. In this study using the ADDIE development model. The ADDIE development model has five stages, namely Analysis, Design, Development, Implementation, and Evaluation [9].The purpose of this research is to develop visual media with the help of the GeoGebra Application on linear program material. The development procedure is described in Figure 1. flowchart.

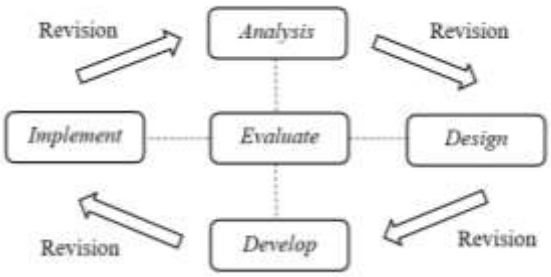


Figure 1. Research Flowchart

In this study, data were obtained and analyzed using validation questionnaire research instruments, and student response questionnaires. The validation questionnaire is used to determine the feasibility of visual media with the help of the GeoGebra Application which is validated by experts. Student response questionnaires are used to determine the effectiveness of visual media with the help of the GeoGebra Application. To test the feasibility of answers given a predetermined score according to Sugiyono (2019) in Table 1.

Table 1. Criteria for Assessment by Material Experts and Media Experts

Category	Score for Question or Statement
Very suitable	4
Suitable	3
Less Suitable	2
Not Suitable	1

In analyzing the data, researchers calculated the points given by material experts and media experts into a feasibility score obtained from the percentage of the score obtained with the maximum score. If the feasibility percentage value has been obtained, then the next is to indicate the quality predicate of the product made based on a measurement scale using a rating scale assessment. According to the score obtained, it is interpreted into the rating scale score according to Sugiyono (2013) seen in Table 2 [8].

Table 2. Rating Scale Interpretation

Description	Percentage (%)
Very Decent	82 – 100
Feasible	63 – 81
Not Feasible	44 – 62
Very Unworthy	25 – 43

The student response questionnaire used to test effectiveness is closed. This aims to avoid more extensive information. According to Sugiyono (2019), the data from student responses are then calculated based on the Guttman Scale as in Table 3.

Table 3. Guttman Scale for Student Response

Answer	Value
Yes	1
No	0

If the percentage value of effectiveness has been obtained, then the next step is to interpret using the criteria according to Sugiyono (2019) in Table 4.

Table 4. Interpretation of Media Effectiveness Criteria

Description	Percentage (%)
Highly Effective	80 – 100
Effective	60 – 80
Less Effective	40 – 60
Not Effective	20 – 40
Very Ineffective	0 – 20

3. RESULTS AND DISCUSSION

The results of the development of visual media with GeoGebra Application on Linear Program material class XI SMA which aims to determine the results of its validity and practicality. The results of the development of the GeoGebra Application from each stage are as follows:

Analyze Stage

The analysis stage is the initial step carried out by literature study and field study. This activity aims to collect and analyze information obtained about the problems and needs of students in the current learning process, namely in terms of learning mathematics, especially in Linear Program material, student characteristics during the learning process, and teaching materials used. Field studies were conducted by interviewing one of the teachers at the school.

Design Stage

At this stage, the preparation of material is carried out according to the curriculum objectives and the design stages of the GeoGebra Application in Figure 2.

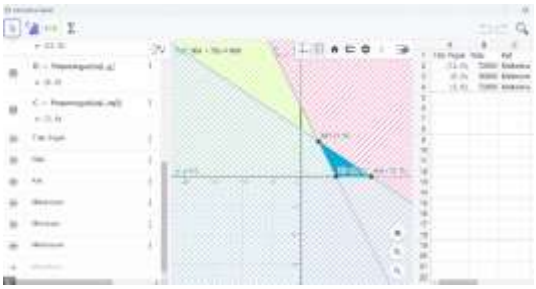


Figure 2. Geogebra Application Design

Development Stage

The media that has been designed and stored in document format is then developed by inserting images related to the explanation of the material as well as suggestions and media improvements in Figure 3.

Before Revision

Suggestions and Improvements
In the media section, a little color should be added to the background so that students are not confused and feel interested in reading the media.
After Revision


Figure 3. Media Suggestions and Improvements

After the media was tested to the validators, there were additional suggestions to add a little color to the background of the text. The validator thought that the previous background color seemed flat and could not make students interested. After following the advice of the validator, we revised some of the background of the text in the media so that it looks different. As for the Geogebra application, suggestions and improvements are in Figure 4.

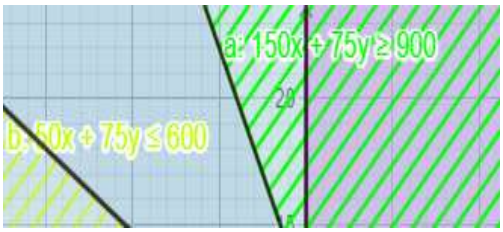
Before Revision

Suggestions and Improvements
In the name section of the function, it is better to change the font color to make it clearer. The display is good and easy to use. The GeoGebra application has been tested to two 8th grade classes on linear equation material using each student's cellphone. In the process of using the application, almost 95% (class voting results) of students who were tested responded that the GeoGebra application made it very easy for students to determine the equation point and create a graph of the linear equation. The obstacle faced is that students' cellphones do not support the GeoGebra application. So, students have difficulty in applying the GeoGebra.
After Revision


Figure 4. Suggestions and Improvements to the GeoGebra Application

After the validation test was conducted to the validator, there was one problem, namely the color of the inequality line used was not clearly visible because of the color selection. Then after the revision, there is a difference in the line between before and after the revision. Furthermore, the validator also tried this GeoGebra to students and it turned out that the results they did not experience difficulties related to the GeoGebra used, the problems that arose came from the media in the form of cellphones they used because they were less supportive. The validation sheet that has been filled in by the validator, then analyzed to determine the level of validity criteria for the GeoGebra Application

developed. Data on the validation results of the GeoGebra Application from the assessment of each validator are presented in Table 5.

Table 5. Media Validation Results

Validator	Empirical Score	Maximum Score	Average Percentage	Validity Criteria
Validator 1	64	75	85,3%	Very Valid
Validator 2	71	75	94,6%	Very Valid
Average Combined Percentage			89,95%	Very Valid

Based on Table 5, it is known that the results of the validation of the GeoGebra Application on the presentation feasibility aspect obtained an average combined percentage of the two validators of 89.95% with the criteria "Very valid". This proves that the GeoGebra Application developed has been prepared in accordance with the format and components that must exist in a GeoGebra Application-assisted teaching material packaged in electronic form. While the GeoGebra Application validation results for each validator using Likert scale measurements are presented in Table 6 below.

Table 6. GeoGebra Application Validation Results

Validator	Empirical Score	Maximum Score	Average Percentage	Validity Criteria
Validator 1	64	75	85,3%	Very Feasible
Validator 2	71	75	94,6%	Very Feasible
Average Combined Percentage			89,95%	Very Feasible

In Table 6, the results of media validation assisted by the GeoGebra Application on the feasibility aspects of presentation, instructional design criteria, technical quality, media display and communication indicators using Likert scale measurements from the two validators obtained an average combined percentage of 89.95% with the criteria "Very valid".

Implementation Stage

After the developed GeoGebra visual media has been tested for validity and revisions have been made according to the validator's suggestions, then further at the implementation stage, the media and GeoGebra are carried out limited trials in small groups consisting of 32 high school students. The trial activities began by teaching students to operate the Linear Program and explaining the activities and components contained in the Linear Program. Furthermore, inviting students to do some learning activities presented in the Linear Program, including working on problems / problems on the media while trying to operate GeoGebra, as shown in Figure 5.

Figure 5. Students Operate and Perform Activities on media with GeoGebra

At the end, students were given a student response questionnaire. The assessment on the student response questionnaire was then analyzed to determine the data on the results of the practicality of the media with the use of Geogebra in the form of a combined percentage average of 32 students and the criteria for practicality, which are presented in Table 7.

Table 7. Data on Geogebra Media Practicality Results

No.	Respondent	Total Score
1.	Strongly Agree	187
2.	Agree	902
3.	Less agree	333
4.	Disagree	68
5.	Strongly Disagree	33
Total Combined Score		**1523**
Total Maximum Score		**2250**
Average (%)		**67,69%**
Practicality Criteria		**Practical**

So it is known that the average percentage of students' assessment of media with

GeoGebra on Linear Program material at the high school level is 67.69% with the criteria "Practical". Based on the responses given by students in the student response questionnaire when using and GeoGebra, it is known that they do not understand the explanation given. Students argue that the explanation given is too fast because of the limited time, GeoGebra is designed simply so that it makes it easier for students to understand the concept of Linear Program. The learning activities presented by GeoGebra can also help students see how to determine the Maximum and Minimum values of a Linear Program.

Evaluation Stage

The evaluation stage in this study was only carried out until the formative evaluation, namely the evaluation to improve the visual media with GeoGebra developed based on the assessment results from the validity test and practicality test. Visual media with GeoGebra was revised based on suggestions obtained from validators on the validation sheet. Things that need to be improved on the LKS include the criteria for communication indicators, there are suggestions that it would be better if in the delivery of material so that students can understand what is being conveyed. And for aspects of technical quality criteria, improvements are made such as adding some background and changing colors on the media so that it can be better understood. While in GeoGebra the thing that needs to be improved is on the instructional design criteria, there are suggestions to pay attention to color contrast in writing each inequality function so that it is easily visible.

Based on the results of GeoGebra development, the products produced in GeoGebra on Linear Program material for class XI SMA are included in the "Very valid" and "Practical" categories. The advantages of GeoGebra in this Linear Program material are ease of use, as well as a concise and straightforward explanation of the steps that make students and teachers able to apply GeoGebra Linear Program to find Maximum and Minimum values practically. While the weakness of GeoGebra in this Linear Program material is that its minimalist appearance makes students less interested in reading and listening to the contents of GeoGebra. Then, the lack of animation and images adds to the "monotonous" impression so that it can make students feel bored.

4. CONCLUSION

The conclusion from the results of the development is that based on the validation test and the effectiveness test, the use of the GeoGebra Application on SMA Linear

Program material is valid and practical. Linear Program material is material that is considered unimportant due to the lack of discussion and repetition that students receive in class. This material is also less attractive to students, because it is considered abstract material so that it raises the stigma that Linear Program is a complicated sub-material. Therefore, it is hoped that the existence of learning media using the GeoGebra Application can facilitate students in learning the Linear Program. In addition, it is also hoped that this Linear Program learning media application can be developed more optimally so that it can facilitate GeoGebra-based Linear Program problem solving.

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