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Development of ICT-Based Mathematical Media on Linear Program Materials to Improve Motivation Learning Students

Puji Karuniakhalida*, Maimunah, Atma Murni

Master of Mathematics Study Program, Universitas Riau, Pekanbaru, 28293, Indonesia

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A B S T R A C T

This research was inspirated by the lack of ICT-based learning media in linear program material. Linear program material has the potential to be developed visually using computer devices to facilitate students in understanding the linear programs. The aim of the study was to develop ICT-based mathematics learning media that met the validity, practicality and effectiveness. The instruments used in this research were material validation sheets, media validation sheets, response questionnaires and student motivation questionnaires. Questionnaire sheets were analyzed quantitatively and qualitatively. Based on the results of data analysis and discussion, it can be concluded that the ICT-based media of mathematics learning is valid with an average value of 3.36 by the material validator and 3.42 by the media validator. This learning media also fulfills practical requirements with an average student response of 3.45 in small group trials and 3.18 in large group trials. Learning media also influence students learning motivation.

1. Introduction

Mathematics is a subject of study that is studied at every level of education. However, from various fields of study, mathematics is considered the most difficult for most students. Sukmadinata (2011) says the difficulty of learning mathematics is often caused by obstacles experienced by students in understanding theory and concepts. One way to overcome this is to use teaching aids and learning media in delivering teaching material.

* Corresponding author. Tel./Fax.: +6285364169070
E-mail: puji.karunia@yahoo.com

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Gagne (in Sardiman, 2011) states that media are various types of components in the environment of students who can stimulate them to learn. Meanwhile, Briggs argues that media are all physical tools that can present messages and stimulate students to learn, while books, films, tapes, and frame films are examples.

In the field of education, the learning process is identified with the process of delivering information or communication. In this case, Priyanto (2009) said that learning media is an integral part of educational institutions. The use of learning media is a creative and systematic effort to create experiences that can teach students so that eventually educational institutions will be able to produce quality graduates. Regarding the media, Arda et al. (2015) also said that media can be defined as something that can be used to convey messages and can stimulate students' thoughts and feelings so that motivation arises to learn (Halidi et al. 2015).

In this era of technology and information, the use of technological sophistication in the development of learning media is not new anymore. One of the learning media that has recently been used is multimedia technology that is available through computer devices. The advantages of computers in storing and processing data and making animations are able to make a different appearance in mathematics learning so that they can attract students' interest in learning mathematics.

The computer-based learning is the learning that uses computers as aids or media (Made, 2011). Teaching materials presented through computer media have an impact on the learning process which becomes more interesting and challenging for students. Malik et al. (2012) argue that computer media also allows students to more easily understand a concept so that the use of computers in the learning process is better than using books, films, or other traditional methods. Regarding computer-based learning, computers can be also the center of information technology having the ability to store large amounts of data. Today information technology combines information stored in the form of documents with information that can be seen on a monitor screen, consisting of words, numbers, diagrams and images.

Research and development of interactive multimedia learning is done in line with technological developments. One of them is the research conducted by Dwi et al. (2013) which aims to improve understanding of concepts and problem solving and similar research conducted by Arda et al. (2015) about developing computer besis media.

In connection with the opinion of Arda et al (2015) that the media can stimulate students' thoughts and feelings so that motivation arises to learn then computer-based learning media will be able to stimulate students to be able to learn independently and can build their own experiences. Related to learning motivation, Ulya (2016) said that learning activities are still conventional (traditional), namely learning in the form of explanation and students listening without understanding, that was also mentioned earlier by Sujana (2006)

Based on observations with several schools of teachers and students, teachers are seen doing conventional learning which causes students not to be motivated as a whole in the learning process. Ulya et al. (2016) also said that low student motivation can have an impact on student learning processes and outcomes that do not improve well. Motivation has an important role in the success of student learning. Students who are highly motivated, have a very high probability of success than students who do not have the slightest motivation. There are several indicators used in measuring student motivation, according to Gottfried (in Nana, 2006) which consists of indicators 1) pleasure to learn, 2) orientation to mastery of material, 3) curiosity, 4) tenacity in doing assignments, 5) high involvement in the task, and 6) orientation towards challenging tasks. Meanwhile, the learning outcome test is arranged based on the grid.

Based on the description above, the researcher is interested in developing an ICT-based mathematics learning media in the subject matter of the Linear Program for class X students. Thus this study aims to develop ICT-based mathematics learning media that meet validity and practicality and effectively increase participants' learning motivation educate on the subject matter of a linear program.

2. Methodology

The form of this research was Research and Development according to Borg & Gall which was modified by Sugiyono (2008). The subjects of this study were 24 grade students of Al Ittihad Pekanbaru IT High School as many as 24 people in a large scale trial and 10 people in a small scale trial and 18 students in the control class. Data collection techniques in this study were literature studies and interviews. While the data analysis techniques in this study were as follows:

1. Validity

Evaluation of product validity in the form of ICT-based learning media was carried out by a validator consisting of material validators and media validators. Assessment by the validator used a scale of 1 to 4 which is presented in table 1.

Table 1: Validator Rating Scale

Scoring scale	Criteria
4	Very good
3	Well
2	Less
1	Very less

Then the results of the validation questionnaire were analyzed with several steps, as follows.

a) Calculate the average score of each aspect with the formula:

$$\bar{x} = \frac{\sum x}{lot\ of\ validators}$$

Information :

$\bar{x}$ = average score

$\sum x$ = the number of scores obtained by each aspect

b) Describing the average score of each aspect obtained becomes qualitative data according to the following assessment criteria in table 2.

Table 2: Qualitative Score Conversion Formulas

Score Range	Criteria
$\bar{x} > Mi + 1{,}8\ Sbi$	Very valid
$Mi + 0{,}6\ Sbi < \bar{x} \leq Mi + 1{,}8\ Sbi$	Valid
$Mi - 0{,}6\ Sbi < \bar{x} \leq Mi + 0{,}6\ Sbi$	Less alid
$\bar{x} \leq Mi - 0{,}6\ Sbi$	Very less valid

Information :
Mi = Ideal average
Mi $= 0.5 \times$(ideal maximum score + ideal minimum score)
Sbi = standard deviation
Sbi $= 1/6 \times$(ideal maximum score - ideal minimum score)

Ideal maximum score = $\sum$ item indicator criteria for the highest score. The ideal minimum score = $\sum$ the lowest indicator score criteria × score. The ideal maximum score on the questionnaire validation by the validator is 4 (four), while the ideal minimum score is 1 (one). In this study, learning media is declared valid if it meets the minimum criteria of "Good".

2. Practicality

Practical assessment was used by teachers and students on computer-based learning media interactive tutorial models on the subject matter of the developed Linear Program. For teachers, the assessment sheet consists of two aspects, namely material aspects and media aspects. The assessment sheet used is in the form of a closed and open questionnaire. For closed questionnaires using a Likert scale with the answer choice criteria: very good, good, good enough, not good, very poor with values of 4, 3, 2, 1. An open questionnaire is used to find out suggestions from the teacher to be used as basic revision. For students, the assessment sheet was made in the form of a closed response questionnaire for the media that has been used. The answer choice criteria were: strongly agree, agree, disagree, and strongly disagree with consecutive values 4, 3, 2, 1.

3. Effectivity

Motivational questionnaire analysis was conducted to determine whether there were differences in student motivation before and after media use. The data processing phase that was carried out is:

Change in the motivation score from ordinal data to interval with uses the formula:

$$T_i = 50 + 10\frac{(X_i - \bar{X})}{SD}$$

Normality test

The normality test aimed to determine whether motivational data before and after using the media is normally distributed or not. The hypothesis in the

normality test is:
H_0 = data is normally distributed
H_1= data is not normally distributed
In this case, H0 will be accepted if the significance value is more than 0.05.

Homogeneity Test
The homogeneity test aimed to show whether the sample groups was from the same (homogeneous) population or not. The hypothesis used was:
H_0 = data has a homogeneous variance
H_1= data does not have a homogeneous variance
The homogeneity test was carried out using the Lavene test with the help of SPSS software. The significance level used was α = 0.05 and H0 was rejected if the significance value was <0.05.

Paired t test (Paired Sample t-Test / Dependent Sample t-Test)
This t test aimed to compare whether the average learning motivation questionnaire of students before and after using the media has a significant difference. Before the data is analyzed, the data is first tested for normality and followed by a homogeneity test. If the data is proven normal, then the average similarity test uses the t-Test was conducted. The t-test formula used is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2} - 2r\left(\frac{s_1}{\sqrt{n_1}}\right)\left(\frac{s_2}{\sqrt{n_2}}\right)}}$$

Information:
$\bar{x}_1$ = Sample average 1
$\bar{x}_2$ = Sample average 2
s_1 = Standard deviation of sample 1
s_2 = Standard deviation of sample 2
${s_1}^2$ = Sample variance 1
${s_2}^2$ = Sample variance 2
r = correlation of 2 samples

The significance level used is α = 0.05. The decision criterion H_0 is rejected if the value of t_count $t_{hitung} < -t_{tabel}$ or $t_{hitung} < t_{tabel}$. The hypothesis in the t test for one sample is:
H_0 = learning motivation after media use is no better than before media use
H_1 = learning motivation after media use is better than before media use.

3. Results and Discussion

In the design phase of the product, the design is done using a paper based design, where the Linear Program material is designed on paper, both in the form of text and images. This stage aims to get an idea of what will be displayed on the computer. The product design that has been made in paper based is then poured in a computer based form. The program used for the design of computer based products is Microsoft Power Point as shown in the Figure 1 and Figure 2.

Figure 1. The opening of the media

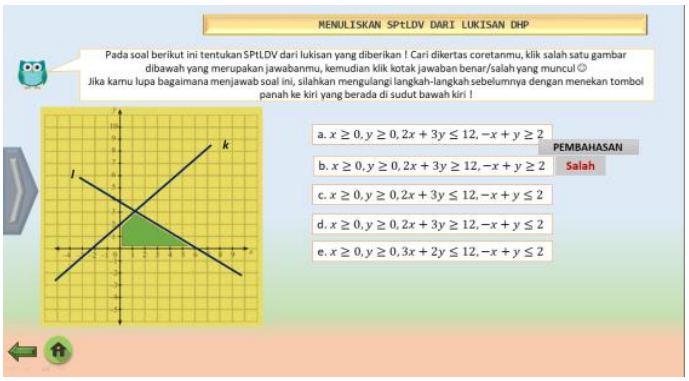

Figure 2. Display of the second meeting on the media

After the learning media was completed, validation was carried out by the material validator and the program validator and continued testing the implementation of media use.

Assessment of Material Validators

Validation by material validators was used to assess the material that had been compiled in ICT-based learning media on the subject of the Linear Program for class X students of SMA. There are two aspects assessed, namely aspects of learning and aspects of the curriculum. Table 3 shows the result of validation of Material Validators.

Table 3. Results of Validation by Material Validators

No	Validator	Average		Overall average
		Aspects of Learning	Curriculum Aspects	
1	V1	3,6	3,6	3,6
2	V2	3,6	3,4	3,5
3	V3	3,2	3,14	3,17
Overall Average				**3,42**

Based on the overall average obtained $\bar{x} = 3.42$, the results of the evaluation from the material validator are stated to be very valid.

Media Validator Assessment

Validation conducted by media validators was used to assess ICT-based learning media products on the subject of the Linear Program for class X students of SMA. Media validator is carried out by a mathematics lecturer. There are two aspects assessed, namely the aspect of appearance and aspects of the program (Table 4).

Table 4. Results of Validation by Media Validators

No	Validator	Average		Overall average
		Cosmetics Aspects	Program Aspects	
1	V1	3,52	3,69	3,6
2	V2	3,54	3,55	3,54
3	V3	2,83	3,05	2,94
Overall Average				**3,36**

Based on the overall average obtained which is $\bar{x}$ = 3.36, the results of the media validator's assessment can be said good and declared valid.

Small Group Trial Results

The level of implementation of learning media was obtained from the results of the questionnaire responses of 10 students (Table 5).

Table 5. Questionnaire result of Small Scale Students

No	Aspect	Average
1	Artistics	3,39
2	Material Presentation	3,44
3	Program	3,52
	$\bar{X}$	**3,45**

Based on the response questionnaire of small group students, it can be concluded that ICT-based mathematics learning media on the subject of the Linear Program for class X SMA students have very good levels of implementation with an average of 3.45.

Large Group Trial Results

The level of implementation of learning media was obtained from the results of the questionnaire responses of 23 students (Table 6).

Table 6. Questionnaire result of Large Scale Students

No	Aspect	Average
1	Kosmetik	3,23
2	Penyajian Materi	3,21
3	Program	3,09
	$\bar{X}$	**3,18**

Based on the responses of the large group students' responses, it can be concluded that ICT-based mathematics learning media on the subject of the Linear Program for class X students of SMA have a very good level of implementation with an average of 3.18. Respondents stated that students can operate this learning media well. The material description of the Linear Program on learning media is easy to learn, the display of button instructions on media and material is very clear and interesting and uses easy to understand language. Students also feel motivation to learn and use this learning media. Respondents also stated that giving animations to visualize material in the Linear Program greatly helped them understand the material so that it was easier to understand. The existence of ICT-based mathematics learning media makes learning activities fun.

Analysis of the Effectiveness of the Motivation Questionnaire

Normality Test Results

The data tested is data that has been converted from ordinal data to interval data. The results of the normality test of student motivation data before and after the use of instructional media using the Kolmogorov Smirnov test with SPSS 24.0 are presented in Table 7.

Table 7. Test for Normality of Student Motivation Data

Motivation	*N*	Average	KS-Z	*Sig.*	H_0	Conclusion
Before	23	62,641	0,089	0,200	Accepted	Motivation Data Students are Normal Distribution
After	23	53,866	0,101	0,200	Accepted	

Homogeneity Test Results

Based on Table 7, it was found that the data was normally distributed and continued with the Homogeneity Test of data on students' mathematics learning motivation before and after using learning media. The hypotheses tested are:

H_0= data has a homogeneous variance

H_1= data does not have a homogeneous variance

Test criteria: if the probability value (sig.) is greater than = 0.05, then the null hypothesis is rejected. The summary of the test results for the homogeneity of the variance in student motivation is presented in Table 8.

Table 8. Homogeneity Test for Learning Motivation Data

Statistik Levene	Dk1	Dk2	*Sig.*	H_0	Conclusion
1,719	1	44	0,197	Diterima	Motivation data before and after is homogeneous

Based on Table 8, the significance level is 0.197, then p> $\propto$ = 0.05. This states that the variance of learning motivation data is homogeneous. Then a difference test was performed using the Paired Sample t-Test.

Paired t test results

The results of t-test data on motivation of students before and after the use of learning media using Paired Sample t-Test with SPSS 24.0 are presented in Table 9.

Table 9. Test of Differences in Learners' Motivation Data

Motivation	**N**	**Average**	**Standard Deviation**	**t**	**dk**	***Sig.***	**H_o**
Before-After	23	8,775	8,979	4,686	22	0,000	Rejected

Based on Table 9, the data shows that the significance level is 0.000, then $p < \propto = 0.05$, it can be concluded that H0 is rejected. Based on Table 9, the value of tcount $t_{hitung} = 4{,}686 > t_{tabel} = 1{,}717$ is obtained. It can be concluded that learning motivation after using learning media has increased.

4. Conclusion

Through this development research, the research produces a product in the form of ICT-based mathematics learning media on the subject of the Linear Program for high school students. This media is considered valid and practical after going through a validation process by experts and two stages of testing to see the level of media implementation and effectively improve students' learning motivation. In the future, there are still many other subjects on mathematics subjects that can be developed in the form of learning media ICT based.

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