



The Development of Learning Video Media Based GeoGebra for Increasing the Students' Mathematical Understanding

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Abstract. This research aimed to produce learning video media based on GeoGebra has been valid, practical, and effective. This development used ASSURE model development design. This research was conducted in Vocational High School Farmasi IKASARI Pekanbaru. The subject of the research are 2 people as the experts of instructional content and 2 people as the experts of instructional media, 6 students for try out of small group, and 73 students for try out of large group divided by two class, those are an experiment class and a control class. The form of data collection instrument are questionnaires of the validity by expert, questionnaires of the practicality and writing test by the students. Data of questionnaires were analyzed with descriptive statistics. Data of test were analyzed with inferensial statistics. The result showed that the evaluation of learning video media by the expert of instructional content is valid with verygood classification (94,167%), the evaluation of learning video media by the expert of instructional media is valid with verygood classification (94,615%). The practicality of learning video media by students is practical with verygood classification (90,037%), and learning video media is effective because there was significant different between *posttest* mean score data of experiment class 42,143 is bigger than *posttest* mean score data of control class 33,763. These result indicate that the learning video media based on GeoGebra has been valid, practical, and effective.

Keywords. Learning video media; GeoGebra; Mathematical understanding

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1. Introduction

The Math is one of the basic knowledge which has the important role in mastering knowledge and technology. Until the specific limitation, it is more better to be mastered by humans especially the students so that they able to apply it in various needs. Remembering the important of Math in the hope they able to master each of materials who are taught and arranged in their school curriculum.

The objectives of the Math learning is that the students are hoped to have the ability: (1) Understanding of the Math concept, explaining the relevance inter-concept, and applying the concept or algorithmic flexibly, accurately, efficiently, and correctly in problem solving, (2) Using of reasoning in the model and character, doing Math manipulation in generalization process, arranging the evidence or explaining the idea and Math statements, (3) Solving the problem which includes the ability for understanding the problem, designing of the Math model, finishing the model, and interpreting the solution which has be gained, (4) Communicating the idea with symbol, diagram table, or another media for clarifying the situation or problem, (5) Having of appreciative character of the usage of Math in the life for instance to be curious, attentive and interested, persistence in Math learning and also confident in solving the problem.¹

Based on the problem above, the existence of the students' mathematical understanding is very crucial nowadays. If without passing the degree of the students' mathematical understanding, they are not able yet to master to the next degree. The decreasing of students' Math quality can be seen on the survey data on the *Program for International Student Assessment (PISA)* that conducted each of three years. On 2003, Indonesia was in the 38th with the score was 360 from 40 states. On 2006, it was in 50th with the score was 391 from 57 states. On 2009, it was in 61th with the score 371 from 65 states.² In 2012, it was in 64th with the score wa 375 from 65 states.³

One of the solutions which can be applied in Math learning is by using the appropriate media. It was line with Djamarah, he stated that the existence of media in the learning process has the important role. The caused of the indistinctness the learning material who is delivered can be helped with media. It is as a medium.⁴

In connection with the utilization of learning media nowadays, the popular media in education field is a learning video. As a audio visual motor of media, it shows sound, picture and also movement simultaneously and harmonically. Thus, video has more superiority than audio or visual media, it presents the material systematically, strength the degree of students' knowledge, and shows the movement of the picture that harmonically with the sound. It is because of the superiority that video, video can be one of the interested media for students so that it can increase the students' mathematical understanding.

GeoGebra is dynamic mathematics software that joins geometry, algebra and calculus. It is

¹Regulation of Mendiknas RI 22(2006), p. 346.

²Kemdikbud (2009), Survei International PISA, [online] available: <http://litbang.kemdikbud.go.id/index.php/survei-internasional-pisa> accessed on [18 September 2015].

³OECD (2015), about pisa Indonesia, [online] available: www.oecd.org/pisa/aboutpisa/indonesia-pisa.html, access on [18 September 2015].

⁴Syaiful Bahri Djamarah, Strategi Belajar Mengajar, (Jakarta: Rineka Cipta, 2010), p. 120.

developed for mathematics learning and teaching in schools⁵. One of the superiority of GeoGebra is able to shift, reflect, turn, and change the object size on Cartesian coordinates area.

Beside that, based on the result of interview the researcher with the two of Math teachers at Vocational High School FARMATIKOM and Pharmacy Ikasari Pekanbaru, one of the hard materials of Math which are taught to the students in the learning process is flat level transformation. The hardness of this material is shown through how to show the movement processing of object position before and after transformed, the transformation result of visual shadow flat type form, another components form which influence the transformation on Cartesian coordinates area. The cause of the using of GeoGebra software to form the flat level transformation efficiently be needed in learning process. Furthermore, another superiority of GeoGebra software of language side and the way of using this GeoGebra software is more interested for the scientists and educators.

Based on the result of Haryoko's research, the students who are taught using video media have the higher score than the students who are taught using conventional method.⁶ It is because of the presenting of flat level transformation through learning video also can be a hope for the students and the Math teacher. Moreover, inside of learning video has entered animation of each flat level transformation of GeoGebra software, surely it is more interested either the students or teacher.

Based on the description of the background of the problem above, the formulation of the problem in this research as follow: (1) Is learning video media based GeoGebra valid for the students at Vocational High School?, (2) Is learning video media based GeoGebra practical for the students at Vocational High School?, (3) Is learning video media based GeoGebra effective for the students at Vocational High School?,

While the objective of the research are: (1) To find the validity degree of learning video media based GeoGebra for the students at Vocational High School, (2) To find the degree practicality of learning video media based GeoGebra for the students at Vocational High School, (3) To find the effective degree of learning video media based GeoGebra for the students at Vocational High School.

2. The Method of the Research

The method of the research which the researcher used was *Research and Development (R&D)*. *Research and Development*. It is a research that used to produce a specific product and test the effectivity of the product.⁷ It is done step by step, start with analyzing the need of development, designing, doing, implementing, until evaluating of the qualified of developed product. During the process of development always be done testing and revising so that the developed product really tested empirically. This research was done in the narrow are, so that it includes in limited try out. It was be done with developing and completing preexistent product.

⁵Markus Hohenwarter dan Judith, GeoGebra Help 5.0, [online] available: www.GeoGebra.org, access on [30 September 2015].

⁶Sapto Haryoko, Efektifitas Media Audio-visual sebagai Alternatif Optimalisasi Model Pembelajaran, *Jurnal Edukasi@Elektro*, 5(1), 2009.

⁷Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (Bandung: Alfabeta, 2013), p. 407.

According to Gustafson and Branch in personal quotation, the design modelling of learning system is classified become three categories. This classification based on the orientation of the usage of those model, is that (1) *Classrooms oriented model* (2) *Product oriented model* dan (3) *System oriented model*. In this research development, the researcher used *classrooms oriented model* because it is an own design learning system model of the researcher that hoped can be applied in the class.

Sharon E. Smaldino, James D. Russel, Robert Heinich, and Michael Molenda in the personal quotation stated that a model of learning system design named ASSURE. This model is developed to create an effective learning activity. It is also used in learning activity that use media and technology. The usage of this model is more focused on the planning of learning to be used in the learning situation of the class actually.

The researcher choose the ASSURE model of the learning system in this development research with some considerations: (1) The development research which be done by the researcher is more focused on the development of learning media, (2) The design model of learning system wished of the researcher can be applied in the class.

The description of developing design procedure assure model had been arranged in this following diagram:⁸

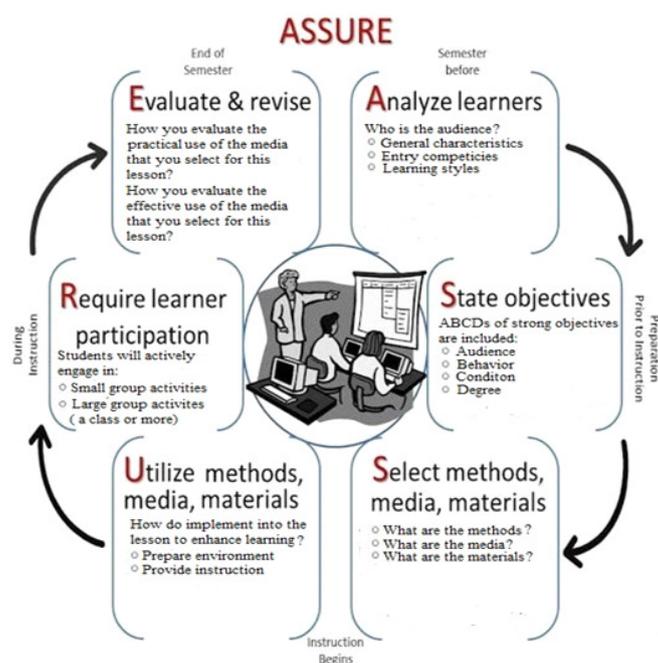


Figure 1. The description of developing design procedure assure model

The subject of try out for validity test of learning video media was instructional content and media experts. While the subject of try out for practicality test and effectivity test of learning video media was the students of eleventh grade (XI) at Vocational High School Pharmacy Ikasari Pekanbaru in 2015-2016 with the population 287 of students.

⁸Adaptation and modification from D. Hala Ibrahim Hassan Ahmed, The ASSURE Model Lesson Plan, University of Khartoum-Faculty of Education, 2014, pp. 3-4.

The tryout of product had been conducted on two different time. On the first time, it was be done at the small group of students, then continued to the second time it was be done at the large group of students minimal in one class. In the try out at the small group, the researcher needed 6 of the students as the sample from one class of the eleventh grade(XI) that taken by sampling purposive technique based on the criterion of Math ability and students' learning style. In the try out in the large group, the researcher took the sample with cluster sampling technique. It is a technique for taking the sample that consisted of member group collected at the group or class. The weakness of this technique is the generalization of research result experienced do mistake.⁹ The researcher decreases the impact of this weakness with taking two classes of the whole class of the eleventh grade at Vocational High School Pharmacy Ikasari Pekanbaru with randomization. Then, it is continued by testing the difference of the fore ability of them. If they have the same fore ability so that the researcher make into one class as experimental class, and another as the control class.

In this research, the researcher used some research instruments that consisted of three aspects are validity, practicality, and effectivity. The description about those aspects as follows:

1. Validity aspect

Validity aspect is used to gain the data that state the validity of developed learning video media. The researcher used two instruments on the aspect validity are validity questionnaire media of material side which is filled by the instructional content experts and validity questionnaire of media side which is filled by the instructional media.

2. Practicality aspect

Practicality aspect is used to gain the data that state the practicality of developed media. To test the practicality of media, the researcher used the practicality questionnaire in form of students' respond questionnaire to the students who had been given treatment with the media of development result. They are the students' try out at the small group in the experimental calass when students' try out in the large group.

3. Effectivity aspect

Effectivity aspect is used to gain the data that state the effectivity of developed learning video media. To test the effectivity of learning video media, the researcher uses the instrument of test in form of written test to the students' experimental and control class. Each of classes, the written test is given in two different times are on the pre test and post tes.

Table 1. Aspect relationship, technique of collecting data, and research instrument of learning video media

No.	Aspect researched	Technique of collecting data	Research instrument
1	Validity	Questionnaire	1. Validity questionnaire media of performance side 2. Validity questionnaire media of material side
2	Practicality	Questionnaire	Questionnaire of students' respond
3	Effectivity	Test	Written Test

⁹Hartono, Metodologi Penelitian, (Pekanbaru: Zanafa Publishing, 2011), p. 52

The Technique of Analyzing the Data

The Technique of Analyzing the Data in quantitative research is directed to answer the formulation of the research problem. It is because of the data is quantitative so that the technique of analyzing the data which can be used is descriptive statistics and inferential statistics. Descriptive statistics is a statistics used to analyze the data with drawing the collected data as they are without making the conclusion for general or generalization. Inferential statistics is a statistics technique used to analyze the sample data and the result treated as the population. Statistics descriptive is used by the researcher to know the validity and practicality of learning video media while inferential statistics used to know the effectivity of learning video media. The description of analyzing the data to know the validity, practicality, and effectivity of learning video media as follow:

a. Descriptive statistics of validity of learning video

The quantitative data is gained from the score given by the validator. The score is the raw value in form of number gained based on the criterion of instrument assessing. The formulation for determining the percentage of validity of learning video media as follow

$$P_{Kev} = \frac{\text{the total score gained}}{\text{the total score criterion}} \cdot 100\%$$

In which;

$$\text{the total score of items} = l \cdot m \cdot n$$

Description

P_{Kev} = validity percentage

l = the highest score of each item

m = total of items

n = total of validators

Interpreting the validity of learning video media based on this following table:

Table 2. The data interpretation validity of learning video media

No.	Interval	Criteria
1	$84\% < P_{Kev} \leq 100\%$	Very good
2	$68\% < P_{Kev} \leq 84\%$	Good
3	$52\% < P_{Kev} \leq 68\%$	Good enough
4	$36\% < P_{Kev} \leq 52\%$	Not good
5	$20\% \leq P_{Kev} \leq 36\%$	Not very good

Source: Modification of Riduwan

The data interpretation validity of learning video media on Table 2.

b. The descriptive statistics practicality of learning video media

The quantitative data gained from the the students' score. Score is a raw value in form of form the number gained based on the criterion of instrument assessing. The formulation for determining the percentage of practicality of learning video media as follow:

$$P_{Kep} = \frac{\text{thetotalscoregained}}{\text{thetotalscorecriterion}} \cdot 100\%$$

In which,

$$\text{thetotal score criterion} = l \cdot m \cdot n$$

Description

P_{Kep} = the practicality percentage

l = the highest score of each items

m = the total of items

n = the total of the students

Interpreting the practicality of learning video media based on the following table:

Table 3. The data interpretation practicality of learning video media

No.	Interval	Criterion
1	$84\% < P_{Kep} \leq 100\%$	Very good
2	$68\% < P_{Kep} \leq 84\%$	Good
3	$52\% < P_{Kep} \leq 68\%$	Good enough
4	$36\% < P_{Kep} \leq 52\%$	Not good
5	$20\% \leq P_{Kep} \leq 36\%$	Not very good

Source: Modification of Riduwan

The quantitative data was gained from the data of post test score of the result of learning at Vocational High School Pharmacy Ikasari Pekanbaru. The effectivity of learning video media is determined from the difference between mean of post test which is presented of learning video media and not presented of learning video media. The kind of the quasi experimental research which the researcher used to determine the effectivity of learning video media is Randomized Class Control Group Pre Test Post Test Design. Randomized Class Control Group Pre Test Post Test Design. It is a modification Randomized Control Group Pre Test Post Test Design in which on the quasi experimental, the experimental and control class taken by randomization. The designing of Randomized Class Control Group Pre Test Post Test Design is drawn as follow:

Figure 2. Randomized class control group pretest post test design

	Pre Test	Treatment	Post Test
E.C.	T_1X	T_2	
C.C.		T_1T_2	

Description: T_1 = PreTest; T_2 = Post Test; X = The treatment by presenting the learning video media
 E.C.= Experimental Class; C.C.= Control Class

The procedure of Randomized Control Class Group Pre Test Post Test Design as follow:

- (1) Choose two classes of horde of the students through drawing.
- (2) Treat T_1 , pretest each of the classes
- (3) Be a one class as an experimental class while other as a control class.
- (4) Maintaining the condition of the two classes as the same, except one thing is that the experimental class has treated X for a specific time.

- (5) Treat T_2 , posttest of each the classes. Then, calculate the mean of them.
- (6) Applying the appropriate statistics test to determine whether there is a significant difference or not between mean posttest each class.

3. The Result and Discussion

The steps which the researcher took using ASSURE model as follows:

Analyze Learners

The general characteristics: the audience are the students, the average age is about 16-18 years old, the various racial, in the intermediate up to high economic level, the moderate technology skill. Included competency: flat model transformation material with the requirement the students have learned the material about function and geometrics field. Students' learning style: visual, audio, and kinestics.

State Objectives

The subject is the students of the eleventh grade of Vocational High School Pharmacy Ikasari Pekanbaru in 2015-2016.

Behaviour: the moderate students' motivation. Condition: the learning facilities are complete at Vocational High School Pharmacy Ikasari and still can be used for instance: projector, fan, lamp and Math teaching equipment. Degree: Vocational High School with KTSP curriculum in which the syllabus contains the basic competency, learning material, and the indicators of flat model transformation material.

Select Method, Media and Material

Method: Metode ekspository

Media: learning video based GeoGebra (individual making and fabricating) with the follow steps are: (1) Arranging the material framework, (2) Organizing the program contents (3) Arranging the script (4) Producing the video includes the voice recording, voice conversion, voice editing, picture recording, animation recording, and animation harmonizing, voice and picture (5) Video validation

Material: the handbook of Math KTSP 2006 for SMK and MAK for XI or the relevant.

The calculation result of learning video media based GeoGebra of material side and media totally was valid in the very good category, and the score of validation totally and successively 94,167% and 94,615%.

Utilize Method, Media and Materials

The chosen classroom is XI class of Pharmacy with the heating control and luminous intensity of the classroom, and learning equipment have been prepared and can be used.

Require Learner Participation

Two of groups who participated in trying of the product, is that: (1) The small group consisted of six of the students (2) the large group divided into experimental class (XI.1 F class) and

control class (XI.2 F class). Both of them can be determined after randomized and tested with the pretest and the result is not significant.

Practicality test was be done in both of the groups while the effectivity test was be done only in the large group.

Evaluating and revising

The practicality of learning video media based GeoGebra includes are the quality material, performance quality, and learning quality aspects. The calculation result of practicality of learning video media based GeoGebra totally was valid in the very good category with 90,073%.

After be drawn and conducted the pretest of the XI.1 F class with the sample of 35 of students as the experimental class and XI.2 F class with the sample 38 of the students as the control class. Then, both of them had given the same treatment except one class is that experimental class. It is presented a learning video media based GeoGebra, while the control class was not. Then, after four meetings they had given post test.

The result of the data post test score of normality test with Chi Squares had encompassed in the following table:

Table 4. The data posttest score of normality test

Kelas	$\chi^2_{\text{calculated}}$	χ^2_{table}	Criterion
Experimental	6,387	12,595	Normal
Control	2,666	14,067	Normal

Based on the result of the research, it can be observed that the value of $\chi^2_{\text{calculated}}$ in the experimental class was 6,387 while $\chi^2_{\text{calculated}}$ of control class was 2,666 with the χ^2_{table} in the 5% of significance level was 12,595 in the experimental class and 14,067 in the control class. Thus, $\chi^2_{\text{calculated}} < \chi^2_{\text{table}}$ means that the distribution of the data was normal.

The result of the data post test score of homogeneity test with the higher variant and the smaller variant had encompassed in the following table:

Table 5. The data posttest score of homogeneity test

$F_{\text{calculated}}$	$df_{\text{numerator}}$	$df_{\text{denominator}}$	F_{table}	Criterion
1,259	34	37	1,76	Homogeneous

After conducting the normality and homogeneity test, the data post test of the research had normal and homogenous distribution. it because of the data post test was normal and homogenous, so that the significance test used T_{test} with *polled varians* formulation.

The result of post test had encompassed in the following table :

Table 6. The data post test score of T_{test}

$t_{\text{calculated}}$	t_{table}	Description
2,205	1,671	Significant

It is because of $M_x = 42,143 > M_y = 33,763$ and the mean difference of posttest between experimental and control class was significant, so that learning video media based Geogebra for increasing the understanding Math concept was effective to be used in the students' population of the eleventh grade of Vocational High School Pharmacy Ikasari Pekanbaru.

4. Conclusion

Based on the result of the research and discussion, it can be concluded that learning video media based GeoGebra for increasing the students' understanding Math concept as follow: (1) Based on the assessment by instructional content expert, learning video media based GeoGebra for increasing the understanding of Math concept totally was stated valid in the very good category (94,167%). Based on the assessment by instructional media expert, learning video media based GeoGebra for increasing the understanding of Math concept totally was stated valid in the very good category (94,615%), (2) Based on the assessment by the students of experimental class, learning video media based GeoGebra for increasing the understanding of Math concept totally was stated practical in the very good category (90,037%), (3) It is caused the mean of post test score at experimental class $M_x = 42,143$ higher than the mean score of post test at control class $M_y = 33,763$ and the difference of mean score of post test between experimental and control class was significant, so that learning video media based GeoGebra for increasing the understanding Math concept was effectively used for the students' population of IX at Vocational High School Pharmacy Ikasari Pekanbaru.

Suggestion

The suggestion which can be delivered for developing of learning video media in Math as follow:(1) Attempt to enlarge the utilization learning video through airwaves either national or regional. One of the superiority of video through airwaves help can give the uniform information to the students in any different places on the same time, and (2) Attempt to save the file in any existence saving for instance: mp4, 3gp, avi, mpg4, etc. If many alternatives of the file so that the chance to open the learning video media in any application on hardware for instance: PC, computer, even Smartphone.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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