

Development of Computer-Based Media for Mathematics Learning at Secondary Schools on the Topic of Lines, Angles and Rectangular

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Abstract . This research is aimed at developing computer-based media for mathematics learning. This media used interactive model to help students understand the topic of lines, angles and rectangular. This development research applied development model by Borg and Gall modified by Sugiyono. The study began by finding the potentials materials and its problems followed by a study of literature. The subject in this research is line, angle and rectangular, including rectangle, square and trapezium. Product design was done through two stages: paper-based design and computer-based. The applications used for product design are Microsoft Frontpage, Microsoft Power Point and Photoshop. Learning media were validated by three experts or validators and were revised based on the input from the validators. The revised learning media were tested on two stages: a small group test consisting of five respondents and a large group test consisting of forty respondents. Based on the analysis of data and discussion, it can be concluded that computer-based media for mathematics learning is valid with an average score of 3.17 on aspect of materials and 3.18 from aspects of media. This computer-based media for mathematics learning also had practicalities with an average score of 97,92% on a small group test and 99,22% in the large group test.

INTRODUCTION

The development of information and communication technology (ICT) is growing rapidly. It has changed peoples' way of thinking, practicality and efficiency for community. The development of this ICT has a promising potential in changing the way a person to obtain and learn information. The ICT also provides an opportunity for teachers to develop instructional techniques in order to get maximum results. One of the advantages of technology is the use of multimedia as the learning media in classrooms. According Syaiful Bahri, [1] the confusion in understanding teaching material in teaching and learning activities may be aided by the presentation of the media as intermediary. In line with that Rusman[2] expressed the benefits of learning media are: 1) Learning can be more attractive to students, so it can stimulate their motivation to learn (2) Learning materials will be very clear, so it can be easily understood (3) Learning method will be more varied, not only verbal communication or lecturing by teacher, but also hands-on activity by student .

In a learning process at schools, Abdur Rahman [3] mentioned that mathematics is considered as the most difficult subject for most students compared to other subjects taught at schools. Mathematics is often considered as a subject that is difficult to understand both in the theory and its application. One branch of mathematics is a geometry. It is said that students' ability of understanding the geometry have not reached the expected goal of learning geometry. Because geometry is perceived to be difficult by most students, it obviously makes a negative impact on their ability of understanding the geometry. As Meserve [4] wrote, "Acceptance of the existence of many geometries is a necessary step in the obtaining of sufficient understanding to apply geometrical concepts effectively to mathematical problems".

One important solution to raise the students' interest in learning mathematics is the use of learning media. Erik [5] shows that the use of learning media can improve students' understanding about the learning material.

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Learning media that are presented by images, texts and animations in form of tutorial programs using a computer can perform as a tutor system, just like what is normally presented by a teacher [6]. These media will increase students' motivation in learning the subject, especially mathematics. According to Duru [7], an experimental teaching method is more effective than teacher-centered as known as traditional teaching method in the knowledge and comprehension level. Teaching geometry involves knowing how to recognise interesting geometrical problems and theorems, appreciating the history and cultural context of geometry, and understanding the various uses of geometry. [8]

The foundation of most mathematics teachers in geometry is poor. Therefore, the government should be encouraged to provide the necessary infrastructures and facilities that will motivate teaching and learning of mathematics, Telima [9]. By using computer-based learning media students directly interact with the computer individually, so that what particular students experience will be different from what is experienced by other students. This ability will accommodate students with the heterogeneous ability to learn in a different climate of effective learning which is individualized by computer-based learning media. This computer-based media can provide visual displays of the abstract concept. Because the media is interesting, attractive and interactive, the computer-based learning media can be used as learning solutions to teaching materials with different restrictions. Various presentations about the field of geometry are investigated from various points of view with some emerging key issues, such as the nature and the role of representations, the link between real objects and theoretical objects of geometry, the link between geometry and the real world underlying several contributions. Referring to the real world can be very helpful for students (Laborde). [10]

Microsoft Office Power Point and Microsoft Office Front Page are part of available computer program. These applications provide everything needed to create this learning media application. In this computer-based learning materials, each material was made in the slide with pictures and animations, accompanied by an appropriate description. It is expected that the computer-based learning media with interactive tutorial models can help motivate students to learn. At the moment, many schools have computer labs and LCD devices that computer-based learning media need for use in schools. The students can also use these media independently without the teachers at home.

RESEARCH METHOD

This research applied an R & D model, which intends to produce the computer-based learning media with a model of interactive tutorials for the topics of lines and angles and rectangles for class VII. These media were tested for their validity and the practicalities to be used by the target audience. The study design of this development refers to the steps of research and development by Borg and Gall modified by Sugiyono [11], they are: (1) The potential and problems; (2) data collection; (3) the design of the product; (4) design validation; (5) the draft revision; (6), product trials; (7) the product revision; (8) utility; and (9) the revision of the product.

Images and animations were processed and edited using Adobe Photoshop CS3 and Macromedia flash 8. This was done in order to get animations and images that fit the needs of the learning media. Web pages were created using Microsoft Office Frontpage 2003, and the subject matter pages were created with Microsoft Office Power Point 2007. Then, they were linked all together into an autorun program using the Longition Autorun Pro Enterprise application.

Research Product was tested into two different groups. Subject lines and angles were tested on small groups of 5 students with the heterogeneous academic ability at class VII SMP Negeri 1 Rengat and a large group trial was given to 21 students from the class VII Rengat. The topics of rectangle were tested into one class VII students of SMP Negeri 4 Pekanbaru. The student who are the subjects of the experiment are the students who have not studied the subject lines, angles and rectangles, but they have all the prior knowledge to understand the materials.

The instrument of collecting data in this study is a validation sheet and questionnaire responses of the students. Instructional media validation sheet contains four aspects: the curriculum, the learning aspect, program aspects and aspects of cosmetics. This instrument using Likert scale with alternative answers 1, 2, 3 and 4. The validation sheet is analyzed to find the validity level of computer-based learning media with models interactive tutorial for subject lines and angles and rectangle by calculating mean of score at each aspect. While the questionnaire responses of the students using Guttman scale with two alternative answers are yes and no. Students' questionnaire responses analyzed to determine the practicalities of computer-based learning media interactive tutorial models for subject lines, angles and rectangle.

Data analysis in this research were validation sheet analysis and student response questionnaire analysis. Analysis of the validation sheet using the following formula.

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An average of each aspect is calculated by the formula:

$$K_i = \frac{\sum_{h=1}^N V_{hi}}{N} \quad (1)$$

Note:

- K_i = average of the i-th criterion
- V_{ij} = scores of the h validator's against the i-th criterion
- N = number of validators
- h = validator
- i = criteria

Calculation of average aspects with the formula:

$$A_i = \frac{\sum_{j=1}^n K_{ij}}{n} \quad (2)$$

Note:

- A_i = mean of the i aspect
- K_{ij} = the average for the i-th aspect of the j-th criterion
- n = number of criteria in the i-aspect
- i = aspect
- j = criteria
- ij = the i-th aspect of the j-th criterion

An average of total aspect validation were calculated by the formula:

$$RTV = \frac{\sum_{i=1}^N A_i}{N} \quad (3)$$

Note:

- RTV = average of total validity
- A_i = mean of the i aspect
- I = aspect
- N = many aspects

Once the average of total validation was obtained, then it put into the validity criteria that were : $3 \leq RTV \leq 4$ is categorized as valid, $2 \leq RTV < 3$ is categorized as moderately valid, $1 \leq RTV < 2$ is categorized as not valid. The calculation for students' response were to score each statement in the student response questionnaire based on the alternative answer. The alternatives answers are strongly agree, agree, quite agree, disagree, and strongly disagree given the successive ratings are 5, 4, 3, 2, and 1. The percentage of response for each aspect were calculated by the formula:

$$R_i = \frac{\sum_{j=1}^n P_j}{\text{Skor maksimal aspek ke } i} \times 100\% \quad (4)$$

Note:

- R_i = Persentase respon aspek ke-i
- P_j = Skor pertanyaan ke-j
- N = Number of statements in the i-th aspect

After calculating the percentage of response for each aspect, then the average percentage of total were calculated by using the formula:

$$RT = \frac{\sum_{i=1}^m R_i}{m} \quad (5)$$

[Type here]

Note:

RT = Average percentage total

R_i = Percentage of i aspect response

M = Number of aspects

Furthermore, the category of response were determined based on the percentage obtained. The response categories used are: 85% ≤ RT category is very good, 70% ≤ RT < 85% category is good, 50% ≤ RT < 70% category is bad, RT < 50% category is very bad.

RESULTS AND DISCUSSION

Product Design

Subject lines, angles and rectangles on this computer-based Learning Media organized by reference to the Curriculum 2013. The products were divided into two parts: first part presented subjects Lines and Angles, the second part presented subject of Rectangles. The subject lines and angles are organized in six sub-material, namely: (1) the concept of points, lines and areas; (2) the concept of angle; (3) the relationship between the two angles (supplementary angle and complementary angle); (4) the ratio between the two angles (opposite angle); (5) the ratio of angle on parallel lines (corresponding angle); and (6) the ratio of the angle on a parallel line (opposing angle). The Subject rectangular consists of 6 parts, namely: (1) the properties of two dimensional area, (2), the perimeter and the area of the square, (3) the perimeter and area of a rectangle, (4) perimeter and the area of trapezium, (5), perimeter and the area of parallelogram, and (6) and perimeter and the area of the rhombus.

To design computer-based learning media with model interactive tutorial on the topic of lines, angles and rectangles, researchers collect an information that can be used as a material for creating the product. The collected data and literature are used as a guide for developing computer-based instructional media design model of the interactive for the subject lines, angles and rectangles. Data collected in the form of teaching materials, as well as the other objects that are needed for program, such as animations, photos, videos and background picture.

In the design phase, researchers created a paper-based design for computer display of the program. This paper-based design used as a guide in developing a computer display. After the paper-based design is completed, the design of products is created by using Microsoft Office Power Point application. Media that was created in Microsoft Office PowerPoint and then packed in the Microsoft Front Page Web interface.

Product Validation

The finished draft of computer-based learning media with model interactive tutorial for the subject line, angles and rectangle is validated by 3 expert on media and mathematics instructional. The score of validation is presented on the following tables:

TABLE 1 Validation score of 1st Product (Lines and Angles)

No	Validator	Class Meeting						Mean	Validation Category
		1	2	3	4	5	6		
1.	Validator 1	3,26	3,52	3,58	3,73	3,58	3,63	3,55	Very Valid
2.	Validator 2	3,58	3,73	3,58	3,52	3,73	3,52	3,61	Very Valid
3.	Validator 3	3,6	3,6	3,53	3,6	3,4	3,67	3,57	Very Valid

TABLE 2 Validation Score of 2nd Product (Rectangle)

No	Validator	Class Meeting						Mean	Validation Category
		1	2	3	4	5	6		
1.	Validator 1	3	3	3	3	3	3	3	Valid
2.	Validator 2	3,07	3,21	3,07	3,36	3,21	3,14	3,18	Valid
3.	Validator 3	3,33	3,33	3,33	3,33	3,33	3,33	3,33	Valid

Source : Researcher data

The validation score of the computer-based learning model interactive tutorial on the subject of lines, angles and rectangles from the validator 1 obtained average score of 3:55, from validator 2 were on average 3.61 and 3:57 from validator 3. The overall average from 3 validator is 3:57 in the category "very valid". Based on the

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evaluation of the three validators, learning media was considered valid and allowed to be processed for the next step which is the evaluation phase.

Revised Draft

Once the model computer-based learning media interactive tutorial on the subject line, angle and rectangle were validated then researcher analyzed the comment and recommendation for revising the product. Next, researchers reviewed and revised the product based-on input of the validation sheet and suggestions. Revisions made on aspects of the curriculum can be seen in Table 3 below.

TABLE 3: Revised Learning Media on the Aspect of Curriculum

NO	Problem	Validator comment	Revised Product
1.	Problem with information of the teaching material	The term used in presented material did not consistent	The product is revised based on suggestion
2.	The use of different colour on some illustration.	Ambiguity of concept because the choice of different colour	The same concept presented using the same colour.
3.	The display of opening slide on topics rectangle	Put more example of two dimensional figure	Two example were added to the three available given.

The revision on aspect of learning activities is presented in following table.

TABLE 4: Media Revision On Aspect of Learning Activities

NO	Problem	Validator comment	Revised Product
1.	There is no information for answering the problem	The additional information is needed to guide student in problem solving	The additional guided information is added
2.	Problem given to students do not match the goal of the lesson.	Problem should match the goal of the lesson	The problem is edited to match the goal of the lesson
3.	The picture of rectangle used in the program .	The Picture should show the properties of rectangle	The picture is changed

Media Revision on the aspect of program is presented on the following table.

TABLE5: Media Revision On Aspect of Program

NO	Problem	Validator comment	Revised Product
1.	<i>Link</i> on media	Some of link does not work as intended	<i>Link</i> is revised
2.	Animation speed	Animation speed is too slow	Animation speed is fixed, getting faster.

[Type here]



Revision on the aspect of Cosmetics can be seen on the following table:

TABLE 6 Media Revision on Aspect of Comestics

NO	Problem	Validator comment	Revised Product
1.	The use of Colour on the opening slide	The colour in opening slide too dark	Colour is changed into brighter colour
2.	The picture position on information	Some picture overlap with the other	Reposition of some object
3.	The use of color on material presentation	The soft colour having low readability	Colour is changed into brighter one

Small Group Trial

In the small group testing, revised computer-based learning media model of interactive tutorials for the subject lines, angles and rectangle were given to five students of class VII with heterogeneous academic ability. Those students who have not studied the subject of lines, angles and rectangle before but had a prerequisite knowledge. Pupils are asked to use the products, once students are finished using the media of learning, they were asked to fill out a questionnaire.

On the basis of the analysis and the calculation of the small groups test results, computer-based learning media model interactive for the material lines, angles and rectangle achieved a mean score of assessment 0.978, and in the category of "very good". From the results, researchers conducted a review of learning media in accordance with the assessment and input from small group test results. Change made by researchers shown in Table 7 below.

TABLE 7 Media Revision after small group trial

NO	Problem	Students' comment	Revised Product
1.	Typing problem	Edit the typo problem	Type problem fixed
2.	Undefined link	Check some undefined link	All Link is checked and revised.
3.	The use of measurement	Consistencyin using cm dan cm2	Problem of measurement unit fixed

[Type here]

Large Group Trial

Once the computer-based learning media model interactive tutorial on the topic of lines, angles and triangle for Class VII revised based on the results of the small group trial, researchers tested it into the big group. The test is done in class VII SMP Negeri 1 Rengat by 21 students who have not studied the subject lines, angles and rectangle. Once students using instructional media, researcher give them a questionnaire about responses from students and ask students to fill in the questionnaire in accordance with their opinion in using the media.

Based on the analysis and calculation of the results computer-based learning media model tutorial for the topics lines, angles and rectangle of class VII in big groups, a mean value are 97.1 on the subject of lines and angles, and 97.7 for material rectangular. The assessment result of these two products are categorized as "very good".

Revised Product

Based on the results of a large group trial, researchers managed a review of the computer-based learning media model interactive tutorial on the subject lines, angles and rectangles. Overall only few revision performed, because the large group trial results have been very good. Revised product is accomplished ed by researchers can be seen in Table 8. Researchers double checked all components of the learning media from the first to the last class meeting. Finishing review the media, computer-based learning media model interactive tutorials for the subject lines, angles and rectangles of class VII and then packed in a Compact Disk (CD).

Tabel 8 Media Revision after Large Group Trial

NO	Problem	Students' comment	Revised Product
1.	Typo problem	Should free of typo problem	Typo problem is fixed
2.	Unactive button	Found unactive button in the opening slide	The information give in opening slide that user need to download all material before using the media.



Discussion

On the basis of the analysis from evaluation carried out by the three validator average score of 3.55 is obtained which is expressed in the category of valid media. According to validator assessment, computer-based learning media model of interactive tutorials for the subject lines, angles and rectangles are eligible to be tested with appropriate revision suggestions. After the media revised based on validator suggestions for improvements, computer-based learning media model of interactive tutorials for the subject lines and angles of class VII were tested twice, the small group and testing of large groups.

In the small group study showed that the reading level computer-based learning media model interactive tutorial on the topic of lines, angles and rectangles Class VII's are good, this can be seen from good students respon toward the use of media. Students mentioned that computer-based learning media model interactive tutorial make learning more interesting and they have fun when learning materials presented in the form of illustrated with pictures and animations. This is consistent with the views of Erik [5] that the use of learning media can give a complete understanding to students about the material being explained. The present of images, text and animation increase student interest and motivation in learning the subject.

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The score obtained from a large group of test was also very good. Based on an analysis of data from the students' responses on the questionnaire in a large group test, computer-based learning media model of interactive tutorials for the subject lines, angles and rectangles are qualified in practical aspects so that it can be used in learning. Students declare that the media display is very interesting to learn and the language used is easy to understand. The animations present to students by media make it easy for student to understand the lessons. This is because the students easily understand the material by looking at the illustrations on media accompanied by an explanation of the oral presentation which is done by the teacher. This is in sequence with the media functionality by Rusman [2], he clarify that the media presentation of the message is not too verbalistic when using visual media.

CONCLUSION AND RECOMENDATION

Conclusion:

This development research produced a computer-based learning media model of interactive tutorials for the subject lines, angles and rectangles for Class VII. This media is considered to have a high validity and practicality after going through the validation process by qualified experts, and students of class VII to ascertain the practicality aspects after going through two stages of testing.

Recommendation and Implication

Based on the research that has been done, the researchers shared some recommendations regarding the development research. Recommendations addressed to anyone who interest to perform the related research. These recommendations are as follows.

1. In this development study, researcher developed a computer-based instructional media models interactive tutorial on the subject lines, angles and rectangles for class VII. Hence it open an opportunity for other researcher to develop media for other subject.
2. This development study only measuring the aspect of validity and practicality. For further research, this learning media can be used as a basis to see other aspects of learning, such as the increased of student's motivation and learning outcomes by using this media.
3. This learning media requires the support of other teaching aids such as computers and LCD, therefore the school interested in using this media should provide for such a support.
4. The teacher who will use this instructional media need to operate computer and LCD, therefore those teachers need to learn these skill to make it easier to use the program.
5. The computer-based learning media will be expensive as schools ask the other party to develop it, teachers should be given additional skills to develop their own computer-based media to meet their needs.

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