Development of mathematical learning devices based on multimedia on circle materials of grade eighth of junior high school

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Abstract. This study aims to develop multimedia-based mathematical learning tools that are valid and practical in circle material. Learning tools developed are Lesson Plan, Teaching Materials and Student Worksheets. This type of research is development research that uses a 4-D (Four-D) development model developed by Thiagarajan and consists of 4 stages namely define, design, development, and dissemination, but due to time constraints, it is only limited to the development stage. The research subjects were seventh-grade junior high school students at the Angkasa Lanud Pattimura Ambon. The results of the study show that the learning devices developed are valid and practical. This is indicated by the general average validator rating for the three devices is 3.44; practicality of learning 92.98% and mastery of students taught by using the results of the development of 71.42%

1. Introduction

Science, technology and information systems that developed rapidly in the late 20th century influenced various fields of human life including the field of education. Multimedia as one of the technologies in the field of computers can be used as a learning media for teachers in delivering material to students. Teachers are required to adjust to developments and use them in learning.

Media is an important key in learning mathematics, especially for students in the basic education stage. This is because mathematics is basically abstract so, it is difficult to understand by students who are still at the stage of concrete thinking. Heinich, Molenda, and Russel in [1] say that learning media is any tool that can be used as a channel message or bearer of information from the teacher to students to achieve learning goals. This means that the media must be well designed by the teacher in order to help him deliver the material so that the learning objectives can be achieved. Computer-based multimedia is one of the media that can be used by teachers in mathematics learning to stimulate and attract students' attention.

Multimedia is a term frequently heard and discussed among educational technologist today. Multimedia is a combination of media such as the internet, text, graphics, videos, animation, and sound in an integrated way. In the education field, we use audio, video, slides, overhead transparencies, etc., to assist in the teaching process inside the classroom. The word 'multimedia' describes a combination of different media. Multimedia is the use of text, graphics, animation, pictures, video, and sound to present information [2]. Interactive multimedia is a reliable technological innovation, and it has the potential to modernize the way we read and explore educational things. Gunawardhana [3] (2016) mengatakan bahwa Multimedia is an interactive as well as educational tool.
Mayer [4] defines multimedia as a material presentation using words and images. The words in question are the material presented in verbal form, for example using the text of printed or spoken words. The images in question are the material presented in the pictorial form or in the form of pictures. The presentation can use static graphics (including illustrations, graphics, photos, and maps) or dynamic graphics (including animation and video). According to him, multimedia learning is learning with two channels or with multiple codes (dual-code learning or dual-channel learning), namely visual and auditory.

A computer-based multimedia presentation can be interpreted as a technology that optimizes the role of computers as a means to display and engineering text, graphics, and sound in an integrated display. With a display that can combine various elements of delivering information and messages. Computers can be designed and used as effective technology media to teach relevant learning material, such as graphic design and animation. This certainly opens up opportunities for the development of multimedia learning that attracts students' attention so that learning activities carried out by students can run actively.

Pea [5] explained that multimedia objects (text, pictures, video clips, and so forth) are important building blocks for developing and conveying a student's understanding for several reasons:
1. Multimedia communication is similar to face-to-face communication.
2. Multimedia is less restricted than written text. Many people come to understand text better with broader media support for its interpretation.
3. Multimedia can place abstract concepts in a specific context (for example, refraction in physics might be depicted in a film of lens and light behavior)
4. Multimedia allows for individual differences in preferred sensory channels for learning. 5. Multimedia lets you coordinate diverse external representations (with distinctive strengths) for different perspectives.

Gunawardhana [3] added that the objective of using multimedia as an educational tool is not to eliminate the teacher from the classroom; rather, it is just a tool, which makes it easier for both students and teachers to learn as well as teach particular subjects.

The circle is one of the mathematical materials taught in class VII SMP which is very good if it is presented using multimedia. Circles are built upon a flat side space which in learning requires the ability of students to draw and imagine parts of a circle and paint a circle then solve problems related to the circle. All of this will be easy for students to do if the presentation uses multimedia. Based on observations and interviews with one of the students' teachers it is still difficult to identify the elements of a circle other than the radius and diameter. For example, when students are given pictures (Figure 1) and are asked to determine the apothem, many answer OQ, OU, and OS.

![Figure 1. The Part of Circle](image_url)

Based on the results of observations and interviews with teachers, about learning the circle, the authors felt the need to develop a multimedia-based learning device on circle material. To support the success of multimedia-based learning, it is necessary to develop a good learning tool for multimedia-
based mathematics learning. This is because one of the most important parts of learning is the preparation of mature learning tools and planning. According to Rusdi (2008), the development of learning tools is a series of processes or activities carried out to produce learning based on existing development theories. The purpose of this study is to produce a computer multimedia-based learning device that is good (valid) on the circle material in class VIII SMP.

2. Methods
This research is development research that aims to develop multimedia-based mathematics learning devices. Learning tools developed consisted of Learning Implementation Plans (RPP), Teaching Materials (BA) and multimedia learning, Student Activity Sheets (LKS), and Learning Outcomes Test (THB) on circle material in class VIII SMP.

The learning device development model used in this study is the development model of Thiagarajan, Semmel & Semmel [6] which is known as the 4-D (four D model) model with 4 stages, namely defining, designing, developing and dissemination. However, due to time constraints, it is limited only to the third stage, the fourth stage (distribution) is not carried out. The 4-D model was chosen because it is simpler, and the steps are in accordance with the steps that the researcher expects.

The learning tools produced must meet the requirements for validity, practicality, and effectiveness. The validity of the device is obtained from the results of the assessment of experts/practitioners reviewed theoretically and consistency among the components of the learning device. Data on the practicality and effectiveness of the device are obtained from the results of field trials. The steps used to provide quality criteria for the product developed are; (a) Data in the form of scores of expert, teacher, and student responses obtained in the form of categories consist of five response choices about the quality of the learning device developed, namely very good (5), good (4), good enough (3), not good (2), and not good (1) converted into interval data; (b) The scores obtained are then converted into five-scale qualitative data, with a formula reference adapted from Sudjana (2002) in table 1 as follows.

| Score Interval       | Grade | Category      |
|----------------------|-------|---------------|
| 80% ≤ X ≤ 100%       | A     | Very Good     |
| 70% ≤ X < 80%        | B     | Good          |
| 60% ≤ X < 70%        | C     | Pretty Good   |
| 50% ≤ X < 60%        | D     | Not Good      |
| 0% ≤ X < 50%         | E     | Not Good      |

Information: X: Actual Score

Based on the conversion formula in Table 1, intervals were obtained for each category. The conversion of assessment scores from quantitative data to qualitative data aims to determine the validity and practicality of the resulting learning device.

3. Finding and Discussion
The development of this learning device uses the development model of Thiagarajan, Semmel & Semmel, namely the definition, design, and development that have been modified as described earlier. At this defining stage, the initial analysis is carried out, student analysis, concept analysis, task analysis and specification of learning objectives.

Based on the results of the initial analysis, the final analysis and analysis of the learning material, the circle material is one of the material that is considered difficult for the eighth grade students of Angkasa Lanud Pattimura Middle School. This becomes a consideration given by students in the learning process. It is also feasible to use learning media that can help in the learning process so that
the class becomes less attractive. Researchers need to do research on material using multimedia computers so that learning becomes more interesting.

The final analysis is the analysis of tasks divided into general tasks and specific assignments. This is done so that more is done to identify students’ skills. Furthermore, the specification of learning objectives is done by describing the specific tasks of students.

The second stage carried out in this research is the design stage. Multimedia design in learning is using computers. Multimedia is designed using Adobe Flash Professional CS5 Software, based on three cognitive theories about multimedia-based learning (Dual Channel Assumptions, Limited-Capacity Assumptions, and Active Processing Assumptions). The next is the selection of learning formats that are adapted to multimedia-based learning. In accordance with the multimedia design and the selection of learning formats, the initial design for learning devices is done, namely Lesson Plan, Learning Materials, and Student’s Worksheet for 2 meetings called Draft I.

After the defining and designing stages have been carried out, the researcher carries out the development stage. The draft I preparation in the form of Lesson Plan, Learning Materials, and Student’s Worksheet, continued at the development stage, namely improvement of Draft I. The steps are taken were expert validation for Draft I by mathematics education. The draft I revisions are based on corrections, input, and suggestions from experts to produce Draft II, then the readability test by partner teachers and students on the Draft II.

Based on the results of the readability test by teachers and students, revisions were made to produce Draft III, which is a good learning device. Draft III has been made, then the learning device is tested. In more detail, in the process of obtaining Draft II, namely the feasibility of learning devices to be tested, there is a need for validation from experts on these devices. Suggestions given by the validator to revise the learning device are used as material for consideration to obtain a good device. In this process, there are three experts who validate.

Learning devices are validated by using a validation sheet that is based on 4 rating scales, which are not good (value 1), not good (value 2), good (value 3), and very good (value 4), results generally from the validator of the device learning is usable with a little revision. Based on the results of device validation can be seen in Table 2.Validator Average Category

| No | Learning Device           | Rating Validator | Average | Category   |
|----|---------------------------|------------------|---------|------------|
| 1  | Lesson Plan               | 3 3 3            | 3       | Good       |
| 2  | Learning Materials        | 3 4 4            | 3,66    | Very Good  |
| 3  | Student Worksheets        | 3 4 4            | 3,66    | Very Good  |
|    | Average general rating    | 3.44             |         |            |

There are various inputs to the Draft I which serve as the basis for the revision activities. The aspects that must be considered in Lesson Plan validation are content, format and time allocation in the Lesson Plan. Based on the results of the validation, it was stated that the Lesson Plan was included in the good and feasible category to be used with a slight revision. The next validation is the validation of Teaching Materials, aspects that are considered in validation Teaching materials are the format and language in the Teaching Materials. The revision of Teaching Materials based on the results of the validator states that Teaching Materials are very good and feasible to use with little revision. Third Validation is carried out for Student Worksheet. According to the validator, basically the Student Worksheets is very good, it's just that it needs to be corrected in its writing format.

After the learning device Draft II (Lesson Plan, Teaching Materials, and Student Worksheets) was completed, Draft II was carried out trial readability by partner teachers and students. The aspects that are considered in revising Draft II are the format of writing and using difficult words that are not understood by students. The results of the revised Draft II which are valid are then called Draft III.
which will be tested to produce the final manuscript. The trial aims to find out how far the effectiveness of learning with the learning devices developed. Trial results can be seen in Table 3 below.

**Table 3. Trial Results**

| Activity      | Result | Category |
|---------------|--------|----------|
| Teacher Activity | First Meeting | 90.9% | Very Good |
|                | Second Meeting | 100% | Very Good |
| Students Activity | First Meeting | 74.81% | Good |
|                | First Meeting | 76.57% | Good |

Based on the data in Table 3, it can be seen that at the first meeting the percentage of teacher activity was 90.9% and student activities were 74.81%. At the second meeting, the percentage of teacher activity was 100% and the percentage of students was 76.57%. Thus, based on teacher activity criteria and student activities in learning is said to be effective if the presentations of teacher activities and student activities is more than or equal to 70%, then the teacher's activities and student activities are said to be carried out.

The teacher and student response questionnaire sheets are given after the lesson is finished at the second meeting. The sheet is used to find out the opinions of teachers and students on learning devices (Lesson Plan, Teaching Materials, and Student Worksheets), the atmosphere of learning in the classroom and learning by using animation. Based on the results of the study, it was found that the analysis of practicality data according to the teacher's response and students' responses to each lesson plan, teaching materials, worksheets, and implementation of learning showed the practicality of learning tools including good categories, which can be seen in Table 4.

**Table 4. Results of the Response Questionnaire**

| Response         | Percentage | Category |
|------------------|------------|----------|
| Teacher’s Response | 100        | Very Good |
| Students’s Response | 99.36    | Very Good |

Table 4 shows that partner teachers respond positively to learning devices reaching 100%. While the positive response of students to the learning device is 99.36%. This shows that the teacher and students give a positive response to the learning device above 70%, so it can be concluded that the teacher and students give a positive response.

Next will be discussed about Learning Outcomes Test. The results of the tests carried out consisted of 6 questions which were translated into 14 points and were followed by 21 students. From the results of the tests obtained, there were 15 students with a percentage of 71.42% who reached KKM (*Kriteria Ketuntasan Minimal/Criteria of Masterying*) and 6 students with a percentage of 28.58% who did not reach KKM. The following is a picture that shows student learning outcomes using a test of learning outcomes made by researchers.
People enjoy multimedia, prefer multimedia learning materials, and believe that multimedia helps them learn (Najjar, 1996). "People generally remember 10% of what they read, 20% of what they hear, 30% of what they see, [and] 50% of what they hear and see..." (Treichler, 1967, p. 15). Multimedia facilitates mastering basic skills of a student by means of drill and practice. It helps in problem solving by means of learning by doing, understanding abstract concepts, provide enhanced access for teachers and students in remote locations, facilitate individualized and cooperative learning, helps in management and administration of classroom activities and learning content, and simulate real life problem handling environments.

This research result in line with opinion with Jastaniyah [7], educators can also use multimedia to express their knowledge in an effective and interesting manner instead of traditional monotonous teaching style. They also give students the valuable learning opportunity while showing a video on a specific topic or discussing an article which is published in a webpage. Thus, the critical thinking abilities of the students will be enhanced.

4. Conclusion
Based on the results of the research that has been done, it can be concluded that after multimedia-based mathematics learning devices on circle material in class VIII of the Middle School are validated, tested for readability and tested, have produced good or valid learning devices, namely RPP, BA, and LKS. This is indicated by:
1. The three validators give a good assessment of learning devices (RPP, BA, and LKS)
2. Implementation of teacher activities in accordance with the RPP developed reached 90.9% in the first meeting and increased to 100% at the second meeting
3. Implementation of student activities at the first meeting reached 74.81% and at the second meeting increased to 76.57%
4. Teachers and students give a positive response to learning devices, namely: teacher response (Rg) of 100% and student response (Rs) of 99.36%
5. The average test results of students who achieved KKM were 71.42%
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References
[1] Kusumah W 2009 Pengertian Media Pembelajaran Media Grafika http://media-grafika.com/pengertian-media-pembelajaran
[2] Najjar L 1996 Multimedia information and learning J. Educ. Multimed. Hypermedia 5 129–50
[3] Gunawardhana L K P D 2016 Using Multimedia as an Education Tool in 9th Annual International Conference on Computer Games Multimedia & Allied Technologies (CGAT 2016)
[4] Mayer R E 2009 Multi-Media Learning Prinsip-prinsip dan Aplikasinya (Surabaya: ITS Press)
[5] Pea R 1991 Learning through Multimedia IEEE Computer Graphics Applications 11 58-66
[6] Thiagarajan S, Semmel D S and Semmel M I 1974 Instructional Development for Training Teachers of Exceptional Children (Minneapolis, Minnesota: Leadership Training Institute/Special Education, University of Minnesota)
[7] Jastaniyah A and Bach C 2017 The Importance of Multimedia in Information Revolution Saudi Journal of Engineering and Technology 2 89–99