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Adobe Flash CS6 to Develop Mathematics Learning Media for Plane Geometry

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Abstract. *Student can master the materials by doing the problems repeatedly. A media enables students work on varied random problems is necessary. This study aimed to provide valid, practical, and effective learning media. This research was a development research, involving 64 junior high school students in Yogyakarta. The instruments used in this study were expert validation sheets, questionnaires, and tests. The data was analyzed using a quantitative descriptive statistical analysis. Descriptive statistics was used to analyze data from students' tests. Meanwhile, descriptive qualitative was to describe the data of suggestions and comments from the validators for improvement. The results of expert validation for the media aspect achieved a very feasible category, while the material aspect also reached a very feasible category. Besides, the questionnaire results on student responses to learning media were also classified as a very practical category. The students' scores met the minimum criteria of mastery learning, meaning that the learning media achieved a very effective criterion. The results of this study imply that learning media can be used as an alternative in improving student learning outcomes.*

Keywords*: educational technology, plane geometry, adobe flash*

Introduction

Due to the rapid growth of science and technology, education has become a determining factor in advancing science and technology in the future (Dinçer & Cantürk-Günhan, 2020; Widodo & Wahyudin, 2018). Technological advances in recent years, such as Netbooks, tablet PCs, personal digital assistants (PDAs), and smartphones, are examples of how these devices and digital video recorders have been introduced to education. Besides, their availability is affordable, and the expansion of computer networking capabilities in primary schools, and intermediate is fast (LeBaron & McDonough, 2009; Sung, Chang, Lee, & Yu, 2008).

Governments and education systems worldwide have viewed the use of Information and Communication Technology (ICT) as a critical problem for improving the efficacy of teaching and learning in schools (Aminoto, Pujaningsih, Purwaningsih, & Dani, 2020; Lin, Wang, & Lin, 2012). The implication of this situation will require the world of education to be more adaptive to develop various learning tools and media by involving information technology as the basis so that the entire learning process can run effectively and improve students' learning outcomes (Bozkurt & Koyunkaya, 2020; Muchlas, 2018; Rhilmanidar, Ramli, & Ansari, 2020; Sarac, 2017).

Technology has a big influence on education (Özpınar, 2020; Sumarni, Jumintono, Sunarsih, Waluyo, Adisucipto, Umar, Wuwung, Manoppo, Setiawan, & Hos, 2020); currently, educators can develop the education system to make learning easier and help students gain learning experiences. With technology, students and educators have better education (Isman, 2003). One of the technology applications is learning media using computer technology (Zayyadi, Supardi, & Misriyana, 2017). Computers has widely used in education (Istiyono, Dwandaru, Setiawan, & Megawati, 2019). This rapid technological advancement integrates multimedia in the learning process based on the required context (Bennett, 2002; Chen & Chao, 2008; Fadzil, 2018; Irawati, 2015). Personal Computer (PC) presents interesting subject matter by entering features and navigation into the media; then, students can learn anytime and anywhere (Dwiyogo, 2018; Prakasha, Sarah, & Hemalathaa, 2020). The application of multimedia technology in a more effective, interactive, and qualified learning can provide a wider and more flexible learning environment, improve students' motivation and interest, increasing knowledge and quality of learning and understanding the material (Azar & Tan, 2020; Gunawardhana & Palaniappan, 2016; Nusir, Alsmadi, Al-Kabi, & Sharadgah, 2013; Septiani, Rejekiningsih, Triyanto, & Rusnaini, 2020; Wu & Tai, 2016).

Digital learning media can be used to implement educational technology (Rahim, Hamdi, & Arcana, 2020). Students can benefit from digital media use and other forms of instructional technology providing more educational opportunities (Kingry, Havard, Robinson, & Islam, 2015; Lehtola, Gemignani, Sutherland, & Jeon, 2014; Russell & Hannon, 2012). Essentially, the instructor is in charge of the teaching process and is seen as a source of expert information passed on to students through lectures in the classroom. The teacher determines the amount of information provided for students, while students remain passive and obedient recipients of knowledge and information and play a small role in learning (Daulay, Firmansyah, & Zakaria, 2017). The educational process requires more than just traditional instructors, and the roles of both students and teachers change with technological developments (Yumni, Jumintono, Ardiani, Wiyatiningsih, Sapan, Munawar, Handayani, Isnawan, & Ratnaningtyas, 2020). Students become learners, and their role will be active thinkers rather than passive listeners. In contrast, the teacher becomes a guide to direct students to relevant information, determines student needs and expectations, then helps them find and use knowledge or information (Emin, Tepe, & Karada, 2003; Muchlas, 2018).

Mathematics is a science that is taught at every level of education (Gerdes, 1998). The abstract nature of Math requires high concentration and seriousness; it is full of symbols that are sometimes difficult to understand (Sriraman, 2009; Wijaya, Hidayat, Zhou, 2020). The fundamental objective of the learning process for students is to grasp the subject matter

(Lemos, 1996). As a result, it is required to use technology in interactive learning multimedia as an innovation.

Multimedia-supported learning plays an active role in making abstract concepts concrete with more stimulation and lesson processing (Sarac, 2017). Learning media developed using a computer is Adobe Flash CS 6, which is equipped with various features. The advantage of Adobe Flash CS 6 is that it can present text, audio, video, and simple frame-based animations, most often used to create moving images, thus creating interaction between learning and students so that students' enthusiasm and motivation increase (Reffiane & Bayutama, 2019).

Previous research on the development of learning media using Macromedia flash/adobe flash CS6 resulted in a product that is feasible, practical, and effective has been conducted in various subjects: batik technology (Asiatun, 2017), biology (Astuti & Nurcahyo, 2019), geography (Ramadhan, Muryani, & Nugraha, 2018; Gayatri, Soegiyanto, & Rintayati, 2018), Pancasila (Iasha, Sumantri, Sarkadi, & Rachmadtullah, 2018), mathematics (Irvan, Mushlihuddin, & Suhartini, 2020; Nurlela, Pratiwi, Permana, Nugraha, Hendrawan, Mujiarto, & Nurkamilah, 2020), citizenship education (Rachmadtullah, Nadiroh, Sumantri, & Zulela, 2018), digital information management (Sabtu, Rukun, Sukardi, Permatasari, & Hayadi, 2019), digital modules (Setiyani, Putri, Ferdianto, & Fauji, 2020).

Based on existing research and development, the novelty of this study is in the development of learning media providing exercise problems that are presented randomly by computers and can be done repeatedly. In other words, the problem completed will be different from the next problem so that learners can train their ability to understand the material presented in the learning media and are expected to stimulate the way of thinking before students assess learning outcomes on other slides.

The mathematical learning media on plane geometry using the adobe flash CS6 software contains material, exercise problems, assessment of learning outcomes, animation, learning videos, text, music, and buttons that serve to connect between slides to produce learning media that attract, motivate, and foster student learning interests and improve students' understanding. The research question in this study is "how is the feasibility, practicality, and effectiveness of the resulting learning media?".

Method

This research used Research and Development (R&D) method, specifically a 4-D development model by Thiagaran, Semmel, and Semmel (1974): defining, designing, developing, and disseminating. The 4-D model for this research is in terms of stages the 4-D model is classified as systematic and following the stages in developing learning media. The

stages of the 4D model can provide clear directions in developing a learning media. In the 4D model, there are special stages in developing learning media systematically, and in more detail (Jatmiko & Fiantika, 2017; Supriadi & Hignasari, 2019).

The samples, 64 junior high school students in Yogyakarta, were selected using purposive sampling. The validity of the learning multimedia was tested by two people, a media expert and a material expert, consisting of one lecturer from a university in Yogyakarta and one mathematics teacher at junior high school in Yogyakarta. The instruments used in this study were (1) expert validation sheets, (2) student response questionnaires, and (3) tests. These instruments were used to determine the feasibility, practicality, and effectiveness of this multimedia learning.

The data analysis technique was quantitative descriptive statistics and descriptive qualitative analyses. Descriptive statistics analyzed students' test results on learning multimedia developed on plane geometry. In contrast, descriptive qualitative described the data of suggestions and comments from the validators.

The results of the validity and practicality of learning multimedia (Saputri, Sukirno, Kurniawan, & Probowasito, 2020; Sari & Wati, 2020) are presented in Table 1.

Table 1. Level of validity and practicality of learning multimedia

Score	Score		Criteria
	Formula	Calculation	
5	$X > X_i + 1{,}8\,SB_i$	$X > 4{,}20$	Very Feasible/ Practical
4	$X_i + 0{,}6\,SB_i < X \leq X_i + 1{,}8\,SD$	$3{,}40 < X \leq 4{,}20$	Feasible/ Practical
3	$X_i - 0{,}6\,SB_i < X \leq X_i + 0{,}6\,SB_i$	$2{,}60 < X \leq 3{,}40$	Quite Feasible/ Practical
2	$X_i - 1{,}8\,SB_i < X \leq X_i - 0{,}6\,SB_i$	$1{,}80 < X \leq 2{,}60$	Not Feasible/ Impractical
1	$X \leq X_i - 1{,}8\,SB_i$	$X \leq 1{,}80$	Very Not Feasible / Impractical

Information:
X = Respondent's score
X_i = Mean ideal, ½ (ideal maximum score + ideal minimum score)
SB_i = Ideal standard deviation, 1/6 (ideal maximum score - ideal minimum score)
Ideal maximum score = Σ item criteria × high score
Ideal minimum score = Σ item criteria × lowest score

The effectiveness result of the developed learning multimedia was to determine the percentage of the overall respondent's answer test results with the following formula (Otoluwa, Eraku, & Yusuf, 2020; Rizki, Gunawan, & Amirudin, 2020).

$$P = \frac{\sum x}{\sum x_i} \times 100\%$$

Information:
P : Percentage
$\sum x$: Number of respondents' answers in one item
$\sum x_i$: The ideal number of values in an item

Furthermore, to determine the level of effectiveness of the developed learning multimedia can be seen in Table 2.

Table 2. The level of effectiveness of learning multimedia

Interval	Criteria
85%-100%	Very Effective
75%-84%	Effective
65%-74%	Quite Effective
55%-64%	Ineffective
0%-54%	Very Ineffective

This learning multimedia product is valid if the average validator score is > 3.40, practical product could be stated as valid if the average student response is > 3.40, and the product is effective if the average percentage of student test scores reach the minimum criteria of mastery learning (> 75%). The the minimum criteria of mastery learning that the school has determined is 75.

Results and Discussion

Defining

At this stage, the activities carried out were analyzing problems in schools related to learning mathematics in the classroom. Exploration was done to gain more knowledge about matters relating to product manufacture. Exploration included curriculum, core competencies, basic competencies, indicators, subject matter, student characteristics, school conditions, specifications, and product components. Furthermore, observations and interviews were conducted with a junior high school math teacher.

Based on observations and interviews with one of the teachers in mathematics studies, the materials used at school were only textbooks and student worksheets. Other information was that there were limitations in using learning media in schools and only used PowerPoint assistance. In the learning process, textbooks, student worksheets, and PowerPoint assistance were used without making their learning media that can build student activity and become additional independent study materials to be repeated anywhere and anytime. Text books, student worksheets, and power points were only able to display two-dimensional elements in the form of illustration images and practice questions limited to student worksheets. In contrast, the plane geometry required real illustrations and more varied practice questions so that learning media that can display real illustrations and varied practice questions was needed to improve and master the material.

Furthermore, observations and interviews were conducted with junior high school students. Student analysis was performed to determine the character and needs of students. Based on the observations made in a Year 8 classroom with 32 students, the students were less interested in learning math subjects. When the teacher explained the material, students tended to not pay attention and chatted with their classmates and were busy with their activities. Teachers

also dominated activities in learning because students were less active in learning. Based on the students' character, it was necessary to use a learning media to attract students' interest in learning and encourage them to be active and more dominating in learning than teachers. Analysis of student needs was students faced the problems in the learning process. Based on interviews with several Year 8 students, information was obtained that students were bored with monotonous learning using textbooks, student worksheets, and power points. In addition, the package book was less attractive because it was presented less color so that student's interest in reading the package book was less. The student worksheets used contained questions that were not varied and limited to the questions contained in the student worksheets and did not immediately get the feedback after answering the questions.

The development of this learning media combined learning materials and practice questions that were varied and could be repeated and immediately knew the score after finishing their task. In multimedia learning, animations and videos were presented and expected to attract students' interest and motivation to understand the concepts of the material and the questions presented.

Designing

After exploring the define stage, the next step was product development design. The information data obtained were used as consideration for developing a new learning resource in the form of learning media. The next stage was making media using Adobe Flash software with the help of other application programs such as Photoshop, Ms. PowerPoint, and others. The stage of making specifications regarding the program was architecture, style, appearance, and material requirements. The design stage required storyboards to describe the flow of learning multimedia design. Learning media comprised two parts: (a) the introduction section consisted of the title, user identity, (b) the content section consisted of the home menu, material menu, video menu, evaluation menu, profile menu, and quit menu. Learning media was designed to display text, color images, video, audio, and practice questions in one learning media. It provided a special attraction for students to learn.

Developing

This stage was the stage of making a product based on the results of exploration and the initial design of the instructional media. The sequence of activities in the making of this stage was: preparation of plane geometry and its completeness (exam questions, answers, and so on), dubbing, creating or gathering instructional films, animating, and creating software/multimedia

programs (products). A home menu, material menu, video menu, evaluation menu, profile menu, and quit menu were all available in the learning media component.

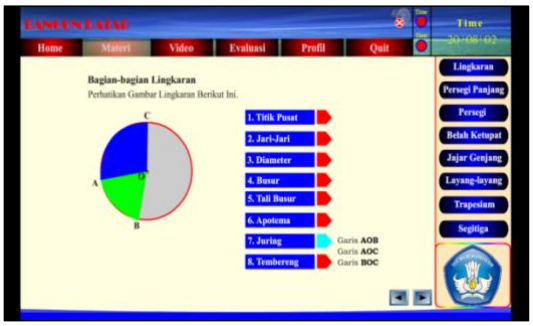

Figure 1. Material menu display

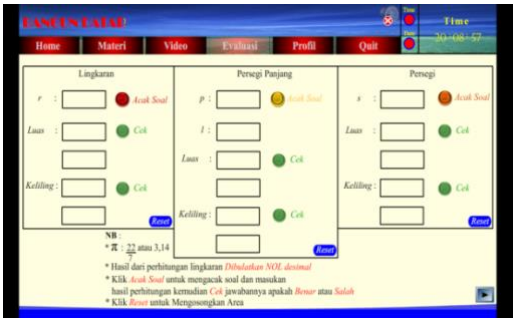

Figure 2. Question exercise display

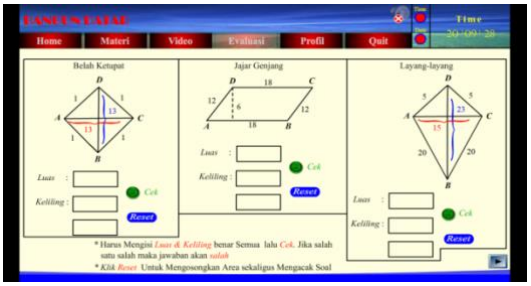

Figure 3. Question exercise display

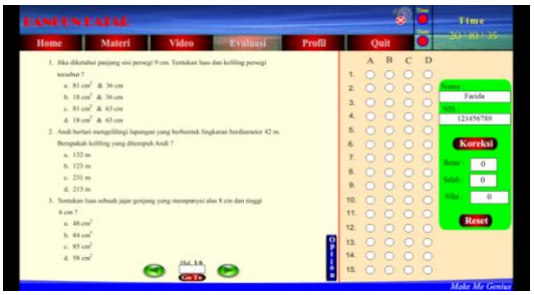

Figure 4. Display of learning outcomes assessment

Learning media was validated by the media and material experts. The findings of the media and material specialists' evaluations aimed to determine the feasibility of learning media and as a guide for revising the product being developed. The results of the media expert's assessment were carried out on the aspects of guidance and information, program performance, systematics, aesthetics, narrative and audio quality, video and/or animation quality, and multimedia design principles with an average of 4.83 in the eligible and excellent criteria without revision. Figure 5 presents the media expert's assessment.

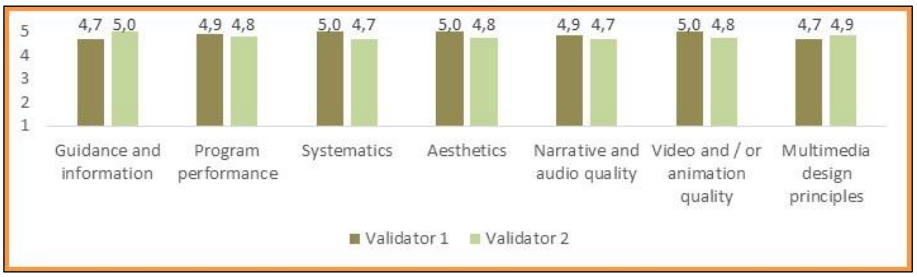

Figure 5. Media expert judgment chart

The outcome of the material expert's evaluation was carried out on the aspects of guidance and information, multimedia content or materials, and the evaluation obtained an average of 4.81 in the eligible and very good criteria. The advice from the material expert was

to correct the practice questions on the triangles so that the numbers that appeared randomly met the requirements of Pythagoras' argument. Figure 6 displays the material expert's assessment**.**

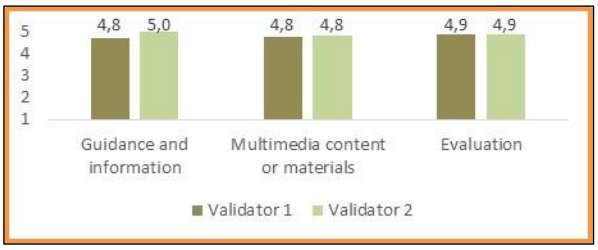

Figure 6. Material expert judgment chart

Furthermore, products that had been improved based on the data and suggestions derived from the media expert and material will be students' evaluation to see how they reacted to the practicality of the media. Media assessment was in the aspects of ease of navigation, the content of cognition, presentation of assessment information, media integration, artistic and aesthetic, and overall function. The results of the small group trial obtained an average of 4.7 in the very practical category. The results of large group trials were the last stage of the trials conducted. At this stage, the product being developed must have been close to perfection after completing the first step. The results of the large group average of the experiment were 4.9 in the very practical category. Figure 7 presents student responses to learning media.

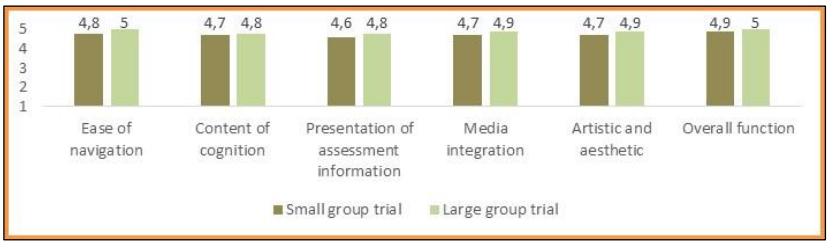

Figure 7. Students' response chart

The product's effectiveness was measured based on student test results, and tests were arranged based on a predetermined test grid. The test results show that all students' scores have reached the minimum criteria of mastery learning. This finding meant that all students had achieved individual mastery learning, making the classical mastery learning percentage 100%. It can be said that the product developed is effective because the percentage of classical completeness on the test results has exceeded the success indicator, namely 75%.

Disseminating

The learning media that had been revised was the next step to be implemented. Products in the form of mathematics learning media were developed and could be distributed. Mathematics learning media was disseminated to two junior high schools to be used by teachers and students in the learning process.

Based on the research and development findings obtained, It might be concluded that the mathematics learning medium created on plane geometry was feasibility, practical, and effective. The initial step in creating learning media was to collect data such as syllabus, lesson plans, book references to be used, and other sources. The following step was to collect the data to create learning materials based on the information gathered. Then, the learning medium designed was then validated by the media expert and material expert. The media that had been proven to be reliable was corrected according to input from the validators. A learning medium that had been completely revised was then tried out in schools through small group trials and large group trials. The data gathered during the trial stage was utilized to assess the feasibility and efficacy of the method of multimedia learning produced. When all of the processes had been completed, the teaching material in the form of mathematical learning material was ready to be used in this plane geometry suitable for learning activities for mathematics. Hence, it is believed that this educational medium would assist students to increase their drive and interest in learning and student understanding. It is in line with research conducted by previous researchers (Asiatun, 2017; Astuti & Nurcahyo, 2019; Gayatri et al., 2018; Iasha et al., 2018; Irvan et al., 2020; Nurlela et al., 2020; Rachmadtullah et al., 2018; Ramadhan et al., 2018; Sabtu et al., 2019; Setiyani et al., 2020) who have made a variety of learning media for the improvement of the teaching and learning process. Learning development and innovation were required to make it simpler for students to grasp the content to be presented.

This developed product had several advantages: the learning multimedia equipped with practice questions that could be repeated before working on test questions, students could practice their ability to understand the material presented in learning media and stimulate students' thinking. This statement was supported by previous research (Beckem & Watkins, 2012; Ruiz-Primo, 2011). With practice questions, students gain understanding and know-how to solve them directly before working on test questions. Furthermore, research conducted by Ringo and Bermuli (2020) reported that giving quizzes and practice questions to train students can improve student understanding in learning. Patni, Parwati, and Suharta (2018) said that by doing practice questions, students could change their way of thinking to be broader in understanding the material given. Then research was also carried out by Khasanah and Sutama (2015) who said that repeating the practice questions can facilitate students' memory and make students think. Almeida and Souza (2010) and Rosenshine (2012) also said that students should be given a lot of practice questions to increase their memory. Furthermore, Cai and Wang (2010) and Tiruneh, Verburgh, and Elen (2014) stated that students experience progress in doing practice questions so that they can complete the test. Arthur, Lochhead, and Narode (2013) also found that students who did practice questions had sharper memories and succeeded

in exams. Test exercises are used to stimulate students' memory and knowledge (Tofade, Elsner, & Haines, 2013).

Conclusion

This learning multimedia is valid, practical, and effective. Validity is proven by the results of media validation and material validation. From the validation results, this multimedia is valid because the material expert's validation findings are in the very valid category and the media expert's validation is in the very feasible category. From product trials, student responses to learning media were a very practical category. The students' scores met the minimum criteria of mastery learning, which means the learning media achieved a very effective criterion.

This research implies that theoretically interactive learning media can increase the spirit and motivation of learning learners and facilitate the learning process to lead to the increased achievement of learning outcomes. Practically speaking, the implications of this research for students can enhance the effectiveness of student learning by utilizing information technology developments such as multimedia learning to learn independently, actively, creatively, and pleasantly and everywhere without being limited by space and time. The product developed can be used as an alternative media in learning mathematics in the classroom. The learning process is more fun and can also be used as new reference material in the form of learning media to support education and quality in schools.

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