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The development of Adobe Flash-based interactive multimedia to enhance students' mathematical communication skills

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Abstract. The rapid development of technology in the community, and the lack of use of technology at schools. The research aims to develop adobe flash-based interactive learning media to improve students' mathematical communication skill. The method was research and development with 4-D model design consisted of four stages, namely defining, designing, developing, and disseminating. The research was in the Junior High School of Al Ma'sum Bandung. The respondents involved were the expert of subject matter, the expert of media, the teacher of Mathematics, 64 students as the sample. Finding: The result indicated that the validation result from the expert of media and the expert of Mathematics was enhance. The overall activity of teacher and students reached in average. Meanwhile, students' mathematical communication skill increased, experiment class higher than control class. The conclusion of the research is that the development of adobe flash-based multimedia version five has been feasible to use and it can enhance students' mathematical communication skill as well as students' interactivity. Moreover, the material delivery is easy to understand and interesting.

1. Introduction

Students are the main actors in the learning process. Teachers as a facilitator should provide an opportunity to the students to interact actively during the learning process. One of learning alternatives demanding students' activities is the interactive multimedia-based learning. Through interactive multimedia-based learning, teachers can help students get the real learning situation to provide understanding of abstract material concretely [1]. The interactive media provides an experience to the students to explore fictional environments and imaginations in learning in the classroom [2].

The reality in the field indicated that interactive multimedia was still less utilized well by some teachers in doing the learning process in the classroom. As a result, the learning was carried out in a conventional way even though multimedia devices were completely available in the classroom [3]. For some teachers, learning by using teachers' and students' handbook has been considered sufficient to meet learning needs in the classroom. Whereas, it is not equipped with clear supporting information. For example, the supporting images in the handbooks are only the illustration drawings made to resemble the original ones. Learning will be meaningful if the learning situation is carried out contextually or learning is based on its real condition.

Teachers can complement the existing shortcomings of the handbooks by utilizing interactive multimedia of computers as alternative teaching materials supporting the learning process in the

classroom [4]. Computers as media can visualize abstract material, so that learning is more interesting and easy to understand. Indicated that students using computer-based learning were better at solving the problems than the students using conventional way [5].

In this research the software used was Adobe Flash. Adobe Flash is a graphic design software being able to design various animations and navigation directly presented into the computer. Adobe Flash provides various features that can display various objects such as sound, image, music and graphic tailored to the needs of leaning media.

With the help of computer as the media, students will be more enthusiastic, directed and skilled, because learning can not only be heard. By visualization the material is easy to understand. The results of research that examine the development of learning multimedia using computer can improve students' learning outcomes [5] [6] [7]. Multimedia can provide a suitable display for learning material with 3-D solid as the topic [8]. Multimedia learning will help learners to more understand the mathematical concepts learnt, so that it can improve students' mathematical communication skill.

The awareness of improving students' mathematical communication skill through the development of adobe flash-based interactive multimedia needs growing, because one of the characteristics of mathematics in the learning process at school is to communicate material using symbols or media generally having been agreed and understood. The regulation of Ministry of Education and Culture (Permendikbud) number 59 year 2014 asserts mathematics is a universal science which is useful for human life, underlying the development of modern technology, playing the role in communicating various sciences, and advance the human thinking. Communicates an idea or mathematical idea by symbols, tables, diagrams, or other media to make the situation or problem clear [9]. The mathematical association [10] describes one of the purposes of learning mathematics is to communicate the use of appropriate media clearly and sequentially. In fact, mathematical communication is rarely emphasized in mathematics learning at schools. Students more often memorize the formula.

Based on the preliminary study by giving test of indicator of mathematical communication skills, the lowest value came to the indicator of daily events in mathematical symbol. It indicated that the mathematical communication skills of student's grade VIII at Junior High School of Al-Ma'sum was still low in category.

Based on the preliminary study, the development of adobe flash-based learning media to improve students' mathematical communication skills had not been developed much. Seeing the limitations of interactive media development, researchers conducted the development of adobe flash-based interactive multimedia as a companion of learning for students grade VIII at Junior High School of AL-Ma'sum in district of Bandung.

Thus, the research questions are: (1) How is the development of adobe flash-based learning media with 4-D model on the topic of prism and pyramid?, (2) How is the learning activity using adobe lash-based interactive multimedia and the conventional one?, (3) Is there any different improvement from the students' mathematical communication skill using adobe flash-based interactive multimedia and the students' mathematical communication skill using conventional learning?. In addition to this, the purpose of the research is to developed adobe flash-based interactive learning media to improve teachers' and students' communication skill and activity during mathematics learning.

2. Research methodology

The research and development with 4-D model design consisted of four stages, namely defining, designing, developing, and disseminating. The population of this research was all students of Junior High School of AL-Ma'sum grade VIII. The sampling of the population used random sampling technique. Three classes of research sample were selected in this research. They were grade VIII-A with 10 students in number and it was a small-scale test class. The class with large-scale test was grade VIII-F with 26 students. It was an experimental class using adobe flash-based multimedia teaching and grade VIII-B with 28 students in number using conventional learning.

The types of data used were quantitative and qualitative data. Quantitative data was obtained from pretest and posttest. While the qualitative data was gained from the validation of subject matter experts and media experts, observation sheet of students' and teachers' activity as well as questionnaire.

3. Result and discussion

3.1. Result

From the research carried out, the result of media development using 4-D model had appropriately run well in each stage. In the defining stage, students had difficulty in learning process, lack of motivation and learning innovation. Then, the media in accordance with the state of the students during the preliminary study was designed. In the media designing stage by analysis corresponding to the needs of students in the field. Then, the media version 2 was revised. In the developing stage the results of validation of subject matter experts and media experts as well as small-scale test using media version 3 were developed. Then, media version 4 as the result of validation was tested in a large scale. In the disseminating stage, the media version 5 was generated and it was appropriate to be disseminated with the appropriate score of validation of the media expert 79% in average, and the worthy score of validation of the subject matter expert 77% in average. The dissemination was carried out to schools and through blogs.

Learning activities using adobe flash-based multimedia in each meeting had increased. At the first meeting, the students who were not accustomed to using the media were still confused using the media. At the second meeting, the students began to get used to ask questions, and provide ideas. At the third meeting, the students were accustomed to beginning learning using Adobe Flash multimedia, asking and propounding their ideas. Overall the teachers' and students' activities were very good in category. Meanwhile, in general observer commented that teachers and students had been accustomed to implementing learning with adobe flash-based multimedia. The observer also argued that the material on the media was extremely suitable for learning. The media was convenient to improve students' mathematical communication skill. The result of recapitulation of teachers' and students' activities in each meeting can be seen in figure 1.
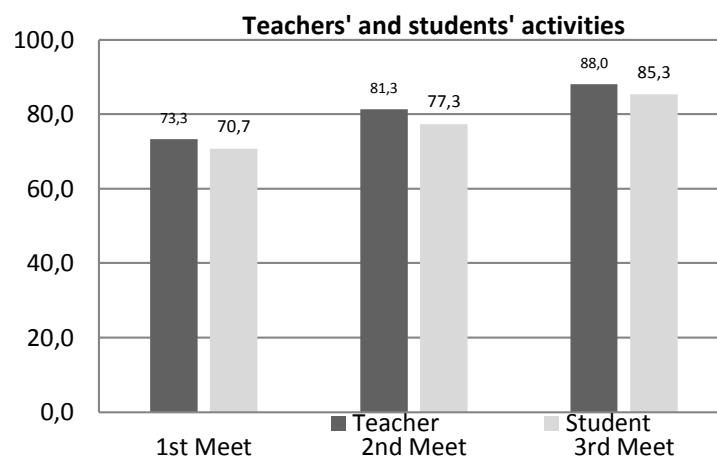

Figure 1. Recapitulation of teachers' and ttudents' activities in each meeting.

In figure 1, the results of analysis of teachers' activities based on observation sheet respectively for three meetings were 73.33%; 81.33%; and 88.00% in percentage with category good and very good. Meanwhile, the students' activities respectively for three times were 7.67%; 77.33%; and 85.33% in percentage with category good, and very good. In addition to this, the overall percentage of teachers' and students' activities was 79.33% in average with category good. Based on the data, the implementation of teachers' and students' activities during mathematics learning using adobe flash-based interactive multimedia was good and had increased in each meeting.

The difference of average score of N-Gain related to the improvement of students' mathematical communication skill at the experimental and control class was 0.50. It lay in 0,50> 0,3 and 0,50 <0,7 and it had average category. Meanwhile, the average score of N-Gain of control class was 0.27. It lay in 0.27<0.3 and it was in low category. It indicated that the enhancement of students' mathematical communication skill in the experimental class using adobe flash-based interactive multimedia learning was better than that of students with conventional learning.

To analyze whether there was the difference of improvement of students' mathematical communication skill, the statistic t test was carried out after it had been known that data assumption had normal distribution and it had homogeneous variance. In this research the assumptions had been fulfilled and the data had normal distribution with homogeneous variance.

The basis for decision making was as follows: if the mark of Sign was ≥0.05, Ho was accepted. If the grade of Sign was <0.05, Ho was rejected. From the calculation result of the t test it could be seen that the score of Sign was (0.000) <0.05, so that Ho was rejected and H1 was accepted. It meant that there was difference from students' mathematical communication skill using adobe flash-based interactive multimedia learning with students using conventional learning. In this study it showed that learning with adobe flash-based interactive multimedia was better than the conventional one.

3.2. Findings and discussion
The development of adobe flash-based multimedia through 4-D models in each stage had already run in accordance with the guidelines. At the last stage media version 5 was generated. It was made by combining some elements. They were animation, audio, text, and very interesting image. Adobe flash as software was used in creating information system applications, animated cartoons, interactive animations, animation effects, advertisement banners, websites, games, and presentations in the learning process [11].

Junior High School of Al-Ma'sum constitutes a boarding school with students' full activity. In this situation the students are easily saturated and have difficulty to understand mathematics lesson. However, with adobe flash-based multimedia learning students were very enthusiastic and got full of encouragement. Besides, the material delivered was easy to understand. The interactive multimedia developed can make students more interested in studying the learning materials [12]. Revealed that an interactive media of computer displaying animated media would grow the attraction, attention and students' motivation in a fun learning process [13]. Stated that interactive learning multimedia had met teachers' needs in improving delivery strategy of learning message, and had met students' diverse needs in studying the subject matter [14]. It was in line with [15] that by using interactive media, learning in the classroom became more effective. revealed that the development of interactive media incorporated various media that could be used for both independent and classical learning, so that the learners with varying degrees of ability could use it without any difficulty to understand the learning materials.

Experimental class using adobe flash-based learning multimedia had higher mathematical communication skills compared with the control one. Students studying mathematics using computer multimedia in the form of flash had significantly higher level of mastery of material compared with students who received the material only in the written text [17]. The media had function to obtain information involving students with real activities, so that learning was fun and the material was easy to understand [2].

Learning media with the program of adobe flash is good to be used to support interactive learning, because the software has more supreme ability compared with other software in displaying media, graphic combination, animation, sound, and has interactivity with the users [19]. The use of interactive media grows positive participation in learning [20]. In addition to this, the use of interactive media makes learning process interesting [21], and can increase students' interest and motivation in learning [22].

4. Conclusion

The development of adobe flash-based learning media with 4-D model on the topic of prism and pyramid in class VIII had run in accordance with the stages of 4-D models. Furthermore, media version 5 which was feasible to be disseminated was generated. Teachers' and students' activities got increased during learning process using adobe flash-based interactive multimedia. Students' mathematical communication skills using adobe flash-based interactive multimedia learning was better than that of students with the conventional one.

Acknowledgement

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