Mathematics Learning Media Development Assisted by Macromedia Flash to Improve Students Visual Thinking Ability and Students Learning Motivation

Mariani[1] Nurliani Manurung[1] Wingston Leornard Sihombing[1]

[1] *Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan, Medan 20221, Indonesia*
[*] *Corresponding author. Email: marianisihombing57@gmail.com*

ABSTRACT
The result shows that: 1) Mathematics learning media assisted by Macromedia flash in improving students mathematical visual-thinking capability and student learning motivation that have been developed have met the valid, practical, and effective criteria. 2) The improvement of student^s mathematical visual-thinking abilities using learning media assisted by Macromedia flash that has been developed is seen from the average N-gain value of 0.45 which means it is in the ^medium^ category. 3) The average and standard deviation of students^ mathematical learning motivation in the first trial as a whole were 77.17 and 10.13, respectively. While the average and standard deviation of students^ mathematical learning motivation in the second trial as a whole were 79.76 and 9.8, respectively.

Keywords: *Mathematic learning, Media development, Macromedia flash, Visual thinking, Learning motivation.*

1. INTRODUCTION

Macromedia flash is a very popular and handy application which can be used for creating Web animation, rich internet applications, desktop applications, mobile games and mobile applications.

One alternative to improve students visual thinking capability is to use mathematics learning media. Many media that can be used include macromedia flash program. The macromedia flash program is a dynamic and interactive program to support learning and solving math problems such as geometry. With various facilities owned. With the help of macromedia flash to be able to describe geometric shapes in a real context. So that students will be easier to understand, not just understanding routine problems.

Learning media is very useful in the learning process, learning media can generate new desires and motivations, generate motivation and stimulation of learning activities, and even bring psychological effects on students who use learning media at the teaching orientation stage and will greatly help the effectiveness of the learning process and delivery of messages and lesson content at the time [7].

There is a good relationship between the use of media with an increase in student motivation, especially in learning mathematics [6]. Therefore, this motivation is very important in creating an effective learning goal. The existence of motivation in students will make students feel more interested in doing something. as well as, with their motivation to learn on students then students will be interested to learn something.

Based on the description above, the authors are interested in conducting research related to learning media, visual thinking skills and students' motivation to learn mathematics, entitled "Development of Macromedia Flash-Assisted Mathematics Learning Media to Improve Visual Thinking Ability and Students' Mathematics Learning Motivation".

2. THEORETICAL STUDIES

2.1. Validity of Mathematics Learning Media Developed by Using Macromedia Flash

A Good learning media is media that is able to increase student motivation and understanding of the subject matter. To obtain good quality media and can create learning that is able to make students active, it

requires stages of development that are appropriate to the development model used. In this study the development model used is the Dick & Carey development model using the macromedia flash application [1]. Media developed using macromedia flash can produce quality media because the media produced will attract more students' attention through animations that are displayed so as to foster student learning motivation.

From the description above, it is reasonable to suspect that the quality of learning media using macromedia flash has a more attractive design quality, good graphics and language with high validity in accordance with the results of quality testing through trials of experts and field trials [2].

2.2. Practicality of Mathematics Learning Media Developed by Using Macromedia Flash

The practicality of the developed mathematics learning media can be seen through the practicality test questionnaire of learning media filled out by students during the mathematics learning process using learning media. The learning media developed is said to be practical if the practicality score from the practicality test of the developed learning media reaches a minimum value of 76% in the practical category [3].

2.3. The Effectiveness. of Mathematics Learning Media Developed Using Macromedia Flash

The success of the learning process in achieving the expected goals cannot be separated from the level of student involvement. The involvement of these students is influenced by their interest and motivation to learn. The use of learning media in the mathematics learning process can arouse desire and bring psychological influence on students. This will determine the student's response to the media [1].

The use of learning media in the learning process will greatly help the effectiveness of the learning process. Besides increasing students' learning motivation, it is also able to improve students' visual-thinking abilities.

In the development of this learning media, the effectiveness test is carried out by looking at the level of student learning mastery through the tests given at the end of the lesson and student learning motivation questionnaires then by looking at the positive responses of students to the developed media and the ideal use of time during the learning process using the developed learning media. take place. Positive student responses were obtained through a questionnaire given by students for field trials after they finished using the learning media. Learning media used by students in the learning process will be considered effective if the learning media developed with macromedia flash can meet the criteria for student responses to learning media at a minimum of good, students' visual-thinking abilities are classically completed and students' motivation to learn mathematics increases and has an ideal learning time [4].

Based on the description above, it is reasonable to suspect that the learning media assisted by macromedia flash developed is effective because it can improve students' visual-thinking abilities and motivation to learn mathematics.

2.4. Mathematics learning media assisted by macromedia flash can improved students visual thinking capability

By observing the characteristics of abstract mathematics lessons that are considered difficult by most students, teachers can make new innovations in the learning process. These innovations include finding out what can make students interested in mathematics. One way is to develop interactive learning media to foster student motivation in terms of learning and improve students' mathematical abilities. Interactive learning media is considered capable of increasing students' learning motivation. Students not only imagine geometric objects in their brains, but students can also see directly the animations of the geometric objects they are studying. This of course will be able to increase the willingness or motivation of students in learning mathematics [5].

Based on the description above, it should be strongly suspected that using learning media developed by macromedia flash can increase student’s motivation to learn mathematics.

3. METHOD

3.1. Type of Research

This research is included in development research. This study uses the Dick & Carey development model. This research is centered on developing mathematics learning media assisted by macromedia flash on cubes and blocks.

3.2. Date and Location Research

This research was carried out at the Bahal Batu I Private Junior High School in Siborong-borong for students in grades VIII-1 and VIII-2 for the 2020/2021 academic year. The time of the research was carried out in 2021.

3.3. Subject and Object Research

The subjects in this research are students in grades of VIII-1 and VIII-2 Bahalbatu Private Junior High School Siborong-borong, each of which consisted of 34 students

in trial 1. The object of this research is the learning media of mathematics with the help of macromedia flash on the material of building cubes and blocks.

3.4. Learning Media Development Procedure

This research is divided into 2 stages, namely the first stage is the development of components of learning media assisted by macromedia flash including (i) the validity of learning media; (ii) the validity of the visual-thinking ability test instrument; and (iii) a questionnaire on students' mathematical learning motivation. The second stage is testing the validated macromedia flash-assisted learning media to see its practicality and effectiveness.

The development of teaching materials in this study refers to the procedure of the Dick & Carey development model. The stages of developing the learning media can be seen as follows:

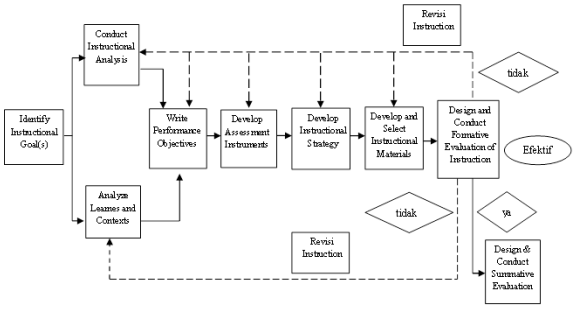

Figure 1 Dick & Carey Development Design Model.

4. RESULT AND DISCUSSION

4.1. Effectiveness Analysis of mathematics learning media assisted by macromedia-flash

Mathematics learning media assisted by Macromedia Flash will be appropriate to use if it can have a positive impact or significant influence on learning. Thus, the developed mathematics learning media assisted by Macromedia Flash must meet the effectiveness criteria, i.e. (1) classical student learning completeness, namely at least 85% of students were in class are able to achieve a score of 75; (2) the achievement of learning objectives is at least 85%; (3) at least 80% of the course gave a positive response to the components of the developed mathematics learning media assisted by Macromedia Flash. Description results of student's mathematical visual-thinking ability in the first and second trials are shown in Table 1.

Table 1 represent that the average mathematical visual-thinking ability of students on the pre-test results is 42.65 and the post-test results is 62.50. And also represent that the average mathematical communication ability of students on the pre-test results is 58.33 and the post-test results is 66.67. Furthermore, the results of classical visual-thinking skills of students in the first trial can be seen in Table 2.

Based on the data in Table 2 that can be seen, the classical completeness of the results of student's mathematical visual-thinking ability in the pre-test trial I was 11.76% while in the post-test trial I was 94.11%. Then the results of classical student learning mastery for student's mathematical visual-thinking ability in the second trial can be seen in Table 3.

Based on the data in Table 3 that can be seen, classical student learning completeness in the pre-test trial II was 65.63% while in the post-test trial II it was 87.50%. In accordance with the criteria for classical student learning mastery, namely at least 85% of students who take part in the learning are able to achieve a score of 71, then the post-test results of mathematical visual-thinking abilities in trial II have met the criteria for achieving classical mastery. So, it can be concluded that in the second trial the application of mathematics learning media assisted by macromedia flash that was developed has met the criteria for achieving mastery classically.

Achievement analysis of learning objectives was carried out to determine the percentage of learning objectives achievement on each item in the post-test of mathematical visual-thinking ability. The post-test learning objective achievements for visual-thinking mathematical abilities in the first and second trials can be seen in Table 4.

Table 1 Description results of mathematical visual-thinking capability pretest and posttest mathematics in Trial I and Trial II.

Description	*Pre-test* Mathematical visual-thinking ability		*Post-test* Mathematical visual-thinking ability	
	Trial I	**Trial II**	**Trial I**	**Trial II**
Highest score	75	100	100	100
Lowest score	16.67	16.67	25	33.33
Average score	42.65	58.33	62.50	66.67

Table 2 Classical Completeness Level of Mathematical visual-thinking ability in Trial I.

Category	*Pre-test* Total Students	Classical Completeness Percentage	*Post-test* Total Students	Classical Completeness Percentage
Completed	4	11.76%	32	94.11%
Uncompleted	30	88.23%	2	588%
Total	34	100%	34	100%

Table 3 Classical Completeness Level of Mathematical visual-thinking ability in Trial II.

Category	*Pre-test* Total Students	Classical Completeness Percentage	*Post-test* Total Students	Classical Completeness Percentage
Completed	20	65.63%	31	87.50%
Uncompleted	14	34.37%	3	12.50%
Total	34	100%	34	100%

Table 4 The achievement of the post-test learning objectives for visual-thinking mathematical ability in Trial I and Trial II.

No	Learning Purposes	Trial I Mathematical visual-thinking ability		Trial II Mathematical visual-thinking ability	
		% Achievement of Learning Objectives	Description	% Achievement of Learning Objectives	Description
1.	Students are able to identify and paint shapes (cubes) based on the complete appearance and classify the shapes based on the same characteristics	71.88%	Not Achieved	79.43%	Achieved
2.	Students are able to explain what can be seen and obtained, and communicate it or make comments and represent efforts to refine and identify the form of information provided.	72.39%	Not Achieve	76.30%	Achieved
3.	Students present problems in visual form such as pictures, graphs, diagrams or words that can help to relate and communicate to solve problems	72.39%	Not Achieved	84.38%	Achieved

From Table 4, first test results of mathematical visual-thinking ability, learning objectives achievement in question number 1 is 71.88%, learning objectives achievement for question number 2 is 72.39%, and learning objectives achievement for question number 3 is obtained. by 72.39%. And it is also seen that the results

of learning objectives achievement for each question of mathematical visual-thinking ability in the second trial, learning objectives achievement for question number 1 was 79.43%; learning objectives achievement for question number 2 was obtained at 76.30%, and learning objectives achievement for question number 3 was obtained at 84.38%.

Furthermore, the average percentage of the total positive response of students in the first trial was 85.52%. And the average percentage of the total positive response of students in the second trial was 93.23%. If the results of this analysis are referred to the criteria set out in chapter III, it can be concluded that the student's response to the components and learning activities is very positive. Because, more than 80% of students who gave a positive response to the components of the learning media developed.

Based on the results of the data analysis of the first trial, it is known that the learning media developed has been effective, this is based on the indicators of the effectiveness of the learning media that have been achieved, namely the post-test results of students' mathematical visual-thinking abilities in the first trial of 94.11% have met the criteria the achievement of classical mastery, learning objectives achievement has reached the specified criteria, the achievement of learning time which is at least the same as the conventional learning time has been achieved, and positive student responses to the components of developed learning media assisted by macromedia flash.

4.2. Analysis of the practicality of learning media assisted by macromedia flash

The practicality of the developed learning media can be seen from: (1) the results of the validation of experts, (2) the ability of teachers to manage learning. Based on the two practicality criteria, it was found that the expert team stated that the learning media could be used with minor revisions and the learning implementation had also met the predetermined criteria presented in Table 5 as follows:

Table 5 The average assessment of the teacher's ability to manage learning in the Trial II.

No	Aspects Observed	Average Each Aspect
1	Kegiatan Awal	4.1
2	Directing students to understand contextual problems	3.8
3	Guiding solving contextual problems	3.6
4	Compare and discuss answers	4
5	Conclusion	3
6	Closing	3.8
Average Capability Teachers		3.7
Category		GOOD

From Table 5 above, the highest score is the teacher's ability to manage the introduction or early learning activities, which is 1 from the maskal score of 5. While the lowest score is the ability of the teacher to conclude is 3. The value of the teacher's ability to direct students in understanding contextual problems is 3 8, the teacher's ability to guide in solving contextual problems is 3.6, the teacher's ability to compare and discuss answers is 4 and the closing activity is 3.8.

The average overall ability of teachers to manage learning using learning media developed in the second trial was 3.7 and was in the "GOOD" category. Based on the reference in Chapter III regarding the teacher's ability to manage learning, it is said to be successful if the ability score is in the "GOOD" category or at least 3.50 ⩽KG <4.50.

Based on the discussion above, it can be concluded that the learning media that has been validated by experts, states that the developed media can be applied or used in the field with little or no revision. In addition, the results of the teacher's ability to manage learning regarding the learning media developed have met the specified criteria. Thus, it can be concluded that the mathematical learning media assisted by macromedia flash that has been developed meets the "practical" category.

4.3. Analyze improvement students mathematical visual-thinking abilities

The improvement of students' mathematical visual-thinking ability in the first and second trials will be seen through the N-Gain from the results of the pretest and post-test mathematical visual-thinking abilities in the first and second trials. The results of the calculation of N-Gain on students' mathematical visual-thinking abilities can be seen in the Table 6 as follow:

Table 6 Summary of results of N-gain mathematical visual-thinking ability test I and trial II.

N-Gain	Interpretation	Total Students (Trial I)	Total Students (Trial II)
$g \leq 0,3$	Low	2	16
$0,3 < g \leq 0,7$	Medium	9	3
$g > 0,7$	High	23	15

Based on Table 6 in the first trial, it can be seen that students who scored N-Gain in the range > 0.7 or experienced an increase in mathematical visual-thinking ability with the "High" category were 23 students, students who experienced an increase in mathematical visual-thinking ability with "Medium" category or got an N-Gain score of 0.3 < g 0.7 as many as 8 people and

students who experienced an increase in mathematical visual-thinking abilities in the "Low" category or got a score of N-Gain g 0.3 as many as 2 person. So, the average gain in the first trial was 0.21 in the high category. Based on Table 6 it can also be seen that there are 15 students who get an N-Gain score in the range > 0.7 or experience an increase in their mathematical visual-thinking ability in the "High" category. Students who experienced an increase in mathematical visual-thinking ability in the "Medium" category or got an N-Gain score of 0.3 < g 0, 0.7 as many as 16 people and students who experienced an increase in mathematical visual-thinking ability in the "Low" category or got a score N-Gain g 0.3 as many as 13 people. So, the average gain in the second trial was 0.37 in the medium category.

4.4. Analyze the improvement of students learning motivation capability

The increase in students' learning motivation in the first trial will be seen through the N-Gain from the results of the pre-test and post-test student learning motivation in the first and second trials. The results of the calculation of N-Gain on students' learning motivation can be seen in the Table 7 as follow:

Table 7 Summary of the results of the N-gain students' learning motivation in the Trial I and Trial II.

N-Gain	Interpretation	Total Students (Trial I)	Total Students (Trial II)
g ≤ 0.3	Low	18	15
0.3 < g ≤ 0.7	Medium	14	14
g > 0.7	High	0	3

Based on Table 7 In the first trial, it can be seen that students who get N-Gain scores in the range > 0.7 or experience an increase in student motivation in the "High" category as many as 0 people, students who experience an increase in student motivation in the "Medium" category or get a score N-Gain 0.3 < g 0.7 as many as 14 students and students who experienced an increase in learning motivation ability in the "Low" category or scored N-Gain g 0.3 as many as 18 people. So, the average gain in the first trial was 0.25 in the low category. And in the second trial, it can be seen that there are 3 students who get an N-Gain score in the range > 0.7 or experience an increase in student motivation in the "High" category. Students who experienced an increase in student motivation in the "Medium" category or got an N-Gain score of 0.3 < g 0.7 as many as 14 people and students who experienced an increase in students' learning motivation were in the "Low" category or got an N-Gain score g 0.3 as many as 15 people. So, the average gain in the second trial was 0.31 in the medium category.

5. CONCLUSION

Mathematical learning media assisted by macromedia flash in improving mathematical visual-thinking abilities and students' learning motivation that has been developed has met the criteria of being valid, practical, and efficient. The improvement of mathematical visual-thinking skills using macromedia flash-assisted learning media that has been developed is in the "medium" category. Students' mathematical learning motivation after using macromedia flash-assisted mathematical learning media that has been developed produces students who have learning motivation in the "medium" group.

REFERENCES

[1] Z. Amir, Risnawati, Psikologi Pembelajaran Matematika, Aswaja Pressindo, Yogyakarta, 2016.

[2] N. Kania, Efektivitas Penggunaan Alat Peraga Maya (Virtual Manipulative) Terhadap PeningkatanVisual Thinking Siswa, Jurnal THEOREMS, vol. 1, 2016, pp. 45-57. DOI: http://dx.doi.org/10.31949/th.v1i1.291

[3] N. Kania, Efektivitas Alat Peraga Konkret Terhadap Peningkatan Visual Thinking Siswa, Jurnal THEOREMS, vol. 1, 2017, pp. 64-71. DOI: http://dx.doi.org/10.31949/th.v1i2.350

[4] Sumarni, A.T. Prayitno, Kemampuan Visual-Spatial Thinking dalam Geometri Ruang Mahasiswa Universitas Kuningan, JES-MAT, vol. 2, 2016, pp. 81-100. DOI: https://doi.org/10.25134/jes-mat.v2i2.349

[5] I. Mulyadi, D. Muhtadi, Proses Berpikir Siswa dalam Menyelesaikan Masalah Geometri Berdasarkan Teori Van Hiele Ditinjau dari Gender, Jurnal Penelitian Pendidikan dan Pengajaran Matematika, vol. 4, 2019, pp. 1-8. DOI: https://doi.org/10.37058/jp3m.v5i1.661

[6] E. Sundari, M.N. Prabawati, Analisis Kemampuan Visual Thinking dalam Menyelesaikan Domain Soal PISA, JARME: Journal of Authentic Research on Mathematics Education, vol. 1, 2019, pp. 131-138. DOI: https://doi.org/10.37058/jarme.v1i2.785

[7] K.W. Wardani, D. Setyadi, Pengembangan Media Pembelajaran Matematika Berbasis Macromedia Flash Materi Luas dan Keliling untuk Meningkatkan Motivasi Belajar Siswa, Scholaria: Jurnal Pendidikan dan Kebudayaan, vol. 10, 2019, pp. 73-84. DOI: https://doi.org/10.24246/j.js.2020.v10.i1.p73-84