

Improving Students' Spatial Ability by Using Macromedia Flash on Geometry Materials

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ABSTRACT

Every student must have and develop spatial abilities to be successful in learning geometry. The rapid development of technology also allows teachers to use macromedia flash as an alternative in developing and improving students' spatial abilities. This study aimed to determine and describe the improvement of the students' spatial ability after getting geometry material by using macromedia flash at MTsN Model Banda Aceh. This research used a quantitative approach with a quasi-experimental design and one group pretest posttest design. The population of this study was all students of class VIII MTsN Model Banda Aceh with random sampling as the sample selection techniques so that the selected sample was the students of class VIII-5. The data collection in this study was carried out using a spatial ability test consisted of pretest and posttest questions. The gained data were analyzed with SPSS version 17 with paired sample t-test and percentage. The results showed that there was an improvement in students' spatial ability after having geometry material learning by using macromedia flash at MTsN Model Banda Aceh. Besides, the improvement of students' spatial ability based on indicator of perception spatial was 61.1%, mental rotation indicator was 55.6%, and indicator of visualization spatial was 66.7%.

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1. INTRODUCTION

One of the mathematical materials that must be mastered by students is geometry. NCTM (Petrus, 2017) stated why geometry needs to be taught at schools because: (1) the world is built by form and space; (2) formal geometry is very helpful for students who experience abstraction problems; (3) it helps to solve the problems in other fields of mathematics; and (4) it helps students think visually. Furthermore, NCTM (2000) also stated that the purpose of geometry taught at schools is that students can use visualization; they have spatial abilities and geometry modeling to solve problems. In the context of the national curriculum in Indonesia, geometry is also a material that must be studied from elementary to high school level. Even more or less 40% of geometry material is studied at the junior high level. However, to study geometry, especially the geometry of space, spatial abilities are needed.

The National Academy of Science (2006) stated that each student must develop spatial abilities and its sense which are very useful in understanding the relations and the nature of geometry to solve mathematical problems. Spatial ability is an important factor to be succeeded in geometry (Battista, 1990; Battista & Clements, 1996; 1991, Battista, Wheatley & Talsma, 1982). Spatial ability can be defined as the ability to evoke, maintain, regain, and change well-structured visual images (Lohman, 1993). De Lange (2003) also said that spatial ability is the ability that supports understanding of the world (3D) which requires an understanding of the nature of objects, relative positions and other things related to spatial. Whereas Linn and

Petersen (1985) declared that spatial ability is a mental process in perceiving, storing, remembering, creating, changing and communicating the shape of space which is then grouped into three categories, namely (1) spatial perception, (2) mental rotation, and (3) spatial visualization. Gutierrez (1997) and McGee (1979) state that there are two main abilities in spatial ability, namely spatial orientation and spatial visualization.

Spatial ability is not only important and needed in the study of mathematics, especially geometry, but it is also highly needed in other cross-science contexts. Strong and Roger (2002) stated that in industrial technology, spatial capabilities are very useful in simulation, multimedia, and modeling. Spatial ability is also very important for chemistry (Pribyl & Bodner, 1987), physics (Pallrand & Sbeer, 1984), engineering (Yue, 2002; Gonzalez, *et al.*, 2016), and astronomy, education, geography, geosciences, and psychology (National Academy of Science, 2006). As a result, adequate guidance and attention are needed from all parties, especially teachers as an effort to develop students' spatial abilities as required in the curriculum.

This is because there are still facts in the field that show students are still difficult in solving geometrical problems that demand spatial ability. Hidayat and Mirza (Nursyahidah, 2016) said that there are still many students who experience difficulties in learning geometry. Furthermore Bustang, Zulkardi, Darmawijoyo, Dolk, & Van Eerde (Septia, Prahmana, Pebrianto, and Wahyu; 2018) stated that geometry is one of the problematic materials because it requires spatial ability. The

results of interviews of mathematics teachers who teach in class VIII MTsN Model Banda Aceh (2018) also stated that the dominant student get difficulty in geometry especially space geometry. This is why students' spatial abilities need to be considered and improved in learning geometry.

Based on the results of a preliminary study in class VIII of the MTsN Model Banda Aceh, it is found that 72% of students had difficulty in solving geometry problems that demanded spatial ability. One of the reasons is that the students are not accustomed to solve the problems that demand spatial abilities such as spatial perception, mental rotation, and spatial visualization. As a result, indicators identify spatial structures vertically or horizontally, identify spatial structures and elements which their position have been manipulated by rotating the shapes, and identify the composition of spatial structures in which changes or movements have not been achieved yet.

One possible alternative that can help students to improve spatial ability in geometry material is by designing the learning process by using macromedia flash. This is because macromedia flash can make the learning more interesting and make it easier for students to imagine in understanding spatial features that are useful in solving every geometry problems.

Macromedia flash is an application that is used to design presentation devices, publications, or other applications that require the availability of means of interaction with the use of projects built with flash, can consist of texts, images, simple animations, videos, or other effects (Wahono, 2002). Simbolon, Mulyono, and Syahputra (2017) also said that the use of macromedia flash can help teachers to design and develop instructional media in the form of animation that can be played with flash movies, aimed to facilitate the students in understanding and identifying mathematical problems provided by the teacher.

The results of Guzel and Gunhan's (2010) research on prospective mathematics teachers' views about using flash animations in mathematics lessons concluded that teachers agree on the importance of using flash animation in mathematics. The results of the three teachers interviewed showed a paradigm change in using flash animation in mathematics from pre-interview and post-interview which showed the importance of technology integration into mathematics learning. The result of a research conducted by Simbolon, Mulyono, and Syahputra (2017) about the efforts to improving the mathematical critical thinking student's ability through problem solving learning strategy by using macromedia flash also obtained results: (a) the application of learning with the problem solving approach using macromedia flash can improve students' critical thinking skills. This can be seen from the achievement of increased learning outcomes obtained 40% in the first cycle to 60% in the second cycle, and 80% in the third cycle. b) the ability of teachers to manage learning with the problem solving approach using macromedia flash in both categories in the third cycle with an achievement of 87.5%.

Based on the opinions and results of previous studies above, the use of macromedia flash in mathematics learning in geometry material is possible to improve students' spatial abilities. The expected goal of this research is to find out and describe the improvement of students' spatial ability after having geometry material learning by using macromedia flash at MTsN Model Banda Aceh.

2. RESEARCH METHOD

This research used quantitative approach with a quasi-experimental research design with one group pretest posttest design. Arikunto (2010) stated that one group pretest posttest design is an experimental model carried out in one group only by comparing the results of the initial test with the final test. The population in this study was all students of class VIII MTsN Model Banda Aceh, while in selecting the sample, random sampling techniques was used and it was students of class VIII-5.

The learning instrument used was the lesson plan, student worksheet, and teaching materials in macromedia flash form. While the data collection instrument is a spatial ability test in description item form developed based on the indicators of spatial ability as presented in Table 1 below.

Table 1. Spatial Ability Indicator

Spatial Ability	The Measured Ability	Indicator
Perception Spatial	Observing a geometry or elements of geometry	Identifying the position of geometry vertically or horizontally
Mental Rotation	Rotating a geometry	Identifying the geometry and elements that have been manipulated by rotating the position
Visualizati on Spatial	Visualizing or manipulating a geometry	Identifying the composition of the geometric in which there is a change or displacement

While the data collection in this study was carried out using tests consisting of pretest and posttest which analyzed using SPSS version 17 and the statistical test used paired sample t-test at a significance level of 5%.

3. RESULTS AND DISCUSSION

Based on the results of the analysis of pretest and posttest data, the average spatial ability of students in geometry material before and after having learning material by using macromedia flash was 40.19 and 83.92. The normality test result of pretest and posttest also shown normal distribution data. Furthermore, an analysis was performed to see the increase of students' spatial ability after having material learning by using macromedia flash used paired sample t-test at a significance level of 5%. The research hypothesis tested in this study was that there is an increase of students' spatial ability after getting learning by using macromedia flash on geometry material at MTsN Model Banda Aceh.

The formulation of the statistical hypothesis is as follows:

H_0 : There is no improvement in students' spatial ability after getting learning by using macromedia flash on geometry material at MTsN Model Banda Aceh.

H_a : There is an improvement in students' spatial ability after getting learning by using macromedia flash on geometry material at MTsN Model Banda Aceh.

The results of data analysis using paired sample t-tests can be seen as presented in Table 2 below.

Table 2. The Result of Hypothesis Test by *Paired Sample t-Test*

Paired Differences			t	df	Sig. (2-tailed)
Mean	Std. Deviation	Std. Error Mean			
-43.7	6.7	1.1	-39.1	35	.000

Based on the results of the hypothesis test presented in Table 2 above it can be seen that the value of sig. < α or $0.00 < 0.05$, so based on the criteria H_0 testing was rejected or H_a was accepted. As a result it can be concluded that there is an improvement of students' spatial ability after learning by using macromedia flash on geometry material at MTsN Model Banda Aceh. The improvement of students' spatial ability on geometry material in this study shows that the students can understand well the given or taught spatial concepts in geometry by using macromedia flash. This is also supported by the result of research by Simbolon, Mulyono, and Syahputra (2017) concluded that the application of learning with problem solving approaches using macromedia flash can improve students' critical thinking skills. The result of the study (Liberna and Nusantari, 2018; Umam and Yudi, 2016) also concluded that there was an improvement of students' mathematics learning achievement after being taught by using macromedia flash.

The improvement of students' spatial ability in this study is also inseparable from the advantages found in macromedia flash that can make interactive buttons with a movie or other object, make changes in color transparency in movies, make changes in animation from one form to another, make movements animation by following a predetermined path, and can be converted and published into several types including .swf, .html, .gif, .jpg, .png, .exe, .mov. The thing that happened in learning by using macromedia flash at the time of the research was also grabbed the students' interesting, curiosity, and motivation to learn due to the display of learning material could be understood easily by the movement of the animations.

Learning by using macromedia flash can also illustrate geometrical shapes in various conditions and positions, so that the spatial ability or spatial of students can really be sharpened. Because before learning by using macromedia flash students had not been able to imagine higher and felt difficulty in imagining if the geometry space is rotated, visualized or manipulated in various forms, and identified the vertical and horizontal position of the geometry.

Another effect of the design of teaching materials in the form of macromedia flash is also very helpful for students to be able to learn independently from teaching materials that have been made in flash flexibly and what students have already imagined can be seen visually. This is relevant to Pesonen's statement (Guzel and Gunhan, 2010) stated that using macromedia flash is an important start in connecting abstract mathematics to the concrete or vice versa, so that learning mathematics is more meaningful.

The improvement of students' spatial ability is based on the indicators of spatial ability as presented in Table 3 below.

Table 3. Improving Student' Spatial Ability Based on Indicators

No	Spatial Ability	Indicator	Percentage (%)		
			Pre-test	Post-test	Improve ment
1	Perception Spatial	Identifying the position of geometry vertically or horizontally	25,0	86,1	61,1
2	Mental Rotation	Identifying the geometry and elements that have been manipulated by rotating the position	19,4	75,0	55,6
3	Visualizatio n Spatial	Identifying the composition of the geometric in which there is a change or displacement	13,9	80,6	66,7

The data also can be presented in the form of the percentage bar charts of the students' spatial ability improvement based on indicators as in Figure 1 below.

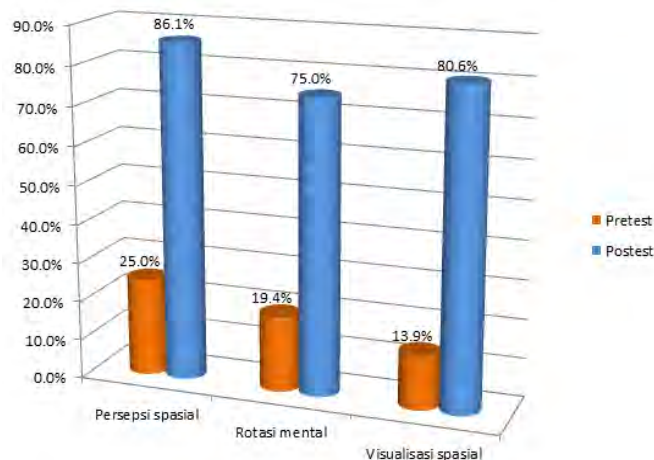


Fig 1. The Percentage of the Improvement of Students' Spatial Ability.

Based on the bar chart above it can be seen that the spatial ability of the students on perception spatial before learning by using macromedia flash was 25.0% and after learning was 86.1% with an improvement obtained was about 61.1%. Spatial ability in mental rotation before learning by using macromedia flash was 19.4% and after having it was about 75.0% with an improvement about 55.6%. The spatial ability of the students in visualization spatial before learning by using macromedia flash was about 13.9% and after learning was about 80.6% with an improvement of 66.7%.

The success in an effort to improve students' spatial ability in this study, using macromedia flash, which is a computer application relevant to the result of Syahputra's research (2013) concluded that a realistic mathematics learning approach on the topic of geometry with the help of a 3-D cabri computer program can improve students' spatial

ability at school categorized as good and medium. Likewise, realistic mathematics learning approaches can improve the spatial ability of students who have high, intermediate and low background of former math abilities. In addition to this, there is an influence between the learning approach and school categories on improving students' spatial ability. Nurkholis's research result (2012) also concluded that the achievement and improvement of students' spatial sense abilities who obtained computer-aided problem-based learning were better than the achievement and improvement of the abilities of students who obtained conventional learning and the achievement and improvement of students' spatial sense abilities in both classes was classified in medium level.

4. CONCLUSION

Based on the results of the data analysis and the discussion that have been described, it can be obtained the following conclusions: (1) There is an improvement of students' spatial ability after having geometry material learning by using macromedia flash at MTsN Model Banda Aceh. (2) Improvement of students' spatial abilities based on indicators obtained that: (a) for indicator of perception spatial, the improvement obtained about 61.1%, (b) for mental rotation indicator, the improvement obtained by 55.6%, and (c) for visualization spatial indicator, an improvement of 66.7% was obtained.

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