Student’s Spatial Reasoning through Model Eliciting Activities with Cabri 3D

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Abstract The purpose of this research is to find the influence of cabri 3D on the improvement of spatial reasoning ability of junior high school students through model eliciting activities learning with cabri 3D. This research is a quasi experimental research. The study was conducted in one of junior high school in Palembang with 143 students as a sample. Sample consist of 71 students with model eliciting activities (MEA) and 72 students through MEA learning with Cabri 3D (MEAC). Data conducted by test spatial reasoning before and after learning approach applied by researcher. The results indicate that the enhanced spatial reasoning abilities who obtain MEAC learning are better than male and female students with MEA learning. This means that learning with cabri 3D has a significant effect on improving students' spatial reasoning abilities. It caused in MEAC learning, the student has opportunity to use cabri 3D that make student more enthusiasm and easier to understand about concept line and angle. Based on the result teacher can apply this approach in mathematics learning to improve student’s spatial reasoning ability.

1. Introduction
Learning is essentially a process of interaction with all situations around individuals. Learning can be viewed as a process directed to the goal and process of doing through various experiences.

In the curriculum of elementary school mathematics education, material geometry has given. In the student’s books, especially to junior high students the material of geometry is so abstractly designed, that the junior high school students, have not been able to fully abstract thinking. Such conditions make the material geometry a burden that is so heavy for students. Other problems that arise include the difficulty in understanding the concept of geometry. One of research which analyzes students 'difficulties on solid geometry, mentions that students' difficulties include the difficulty in visualizing the polyhedron, especially in understanding the shape, elements and nature of polyhedron [1]. The existence of this difficulty will certainly have an impact on student learning outcomes, whereas in fact geometry is very important because many activities in everyday life associated with geometry.

Learning geometry helps students develop logical abilities [2]. In addition, geometric representations can be used to explain mathematical concepts and procedures. From the beginning of the beginning to more than two hundred and fifty years ago, geometry has been developed in several key aspects: (a) interaction three dimension geometry in space. Knowledge is concentrated on length, area and volume and relationships between them; (b) three dimension geometry and its changes in space and (c) three dimension geometry as the basis of reflection on visual information through representation, explanation, generalization, and documentation [3].

One of the efforts to overcome the problem one of them is the teacher can apply the appropriate learning approach and use the media for the learning of geometry in addition to the presentation of realistic problems that is through the use of information technology such as the use of geometry-related software. The integration of the software in this lesson enables the learning to be more interactive. Students can understand the concept given with the help of software, students can manipulate and visualize through software.

One of the appropriate learning approaches is the model eliciting activities with cabri 3D, in these learning steps students are given contextual problems presented with cabri 3D. Six principles in that must be applied in applying model eliciting activities approach are the model construction Principle,
the reality principle, the self-assessment principle, The construct shareability and reusability principle, and the effective prototype principle [4] [5]. Cabri 3D is one of the software that can be used in the learning of geometry, then the students are given time to think what steps should be taken to solve the problems given. Furthermore, students and their groups discuss the problems to find the right solution, the discovery of this solution can be assisted by visualization using cabri 3D software. Then they presented the results of the discussion. So through learning model eliciting activities with cabri 3D allegedly can improve students' spatial reasoning ability. The purpose of this study was to find influence of cabri 3D on the improvement of spatial reasoning ability of junior high school students through model eliciting activities learning with cabri 3D.

2. Experimental Method
This research is quasi experiment research, with sample of 143 students of class VII from one junior high school in Palembang. The sample was divided into two groups, one group was treated with MEA learning and other groups through MEAC learning. Before the learning was applied, the researcher first made the teaching materials and student worksheet for both groups, and spatial reasoning ability test. They are evaluated and validated by four validators in interface, content, and language aspect. Content validity covers the appropriateness of learning materials, student’s worksheet and test with basic competences, indicators, materials, and students’ characteristics. Interface validity is about their clarity, which does not have ambiguous interpretation and unclear figures. Besides, language used in the learning materials, student’s worksheet, and test is easy to be comprehended by students. The result from these four validators shows that the learning materials, student’s worksheet, and test are valid and reliable. The data conducted by test, the reasoning ability test given by the researcher before and after treatment. From score pretest and posttest obtained n-gain score.

3. Result and Discussion
To obtain a description of the quality of students’ spatial reasoning improvement abilities, the data were analyzed descriptively to determine the mean of n-gain and standard deviation. Table 1 shows descriptive statistics of students’ spatial reasoning abilities data based on gender. The average n-gain spatial reasoning ability of male students obtaining MEAC learning is higher than the average increase of spatial reasoning ability of female students who have learned MEA. Likewise for female students, the average increase in the spatial reasoning ability of female students obtaining MEAC learning is higher than female students who have learned MEA.

| Table 1. Descriptive statistics of students’ spatial reasoning abilities data based on gender |
|-----------------------------------------------|
| Learning approach | MEAC | MEA |
|-------------------|------|-----|
| Male Subject      | 36   | 40  |
| n-gain average    | 0.463| 0.279|
| Stdev             | 0.166| 0.199|
| Female Subject    | 36   | 31  |
| n-gain mean       | 0.439| 0.233|
| Stdev             | 0.163| 0.279|

After the test of normality and homogeneity, then tested the difference of average increase of spatial reasoning. For homogeneous data used t-test, while non-homogeneous use t’-test. The mean difference test results are shown in Table 2 and Table 3. In table 2 the probability value (Sig.) 0.000 while in Table 5 the probability value is 0.001, in this case the two probability values are less than 0.05. This means that the probability value is smaller than the specified significant level. Thus H₀ is rejected, meaning there is a significant difference in the increase of spatial reasoning in students who have MEAC and who have MEA learning, both for male and female students.
Table 2. Result of Mean Differences Test of Male Students

| T Value | Sig. | Ho     | Interpretation  |
|---------|------|--------|-----------------|
| Male    | -4.356 | 0.000  | Rejected        | There difference |

Table 3. Result of Mean Differences Test of Male Students

| T Value | Sig. | Ho     | Interpretation  |
|---------|------|--------|-----------------|
| Female  | -3.163 | 0.001  | Rejected        | There difference |

Based on the above results, MEAC learning has a positive effect on student activity in the classroom during the learning process. In other words, the results of this study indicate that MEAC learning is better at improving students' overall spatial reasoning ability. This is because MEAC learning facilitates students in training and developing spatial reasoning abilities. Due to the learning of MEAC students are directly involved to understand the concept given by visualization using the Cabri 3D, so it is possible to get through the activities of the students able to train and develop their spatial reasoning ability. Figure 1 shows a cube in cabri 3D and student can determine relation about line and make a different position.

![Cube in different Position](image1)

**Figure 1. Cube in different Position**

In Figure 2 Students can know how to draw an angle and it size.

![Types of Angles](image2)

**Figure 2. Types of Angles**

Student also can proof that

\[ \angle AED = \angle BEC \text{ and } \angle AEC = \angle BED \]
Visualization in the learning of mathematics is not new, because mathematics involves symbols, diagrams and abstract notations that require visualization, visualization is the ability, process and product of creation, and what’s on mind [6]. In the learning students are given opportunity to discuss with friends of his group, plan and determine the appropriate steps in solving the problem. This activity also supports students to increase their knowledge and open their insight and reasoning ability. Cabri 3D is not only used as a software that presents mathematics geometry but can give ease of math by show the authenticity of various models. This software makes it easy for students and teachers to explore different geometry shapes and models. Students can be more active in learning by exploring under the guidance of teachers. This software also provides convenience to students to be more able to prove theory and concept independently by using a little calculation and simple manipulation.

The findings of this study are also supported by the results of Wulandari’s research revealed that there are differences in student achievement using the application of realistic mathematics learning assisted Cabri 3d.v2 software and students who use conventional learning on Materials Dimension Three Geometry [7]. In addition, In the learning of the use of software Cabri II Plus can be used as an effort to improve the ability to arrange geometric proof. Mathematics learning with model eliciting activities needs to be applied to schools so that the application of learning becomes wider, and need a variation of learning by using model eliciting activities, this will be able to improve student ability in mastering mathematics concept [8].

Based on the mean of enhancement spatial reasoning ability, male student at MEAC and MEA learning had better than female. It suitable with the theory that men are on average better at some things, notably “spatial” stuff involving the ability to mentally process shapes, patterns and images, while women are better at social, emotional and perhaps verbal tasks [9]. The other said that Spatial abilities have relationship with mathematics test scores. This relationship indicates that gender differences in spatial abilities may contribute to gender differences in mathematical problem solving [10] and there difference spatial ability between male and female cause by biologic and socio-cultural factor [11].

4. Conclusion

Based on the mean value of the increase of spatial reasoning ability obtained by the students and the result of the difference test analysis, it is concluded that male students who obtained MEAC got improved spatial reasoning ability better than male students who obtained MEA. This means that MEAC learning has a significant effect on improving students' spatial reasoning ability. Based on the average score of the students' spatial reasoning ability improvement and the results of the difference test analysis, it was concluded that female students who obtained MEAC got improved spatial reasoning ability better than female students. Suggest to the teacher can apply MEAC learning approach to increase student’s spatial reasoning ability and for the other researcher can research to another mathematics ability.
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