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Improvement Students' Spatial Ability and Self Confidence Through Inquiry Learning With Geogebra at SMA Negeri 19 Medan

Tuti Mariani Malau[1] , E. Elvis Napitupulu[2] , Dian Armanto[2]

[1]SMA Negeri 19 Medan, Jl. Seruwai Kec. Medan Belawan
[2]Universitas Negeri Medan, Jl. Willem Iskandar Pasar. V

Email: Email: tutimariani_malau@yahoo.com[1]

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Abstrak

Penelitian ini bertujuan untuk melihat perbedaan peningkatan kemampuan keruangan dan percaya diri siswa yang diajar dengan model pembelajaran inkuiri berbantuan GeoGebra (MPIG) dan model pembelajaran inkuiri tanpa berbantuan GeoGebra (MPITG). Populasi dari penelitian ini adalah siswa-siswi SMA Negeri 19 Medan. Sampelnya adalah siswa kelas X yang dipilih secara acak. Kelas eksperimen 1 diajar dengan menggunakan MPIG dan kelas eksperimen 2 diajar dengan menggunakan MPITG. Instrumen penelitian ini adalah tes kemampuan keruangan dan skala percaya diri. Data dianalisis dengan menggunakan analisis kovarian dan uji Mann-Whitney. Hasil penelitian secara umum menunjukkan bahwa peningkatan kemampuan keruangan dan percaya diri siswa yang diajar melalui MPIG lebih tinggi daripada melalui MPITG.

Abstract

This study aims to find out the difference of spatial ability and self-confidence students improvement that were taught through inquiry learning model with GeoGebra (ILMG) and inquiry learning model without GeoGebra (ILMWG). The population of the study was the students at SMAN 19 Medan. The sample was the tenth grade students who randomly selected. Experimental 1 class was taught by ILMG and experimental 2 classes were taught by ILMWG. The instruments of this study were spatial ability test and self-confidence scale. The data were analyzed with the analysis of variance and Mann-Whitney analysis. In general, the results of the study shows that the improvement of students' spatial ability and self-confidence who were taught through ILMG higher than ILMWG.

Keywords: inquiry learning; geogebra; spatial ability; self confidence

INTRODUCTION

Education is one of the efforts to increase the quality of human resources with such characteristics as having good knowledge, the ability to solve and review their daily problems as well as the positive attitude towards their environment.

Mathematics as one of subjects in school is regarded to play an important role in shaping students to be better, because mathematic is a media analysis of thinking to something logically and systematically. In mathematics learning, there are five standard materials, such as: Operation and Its Number, Algebra, Geometry, Measurement, Analysis of Data and Probability (NCTM, 2000).

Geometry was one of the mathematics branches taught at school. Geometry can give a situation to students for studying structure of mathematics and developing the

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theorems in mathematics system. According to Galileo (Burshill-Hall, 2002), Geometry was the key to understanding nature. But the irony is that they meant totally different things by this phrase. And then, Kartono (2010) "from Psychology, geometry was the presentation of visual abstraction from experience, pattern, measurement and mapping". Geometry was not only developing cognitive abilities but also helping students in shaping a good memory such as concrete to be abstract.

Clement and Battista (1992) stated that the ability needs to be mastered by students in learning the concept of geometry is the spatial ability. According to Clement and Battista (1992), spatial ability is the ability that includes a person's cognitive processes in representing and manipulating spatial objects, their relationship as well as their transformational shape.

In the interdisciplinary context, the spatial ability is really needed. Strong and Smith (2001) suggested that in the technology industry, the spatial ability is very useful in such applications like simulations, multimedia and modeling. Alias et al (2002) suggested that it takes a good spatial ability to learn and solve the engineering problems. A quite similar opinion is stated by Xiang-wei (2007) who found in their research that almost all the topics in the "drawing machine" need the high spatial ability.

Furthermore, Maier (1996) divided the spatial capabilities into five aspects: (1) Spatial Perception, the ability to observe a geometry or parts of it which is placed in horizontal or vertical position; (2) Spatial Visualization, the ability to imagine or provide a snapshot of which part of geometrical space are changed or transferred, (3) Mental Rotation, the ability to rotate a geometry quickly and accurately; (4) Spatial Relations, the ability to understand the spatial form of an object or part of the objects and the relationship among the parts to one another; (5) Spatial Orientation, the ability to find their own guidelines physically or mentally in space or be oriented to someone in the special spatial situations.

Some of the above statements show how important the spatial ability to be mastered by the student, but the reality indicates the opposite to what is expected. The reality captures that the students' spatial abilities in Indonesia is still low and needs to be improved.

The low spatial ability of students can be seen from the results of the observations conducted by the researchers on 4 August 2015 in class XI SMA Negeri 19 Medan. From the results of the students' answers, it can be seen that the number of students who are able to solve the problems correctly in accordance with the indicator reached is 10 people, or 25%, and the students who are not able to solve the problems correctly in accordance with the indicator reached are 30 people, or 75%.

The success of an education can be viewed from various aspects; one of them is the quality of human resources, by empowering the students. Skinner (Susilo, 2006) argues that learning is a behavior. By the time students learn, the students' response becomes better in absorbing the lessons. On the contrary, if students do not learn, their responses are decreasing. This means that a person experiencing a learning process will experience changes in behavior, from being not able to, being hesitated and finally being sure.

Self-confidence is very important for students to succeed in learning mathematics (Yates, 2002). By the existence of confidence, the students will be more motivated and more likely to learn mathematics, which in turn it is expected that mathematics achievements are also more optimal. It is supported by several previous studies which revealed that there was a positive association between self-confidence in learning mathematics and its learning outcomes (Hannula, et al., 2004). This means that higher mathematics learning outcomes are achieved by every student who has a high index of self-confidence.

Confidence must be possessed by a student in learning, because by possessing the confidence there will be a belief in the individual that determines how one would assess and appreciate him. By growing confidence on students, they are expected to know and understand their own strengths and weaknesses. However, what becomes the problem today is that the students are lack of self-confi-

dence. From the interviews conducted by the researchers to the students at SMA Negeri 19 Medan, it is found out that most students feel bored of learning mathematics. In general, they argue that math is more difficult than other subjects.

Besides, mathematics is considered to have too much formula so students often have difficulty in memorizing and using them to solve the problems. Students always complain of having no abilities, especially in mathematics. While following the lesson, the students easily give up and complain on their learning difficulties. If they are asked to work on the problems in front of the class, they are over-afraid and not sure of the answer. Such behavior which is less able to express their opinions and their thought of math as a scary thing can cause students feel unable to study them, resulting in low mathematics learning outcomes.

The low spatial ability and confidence of students are affected by several factors, including the learning model used by the teacher. The results of interviews conducted by researchers to the math teacher Class X SMAN 19 Medan showed that 70% of mathematics learning in class is still teacher-oriented, it means the learning occurs is still largely dominated by teachers, while students sit passively receiving the information of knowledge and skills. The phenomenon of the teachers' learning process in the real practices is also strengthened by the Somerset and Suryanto (Asikin, 2002) who suggests that the study of mathematics that had been carried out by the teacher is lecturing, discussion, assignments or based on the behaviorists and structuralism' belief.

As an effort to improve the students' spatial ability and confidence a model that supports the learning is needed. One of them is a model of inquiry learning. Inquiry learning model is a model that is based on constructivism learning concept. According to Sanjaya (2006), inquiry learning is a series of learning activities that emphasizes the process of critical and analytical thinking existed. Some of the reasons for choosing this model is the steps of Inquiry learning which present a question or problem, make hypotheses, design the experiments, conduct the experiments to obtain information, collect and analyze the data and make inferences. This makes the student become a major role in the learning process so that students will understand the concept they are learning. This will certainly affect the increase of the students' spatial ability and confidence while understanding the three-dimensional. In other words, the inquiry learning is very influential in improving the students' spatial ability and confidence.

In learning geometry, what needs to be done is providing the information about the number of edges, the number of sides, how to find the area and how to find the volume without taking the children to explore the geometry when they are rotated, turned and seen from different viewpoints (Syahputra, 2011). Thus it is necessary to use the media that is able to facilitate the students to explore the subject matter of geometry.

One of them is a computer assisted learning media which is capable of facilitating the students to explore the subject matter of geometry, namely GeoGebra. GeoGebra is a computer program (software) for teaching mathematics, especially geometry and algebra. GeoGebra can help students observe the abstract objects of geometry and makes them look more real. Through this GeoGebra software, students will find it easier to understand the concepts and the relationships contained in a three-dimensional.

The use of the inquiry learning model with GeoGebra is certainly going to train and hone the students' spatial abilities, resulting in their increased spatial ability. Furthermore, the increasing spatial ability of students makes them more confident in completing a three-dimensional problem. Students will try to solve the problems with all the capabilities they have. Even the difficult problem was no longer something scary but a challenge for the students, because they have the ability to solve the problems.

METHOD

This research was conducted in SMA Negeri 19 Medan with quasi-experimental research design using two *groups (Pre-test and Post-test)*. The population of the research was students in SMA Negeri 19 Medan. The samp-

les were taken two classes, namely X MIA 4 as an experimental class 1 and X MIA 3 as the experimental class 2. The Inquiry learning model with GeoGebra was given in class experiment 1, while the inquiry learning model without GeoGebra was given in the experimental class 2.

The data were collected by using two instruments. They were spatial ability test and self-confidence scale. The spatial ability test consists of four items in the form of essays. The material chosen for test is geometry. The test had been checked in terms of face and content validities and reliabilities. Self-confidence scale was adapted from Santrock (2003). The scale consists of 40 items in the form of Likert scale.

Data Analysis Technique

Spatial ability test were analyzed by analysis of covariance (Anacova). Before Anacova was used to analyze the data, the normality and homogeneity of the group data of Inquiry learning model with and without GeoGebra need to be tested, then the regression model between the dependent variable Y (posttest) and the independent variable X (pretest) meet the linear relationships in each category or level factor to consider. Thus, it is important to examine whether there is an effect of X (pretest) to Y (posttest) for each group with a regression model linearity test. The regression model of inquiry learning with GeoGebra models group and the regression model of inquiry learning without GeoGebra models group must be aligned (alignment test of two regression models).

Furthermore, to test whether the parallels differences were significant, then the analysis of covariance using statistics-F was administered. Criteria reject the if with.

Self-confidence scales were analyzed with the Mann-Whitney test because the data of students' confidence is ordinal and not normal. The steps in the Mann-Whitney test were determining the value of U, having obtained a U value then the value of Z is searched. The criteria for H_o rejection is $Z_{cal} < Z_{tab}$. Data processing is performed by using SPSS of version 17.00.

RESULT AND DISCUSSION

The Improvement of Student' Spatial Ability

Spatial ability is the skill to visualize and create images in the form of dimension 2 or 3. Spatial ability has several aspects, namely Spatial Perception, Spatial Visualization, Spatial Mental Rotation, Spatial Relations and Spatial Orientation.

The analysis of data on the average post-test score of spatial ability taught by ILMG is 73.47 and the post-test mean score of spatial ability taught by ILMWG is 67.96. Since the results of requirements test have been fulfilled, then the improvement of students' spatial abilities is analyzed by the Covariance analysis as a variance analysis modification.

To find out the improvement of students' spatial ability, the following hypotheses are proposed: The spatial ability improvement of the students who are taught by ILMG is significantly the same as those who are taught by ILMWG, and The spatial ability improvement of the students who are taught by ILMG is sig-

Table 1. Analysis of covariance for spatial ability by SPSS 17.00

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9751.799[a]	2	4875.900	258.681	.000	.869
Intercept	14682.287	1	14682.287	778.938	.000	.909
modelpembelajaran	292.637	1	292.637	15.525	.000	.166
Tesawal	6914.964	1	6914.964	366.859	.000	.825
Error	1470.230	78	18.849			
Total	415859.375	81				
Corrected Total	11222.029	80				

a. R Squared = ,869 (Adjusted R Squared = ,866)

nificantly higher than those who are taught by ILMWG. The summary of those tests is shown at Table 1.

The results of calculations for the spatial abilities acquired showed that F_{val} = 15.525 and by Table F, within the significance of , it is obtained that = . It is found that , thus is rejected. This means that the improvement of spatial ability of students who were taught through ILMG is higher than ILMWG.

The high spatial ability of students can be seen on the aspects of Mental Rotation and Spatial Perception, by using the help of GeoGebra software, students find it easier to express the shape or position of geometry as a result of rotation through the icon Rotate Around Line and they can observe a geometry that is placed in a horizontal or vertical position.

Student' Self Confidence

Confidence is a self-evaluation so that someone can believe in his ability to undertake measures to achieve their happiness. The indicators of confidence are (1) Directing or ordering others; (2) Using the sound quality that is adjusted to the situation; (3) Expressing opinion; (4) Sitting with others in social activities; (5) Working cooperatively in a group; (6) Looking at the other person when talking; (7) Maintaining eye contact when a conversation is in progress; (8) Starting a friendly contact with others; (9) Maintaining appropriate distance between oneself and others; (10) Speaking fluently, only having a slight doubt.

The data analysis showed that the average score of confidence post-test of students who are taught by using Inquiry learning model with GeoGebra is 125.36 and the mean score of confidence post-test of students who are taught by using Inquiry learning model without GeoGebra is 113.92. To find out the improvement of students' self-confidence, the following hypotheses are proposed: The self-confidence improvement of the students who are taught by ILMG is significantly the same as those who are taught by ILMWG; and The self-confidence improvement of the students who are taught by ILMG is significantly higher than those who are taught by ILMWG

To test the significance of the truth of the confidence post-test in both classes, statistical testing needs to be done. Due to the scale data of students' confidence is in a form of ordinal data, the statistical test used was statistically non-parametric Mann-Whitney test (U test). By the help of 17.00 SPSS, the statistical results of Mann-Whitney test (U test) can be seen in the following table;

Table 2. The Average Results of Students' Confidence Scale

	Group	N	Mean Rank	Sum of Ranks
Confidence	Exp 1	41	53.71	2202.00
	Exp 2	40	27.98	1119.00
	Total	81		

Table 3. Mann-Whitney Test Result of Students' Confidence Scale

Statistics Test [a]	
	confidence
Mann-Whitney U	299.000
Wilcoxon W	1119.000
Z	-4.931
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable

From the Table 2 and 3, the table of Ranks in columns Sum of Ranks, it is obtained that the total ranks of experimental class 1 = 2202.00 and the total rank of the experimental class 2 = 1119.00. Furthermore, in Table of Statistics in row U Mann-Whitney U = 299,000, it is obtained that the test statistic Z by -4.931 and value of Asymp, sig (2-tailed) was 0,000. When it is compared to the alpha value of 0.05, this implies H_o is rejected and H_a is accepted which means there is a significant difference between the students' confidence who are learning in the experimental group 1 and experimental 2.

Based on the collected data, it can be seen that the total score of students' confidence- scale of the pre-test and post-tests is 4453 and 5140, while in the experimental group 2, it is 4043 and 4557, the data from the experimental class 1 showed that the confidence of students is better than the ones in the experimental class 2.

The difference of pre-test score in the

experimental group 1 is higher than the difference of pre-test score in the experimental group 2. Based on the average increase, it seems that the increase in the experimental class 1 is higher than the increase in the experimental class 2. Thus the inquiry learning model with GeoGebra had a significant impact on the improvement of students' confidence.

The high confidence of students taught by using Inquiry learning model with GeoGebra can be seen in the aspect in which students express their opinions freely on the steps of making the hypotheses and conducting the experiments. Not only the aspect of expressing the opinions is increased, the aspect of sitting with other people in social activities as well as learning cooperatively in groups is also increased. This result is suitable with Kartono (2010) and Prabowo (2011).

CONCLUSIONS

Based on the research finding and the statistical analysis conducted, several conclusions can be drawn as follows: (A) The spatial ability improvement of students who received the inquiry learning with GeoGebra is higher than students who received the Inquiry learning without GeoGebra which is 50.41%; and (B) The self-confidence improvement of students who received the inquiry learning with GeoGebra is higher than students who received the Inquiry learning without GeoGebra which is 15.42%.

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