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Geogebra assisted blended learning on students' spatial geometry ability

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Abstract. This study aims to know (1) the effect of Geogebra assisted blended learning in enhancing spatial geometry ability, (2) the response of the learning. This research method uses quantitative research with a quasi type experimental design and research design using the pretest-posttest control group. The subject was Mathematics Education students on State Institute of Islamic Religion (IAIN) Takengon who studied field and space analytic geometry in the academic year 2019/2020. Data collection using tests and questionnaires that are validated by experts. The data hypothesis test uses the t-test involving requisite pretests (normality and homogeneity) beforehand. The results showed that Geogebra assisted blended learning was effective in enhancing geometry spatial ability, and students' response was also very good.

1. Introduction

Technology has an important role in learning [1]. Information technology helps students to develop their abilities in the 21st century. Technology, as a tool used in learning, has unbelievably comprehensive benefits.

The use of this advanced technology has reached many sectors, including education schools and higher institutions [2]. Technology has become an important source of learning. Several research results in applying technology in the instruction and learning process have developed rapidly [3-8]. There are many options for choosing a technology that is taken based on needs and goals.

Blended learning is one of the learning alternatives to using technology in education. Blended learning is not only a blend of straight instruction (face to face) and online instruction but more than that as a component and common relation [9-10].

Students have a good understanding of the learning objectives conveyed; online learning must have a good and attractive appearance. One of the software used in increasing online learning exciting and attractive, is GeoGebra's open source software.



GeoGebra is created, especially for learning geometry and algebra [11]. There have been many studies on the effectiveness of using Geogebra [12-17].

In instruction and learning geometry, it has often been realized that students still require process knowledge and skills in understanding geometric shapes. Even though teachers provide the necessary knowledge to assist students in understanding concepts, this perception is supported by research [18] in which students face a challenge in learning geometry and several struggles to understand the theory and knowledge requested. Geometry is one of the materials contained in mathematics learning. Geometry is an important ingredient in the Indonesian program of study and is trained by students from basic school to university level [19].

Geometry figures actual thinking to be abstract and helps students examine and understand the world, and equips them with utensils that can relate to other mathematics parts. Studying geometry requires the skill to symbolize an abstract theory in two/three dimensional visual figures and create changes to a geometric figure called spatial ability.

Spatial ability can be broadly defined depending on the discipline's perspective but generally includes the process of visualization, mental rotation, symmetry, perspective taking, orientation placement, sounding/rearranging, and navigation [20]. It can be defined that spatial ability can identify and operate the spatial properties of things and the spatial relationships between things [21].

In the National Academy of Science, it is argued that every student should strive to increase skills and spatial intelligence, which are very useful in knowing associations and properties in geometry to work out mathematical problems in life [22].

Spatial reasoning has a basic function in learning mathematics. Mathematics learning to be a difficult and active system of interrelated components that essentially rely on spatial reasoning, rather than on those based on quantitative or numerical concepts as is often unsaid [23]. The development of the concept of number may have been primarily spatial in origin. Certain spatial skills have been found to predict mathematical achievement, are malleable, and can be developed from an early age [24-25].

2. Research Methods

2.1. Research Design

This type of research uses a quasi-experimental method; the sampling is carried out in the existing groups. The experimental design used in this study was the pretest post test control group design. The research design is described as follows:

Pretest	Treatment	Post tet
O	X	O

Explanation:

O: Pretest Post test

X: Application of learning with Geogebra assisted Blended Learning

2.2. Research Subject

The research subject was Mathematics Education students on State Institute of Islamic Religion (IAIN) Takengon who studied field and space analytic geometry in the academic year 2019/2020.

2.3. Data Collection Techniques

Learning is designed to carry out learning actions that can be carried out optimally. The research instrument was a mathematical spatial geometry ability test consisting of 5 questions in a description. The data obtained from the initial test scores of spatial geometry abilities were compared to each student's total scores on the final test scores. The level of significance of the increase in mathematical spatial geometry skills after students used GeoGebra based geometric learning was tested using the t-test statistic.

3. Result

3.1. Results of Student Test

Description of the research data, namely the pretest and post test scores of students' spatial abilities using GeoGebra are as follows:

Table 1. Data Normality Test of Students' Geometry Spatial Ability

Shapiro-Wilk		Interpretation
Df	Sig.	
14	0.72	Normal Distribution

Table 1 explains that the data on students' geometry spatial ability is normally distributed.

Table 2. Data Homogeneity of Students' Geometry Spatial Ability

Statistic Levene	Significance
2.65	0.80

Table 2 explains that the value of significance > 0.05 means that hypothesis H_0 is accepted $H_0 > 0.05$, which means hypothesis H_0 is accepted, and H_1 is rejected. It means that the data as a whole are homogenous.

Table 3. Test the Difference in Students' Geometry Spatial Ability

t-value	Asymp. Significance (2-tailed)	Interpretation
2.53	0.002	H_0 rejected

Table 3 explains that the mean difference test of students' geometry spatial ability obtained t value = 2.53 with Sig. = 0.002, which is smaller than $\alpha = 0.05$, so that H_0 is rejected. There is a significant difference in the achievement of the average score of students' geometry spatial ability before implementing geometry learning using GeoGebra assisted by blended learning and after GeoGebra learning assisted by blended learning. The conclusion is Geogebra geometry learning assisted by blended learning effectively increases students' geometry spatial ability.

Furthermore, to determine the level of students' spatial ability, data collection was carried out based on the spatial ability test instrument, which is presented in the following diagram:

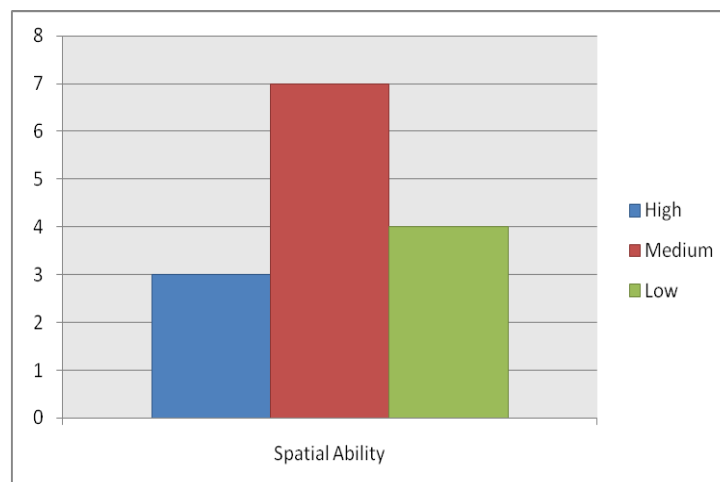


Figure 1. Level of Spatial Ability

From the diagram above, it is found that students have different levels of spatial ability. There are three students or 21.4%, who have a high level of spatial intelligence, seven students or 50% of students, have a moderate level of spatial ability, and four students or 28.6%, have a low level of spatial ability.

3.2. Results of Students Response

Fourteen students filled out the student's responses. The student response score is then recapitulated and analyzed. The summary of the student's responses result in the score is exposed in Figure 1.

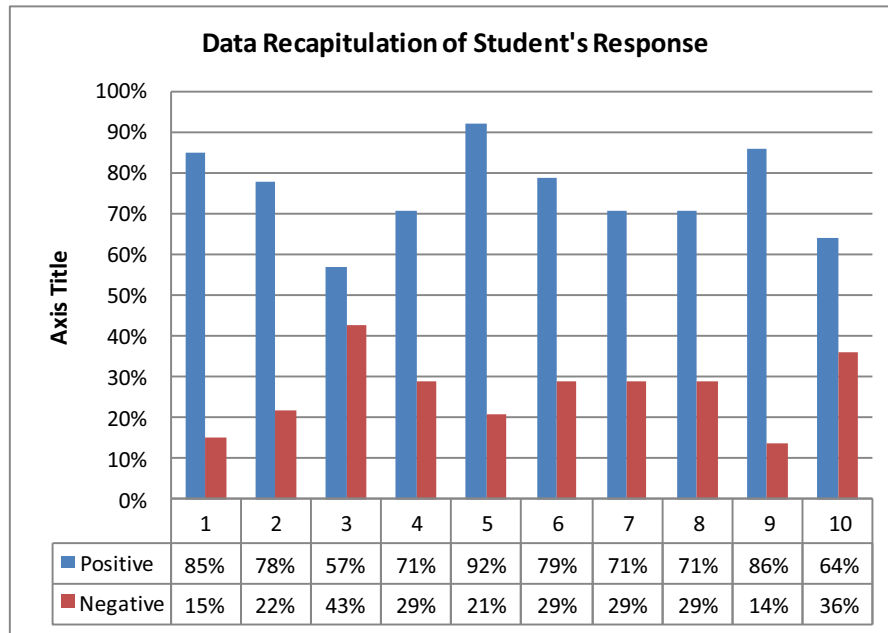


Figure 2. Data Recapitulation of Student's Response

Explanation:
1. Excited about using Geogebra software
2. Study a lot using Geogebra
3. Feel confident using Geogebra during the activities
4. Very interested in the learning process
5. Get advantage through the lecture students interaction
6. Capable to visualize and answer the questions after each activity
7. Capable to think creatively and critically in the discussions and during the question and answer session
8. Capable to create logical assumptions when attempting to hypothesis
9. Enjoying learning mathematics much more using Geogebra
10. Capable to figure better relations between before and latest learning

The results from Figure 2 show that, in general, students gave positive feedback to GeoGebra. The majority of students, about 92% of students, stated that they get a lot of benefits through student-teacher interactions when using GeoGebra, 82% of students stated that they were interested in using GeoGebra, were involved in the learning process, and were able to visualize and answer questions after each activity.

About 79% of students stated that they were able to think creatively and critically in discussions. During the question and answer session, they were able to make logical assumptions when making hypotheses. They also enjoyed learning mathematics more when using GeoGebra and could figure better relationships between previous learning and new learning. Though some students stated that they were not confident when using GeoGebra.

4. Discussion

The use of GeoGebra in the learning process helps think about geometric concepts whose objects of study are abstract to be more interesting and easier to understand by students. With multimedia assisted learning being more effective than conventional learning, students can explore geometric concepts and feel not afraid of being wrong. GeoGebra can increase students' interest and creativity to prefer learning with GeoGebra rather than conventional learning. GeoGebra has been helping students' thoughtful geometric concepts [29]. In other studies, it is stated that GeoGebra has a positive effect on students' understanding of geometric concepts[30].

GeoGebra is a developed learning medium that requires students to seek knowledge by exploring and building their knowledge independently. Students construct their knowledge, not receive it directly from the teacher; this is following constructivism theory. Although GeoGebra has been declared to improve students' mathematical spatial abilities, in its application, the media still has several limitations, including there is no direct manual on the use of GeoGebra for various materials. It is hoped that there will be a manual on using GeoGebra for various materials in the future.

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