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Application of the Geogebra Assisted Problem-Based Learning Model to Increase Student Activity and Learning Outcomes

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Abstract: This research is motivated by the low level of activity and student learning outcomes in mathematics at MTsN 3 Kota Tangerang. This can be seen from the students' difficulties in solving math HOTS questions. One of the causes of this is the not yet optimal application of innovative learning models, where teachers still dominate the activity in learning activities in class, so that students still have difficulties in conducting investigations of abstract concepts. Therefore, the Geogebra application is needed to concretize abstract mathematical concepts and attract students' interest in learning mathematics. The purpose of this study was to determine the increase in the activity and learning outcomes of SMP/MTs students by using problem-based learning assisted by the Geogebra application. The method used in this research is a Quasy experimental research with one group pretest posttest design. Researchers took one class of six class VIII by means of random sampling. The sample of this research was 39 students of class VIII-1 MTs Negeri 3 Tangerang City. The research instrument was a matter of description and observation sheets of student activity. The results of the quasi-experimental research show that problem-based learning assisted by Geogebra can increase student activity and learning outcomes.

Keywords: Problem based Learning, Geogebra Application, Activity, Student Learning Outcomes.

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INTRODUCTION

Learning is an effort to create conducive conditions, namely generating effective learning activities among students (Sukmara, 2007: 63). The success of the process and results of learning in the classroom is influenced by several factors, including teachers and students. Teachers are required to master learning strategies and methods in delivering material, creating a classroom atmosphere that causes students to be actively motivated in learning will allow for increased activity and learning outcomes.

The results of preliminary observations on mathematics learning outcomes in class VIII students of MTs N 3 Tangerang City for the 2019/2020 academic year, identified that student learning outcomes in mathematics were classified as low. In the learning process, the teacher has not used interactive application-assisted learning methods, models and strategies so that the delivery of material tends to be monotonous and less interesting.

This is in line with what was stated by Junaedi (2016) that the teacher continues to return to normal activities, which starts by explaining the subject matter and giving examples of questions that have been provided in the textbook. These findings indicate that even though the curriculum has undergone changes there are still many teachers who have not changed their learning strategies according to the demands of the curriculum. Learning conditions like this lead to low students' understanding of concepts, especially in abstract mathematical concepts. As a result, students are unable to solve problems that require higher-order thinking skills and student learning outcomes are low.

Low student learning outcomes are also the impact of low student learning activity during the learning process, most students look tense and passive. Learning is still one-way, only a few students participate in learning, the use of learning media is not optimal and the progress achieved by students is not appreciated.

A strategic step that can be taken to overcome the problem above is to try using a problem-based learning model that can provide a stimulus for students to understand the essential concepts clearly. PBM uses real-world problems to develop students' problem-solving skills. Guidelines for implementing PBM according to Fogarty (Rusman, 2010) consist of 5 steps, namely: 1) orienting students to contextual problems, 2) organizing student learning tasks related to contextual problems encountered, 3) guiding students in researching individually/groups, 4) develop and present the results of student problem solving, and 5) analyze and evaluate the correctness of the problem solving process

In its application, the problem-based learning (PBL) model still has weaknesses, students still have difficulty carrying out individual or group investigations, especially on abstract mathematical concepts. For that we need a media that can help visualize abstract concepts to be more concrete. One application that can be used to overcome this problem is the Geogebra application.

Geogebra is computer software used in learning mathematics, especially geometry and algebra. Geogebra application is useful for teachers and students. Geogebra provides an effective opportunity for teachers to explore interactive learning that allows students to explore various mathematical concepts. According to Lavicza (Hohenwarter, 2010), several studies have shown that Geogebra can encourage students' discovery and research processes in class.

Based on the description above, it is important for a teacher to choose the right learning model according to the characteristics of the material and students and integrate it with technology so that new variations emerge which are expected to increase student activity and learning outcomes. This study aims to determine the extent to which the application of problem-based learning assisted by Geogebra in increasing student activity and learning outcomes.

METHODS

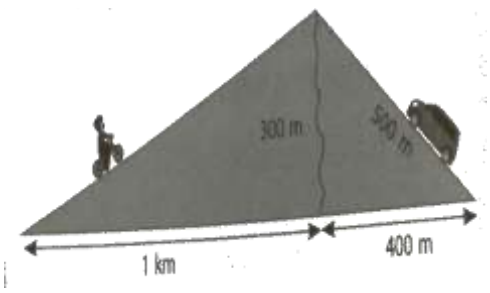
This research is a quasy experiment with one group pretest posttest design (O1 X O2). The research subjects were 39 students of class VIII/I MTs Negeri 3 Kota Tangerang which were determined purposively. The research subjects were first given a pretest in the form of a description question (O1) to determine students' initial abilities before learning. Next, Geogebra assisted problem-based learning is applied. At the end of the lesson, a posttest (O2) is given in the form of 6 description questions.

The data collected is data regarding student active learning and competency achievement (learning outcomes) obtained from observing student learning activeness using observation sheets and learning achievement tests. The research instruments were essay tests and student activity observation sheets. In the following, examples of test items and student activity observation sheets are presented.

Example 1: Student learning outcomes test items

A peak can be reached from two roads which are described as lines on the left and right, as in the following picture!

a. Determine the gradient of the path on the left?
b. Determine the gradient of the path on the right?
c. Why is it advisable for cyclists to take the road on the left to get to the top?



Example 2: Student Activity Observation Sheet

Table 1. Example of Student Activity Observation Sheet

No	Hasil Pengamatan	Hasil Pengamatan			
		B	C	K	E
	Student Activeness in Class Discussions and Group Discussions				
1.	Discuss to solve the initial problem given				
2.	Ask and solve problems individually and in groups				
3.	Share ideas with group mates during group discussions				
4.	Share ideas with friends during class discussions				

Information: B = Good C = Enough D = Poor E = Bad

To determine the increase in student learning outcomes using student gain scores. The amount of increase is calculated by the normalized gain formula, namely:

$$< g >= \frac{S_{postes} - S_{pretes}}{S_{maks} - S_{pretes}}$$ (Hake, 1999)

The gain calculation results are then interpreted using Hake's (1999) classification which can be seen in the following table.

Table 2 Classification of Normalized Score Gain

Normalized Score Gain	Interpretation
$(< g >) > 0{,}7$	High
$0{,}3 < (< g >) \leq 0{,}7$	Normal
$(< g >) \leq 0{,}3$	Low

Data from observations of student activities are expressed in categories, a score of 4 for the good category, a score of 3 for the sufficient category, a score of 2 for the less category, and a score of 1 for the bad category. This data is processed until the final data is obtained in the form of averages and percentages of each aspect of activity. Percentage on both activeness is calculated by:

$$P = \frac{Q}{R} \times 100\%$$ (Lindawati, 2010)

Information:
Q = average collective score obtained in an activity.
R = maximum score of an activity, which is 4.

RESULTS

The research results obtained were in the form of post-test average scores and normalized gain scores as well as observational data on student activity during the learning process using the Geogebra-assisted problem-based learning model. The results obtained from implementing Geogebra-assisted PBL are described as follows.

Active Student Learning

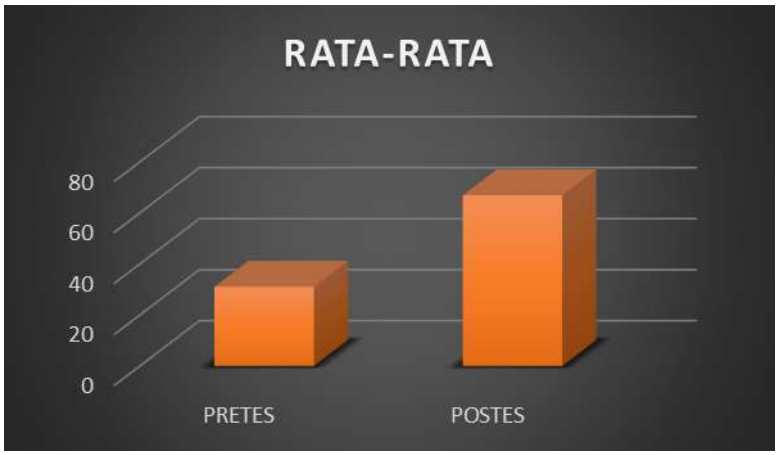
The results of observations on student activity through student learning activeness instruments during learning using the PBL model assisted by the Geogebra application showed a significant increase in student learning. Observations were made on activities such as: a) student activity in class discussions and group discussions (sharing ideas during group/class discussions, expressing ideas and ideas, asking teachers/other groups, observing and commenting on the work of other groups); b) the activeness of students in responding to directions from the teacher (asking questions that are confirmation and require explanation). Data on student learning active results can be obtained shown in Figure 1.

Figure 1 Data on the results of student learning activity

From Figure 1 it can be seen that before learning the Geogebra-assisted PBL model the percentage of student activity was 62.5%. However, after learning the PBL model assisted by Geogebra, the percentage of students' learning engagement became 92.85%. This shows that there is a significant increase in the percentage of student learning activeness, which is equal to 30.35%.

Student learning outcomes

Based on the results of data analysis from pre-test and post-test scores, there was an increase in the average score after the learning process was carried out with the Geogebra-assisted problem-based learning model shown in Figure 2. To determine whether there was an increase in student learning outcomes, the N-gain score test was carried out.



Gambar 2 Data skor rata-rata pretes dan postes

Table 3 Resume Pretes, Postes dan N-Gain Hasil Belajar Siswa

RESUME	Gain Score		
	Pretes	Postes	N-Gain
Smallest value	15	40	
Greatest value	50	92	
Standard deviation	7,06	13,18	
Average	31	67	0,53

From the results of the N-gain score test calculation above, it can be seen that the average N-gain value is 0.53 which is included in the medium category. This shows that there is an increase in student learning outcomes after obtaining problem-based learning assisted by the Geogebra application.

DISCUSSION

The results of data analysis revealed that problem-based learning assisted by Geogebra can increase student activity and learning outcomes. This is possible because in problem-based learning students are required to work in groups, discuss contextual problems given by the teacher so that they can improve understanding of concepts. With increasing understanding of the concept, student learning outcomes also increase. This is in line with what was stated by Pramudya et al (2019) that activity is direct student involvement in the learning process in class. Students who are actively involved in learning activities can affect student learning outcomes.

The use of Geogebra also has a big impact on increasing students' activeness and understanding of abstract mathematical concepts. This is reinforced by the research results of Zulnadi and Zakaria (2012) stating that the use of Geogebra can increase conceptual and procedural knowledge. Conceptual knowledge can be categorized as student learning outcomes, while procedural knowledge can be categorized into student activity.


Figure 1 Student discussion activities during learning

The picture above shows student activities when learning mathematics using learning. Students are given contextual problems that lead them to a certain concept. After that, they are required to find a solution to the given situation. Students can use the Geogebra application via their respective smartphones to complete or check the correctness of solutions to math problems. Students can check their own answers to the questions given. By using the Geogebra application, learning mathematics becomes interesting and fun, because it is more interactive. So that students can increase their activity and learning outcomes.

During the learning process of the Geogebra-assisted PBL model, students are required to work together and discuss with each other in their groups so as to increase student activity. Student activity can be observed from group discussion activities and presentations in front of the class. Students who are required to be active in learning will also appear student motivation. Another factor with the existence of interactive learning media can increase students' interest in learning. This is in line with the results of Wigati's research (2017) The application of Geogebra can improve students' ability to solve problems, activeness and student learning motivation.

Figure 2 Students present the results of group discussions in front of the class

In the picture above the group representatives present the results of the discussion through presentations, followed by an inter-group discussion led by the group making the presentation. Asking questions during group presentations is also able to make students know knowledge that has not been known to students so far. The teacher gives an evaluation and checks all the problem solving done by students. Student representatives are required to explain the results of their work in front of the class. By getting used to solving problems on their own, it turns out that students can remember concepts longer and are able to apply these concepts in solving problems.

Several relevant studies use the Geogebra application as a learning medium or tool in learning mathematics. Geogebra can be used to create digital and interactive worksheets. This media can be used to explain mathematical concepts or to explore mathematical concepts. Teachers can also display it in front of the class with the help of a computer to train students in exploring mathematical concepts. In addition, students can use their respective smartphones to learn to explore independently related concepts that have been taught. Geogebra-assisted learning media helps in visualizing or painting graphs accurately, dynamically and attractively so that students are helped to understand abstract mathematical concepts. This is in line with the results of Nopiyanti's research (2012) which developed a Geogebra-assisted mathematics learning tool that had an impact on increasing student engagement during the learning process. This can be seen from the interactions that occur between students and students and students and teachers as well as students' sense of responsibility for the assignments given during the learning process takes place. In addition to increasing student involvement, it can also increase student learning achievement in mathematics. The results of research conducted by Krismayanti et al (2018) show that students experience an increase in learning outcomes

after receiving problem-based learning. In addition, the PBM model can also increase student learning motivation.

The use of Geogebra in learning can apparently increase students' motivation to learn mathematics. The Geogebra application makes learning mathematics more interesting and fun. Geogebra can help concretize abstract mathematical concepts so as to attract students' interest in learning mathematics. Students feel happy because Geogebra is easy and practical to use on their respective smartphones. For students the use of the Geogebra application in learning is something new where previously there were no teachers using the Geogebra application in the learning process.

CONCLUSION

Based on the results of the research and discussion, it was found that problem-based learning assisted by Geogebra can increase student activity and learning outcomes. The problem-based learning model combined with the Geogebra application can visualize mathematical concepts accurately, dynamically and attractively so that students can understand abstract mathematical concepts.

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