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Students' Ability in Making Mathematics Generalizations Through Geogebra Assisted CPS on Straight Line Equations

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ABSTRACT
This study aims to examine the effect of geogebra-assisted CPS learning on the ability to make mathematical generalizations of students. This type of research is descriptive qualitative. The subjects taken in this study were 5 students from 17 students of class VIII.3 Al-Ittifaqiah Integrated Islamic Junior High School. The instrument used is a test. The written test consists of 3 essay questions for straight line equation material. The test results data were analyzed descriptively which were then grouped into several criteria. The results of the study concluded that in problem 1 students have been able to solve existing problems and some students have reached the generalization stage, in problem 2 students are very difficult to solve problems because they cannot identify existing problems and have not been able to use the results of problem identification to solve problems and, in problem 3 students do not identify existing problems and have not been able to use the results of problem identification to solve problems, but by directly formulating known information in the form of a gradient concept that passes through two points. but students are still not able to solve the problem and generalize it. So it can be concluded that students have no difficulty in solving problem 1 and very difficult in solving problem 2.

Keywords: *Mathematical Generalization, Creative Problem Solving, ICT.*

1. INTRODUCTION

Mathematical thinking ability is an ability related to students' ability to reason in order to build mathematical arguments, the ability to develop strategies or methods, ability to understand mathematical content, and the ability to communicate ideas [1]. Mathematical thinking ability or process is an inseparable part in the mathematics learning process. Therefore, learning mathematics in schools aims to train thinking patterns and reasoning in drawing conclusions, develop problem solving skills, and develop the ability to provide information or communicating ideas through oral, written, pictures, graphs, maps, diagrams. One of the abilities that includes the ability to think mathematically is the ability to abstraction [2]. Then [3] adds that abstraction is a process or activity carried out by students to gain understanding and understand basic mathematical concepts through conditions related to something abstract.

Abstraction ability can help describe mathematical concepts contained in a contextual problem [3]. This shows that abstraction skills need to be trained and grown in the mathematics learning process. With mathematical abstraction skills, it can help students understand concepts or situations in abstract mathematics. Therefore, abstraction ability is a basic ability that must be possessed by students in learning mathematics because it is an ability that describes mathematical concepts in a mathematical problem and it can be said that abstraction abilities can build problem situation models [4].

Meanwhile, according to [2] there are five characteristics of abstraction, one of which is generalization. Generalization is the process of making conclusions from special circumstances into general conclusions based on existing facts regarding certain patterns or rules [5]. Generalization is one of the important reasoning mastered by students [6] With the ability of mathematical abstraction in the generalization type, students can find relationships between patterns so

as to produce convincing arguments (conclusions). Generalization is the process of drawing a conclusion in the form of a essence or main idea from the learning process they have learned [6]. So that this conclusion is drawn after students go through all the series of solving processes or finding solutions to a problem.

Reality on the ground, students still have difficulty in making generalizations. [7] stated that the difficulty of students in learning is that students have difficulty in finding the desired main idea of the problem and students also have difficulty making general abstract generalizations. Besides, the learning used by the teacher does not pay attention to the students' abilities, There are several reasons behind the low generalization ability, including because students do not understand the problems in the questions, students find it difficult to connect between concepts and the activity of students who tend to be weak [8]. According to [9], in the category of high generalization ability, students have mastered three aspects of generalization indicators, namely perception, expression, and symbolic of generality. Then the students who have moderate generalization ability are able to fulfill two aspects, namely perception and expression. Meanwhile, students with low generalization abilities have not been able to fulfill at least two aspects of generalization indicators.

Generalizations are most often expressed in mathematical structures. In learning such as straight-line equations, the ability to generalize is important for students. One of the content standards studied is numbers and operations (number and operations) and algebra (algebra) which are related to (Principles and Standards for School Mathematics in) [10]. The subject of slope in straight line equations also needs to be mastered by students because this subject is used as a prerequisite material for mastering the next material, such as quadratic functions, linear programming and etc. However, based on the results of research conducted by [11] In working on questions about straight-line equations students often make language, conceptual and procedural errors, but also cannot make conclusions from the available facts. Students also find it difficult to find relationships between concepts to make generalizations.

Based on the problem above, then we need something that can guide the abstract thinking process of students in solving the problem where by using it students can guide students in understanding, convey and develop their mathematical ideas. Through a learning process that emphasizes the ability to think creatively based on previous experience, the Creative Problem Solving learning model is one of the right models as a means of solving student problems during learning [12]. Other than that, Creative Problem Solving is also able to train the ability to study generalizations and mathematical situations to be able to draw a conclusion.

In addition to using the CPS learning model, Learning media is also one of the things that can support the student learning process. Learning media based on Information and Communication Technology (ICT) is one of the teacher's tools so that learning becomes interesting and fun, can motivate and facilitate students in learning mathematics and facilitate teachers in delivering information [13]. ICT used as a learning medium can help clarify the presentation of concepts or messages in order to overcome verbal material [14]. In addition, the existence of technology in education is very useful in improving the quality of education, effectiveness and efficiency of the learning process and facilitate the achievement of educational goals [15]. Learning media that is able to maximize the application of the CPS model on straight line equation material, one of which is by using GeoGebra.

GeoGebra is a computer software that can be used to make it easier to visualize and clarify mathematical concepts [16,17]. GeoGebra can be used as an evaluation material to ensure whether the image or object that has been created is correct and correct, so that with this students' mathematical problem solving abilities develop and the time required in the implementation of the learning process becomes effective and efficient.

Therefore, in this study, we will examine more deeply the effect of Geogebra-assisted CPS learning on the ability to make mathematical generalizations of students on the material of straight line equations.

2. METHOD

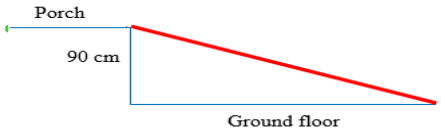
This type of research is descriptive research, which aims to describe the abstraction ability of students in the generalization type through learning that uses the Creative Problem Solving learning model and is assisted by ICT. The research subjects in this study were the eighth grade students of Al-Ittifaqiah Integrated Islamic Junior High School Indralaya in the 2021/2022 academic year.

In the implementation of this research, three meetings are needed. At the first and second meeting, researchers will teach in class by applying CPS-based learning using LKPD that has been prepared with the help of Geogebra. At the last meeting the researcher will test the research subjects to see the generalization ability of students after the implementation of CPS-based learning with the help of Geogebra. Therefore, the instrument used in this study is a test. There are three problems that are used to see the students' mathematical generalization ability.

Problem 1: The following are the laws and regulations for the slope of a road or traffic according to the country of Australia

The slope of the road for wheelchair users should not exceed 0.15.

Behind the school will be built a special road for wheelchair users will be built to make it easier for them. If the length of the road will be built from the lip of the veranda as long as seven meters. Take a look at the sketch of the back porch of the school below!



Is it true that the length of the shortest path from the lip of the veranda is 600 cm with a special road slope for wheelchair users that can be built to meet the safety requirements for wheelchair users? Explain!

Problem 2: Company CV. Torik Mega Jaya bought a new truck for IDR 360,000,000.00. The price of the truck will depreciate IDR 12,000,000 per year. The depreciation equation is as follows y = 360,000,000 – 12,000,000 x, where y represents the price of the truck and x is the age of the truck in years. After 6 years, CV Torik Mega Jaya sold the truck for IDR 300,000,000.00. Is the CV profit / loss?. Explain your reason!

Problem 3: Sporting goods companies report that sales of sports equipment between 1990 and 2000 increased by an average of IDR 92.40 million per year. In 2000, total sales were Rp. 1,704.40 million. If sales increase by the same average. Did the company get a total sales of less than 1 million in 2008?

The test result data were analyzed descriptively using four indicators and six descriptors as follows:

Table 1. Mathematical generalization ability indicator

Indicator	Descriptor
Perception of generality	Students identify the rules or patterns of the given problem
	Students are able to perceive rules or patterns based on facts
Expression of generality	Students describe the results of the identification of rules or patterns
	Students are able to apply the rules or patterns found to determine the next structure
Symbolic expression of generality	Students produce a general rule or pattern that is formulated symbolically
Manipulation of generality	Students apply rules or patterns that have been found in other problems

3. RESULT AND DISCUSSION

This research was conducted at the Integrated Islamic Junior High School Al-Ittifaqiah Indralaya located in Tanjung Lubuk, Indralaya, South Sumatra Province. Data collection was carried out in odd semesters with the number of students. This research was conducted based on three stages, namely the preparation stage, the implementation stage, and the final stage.

The preparation stage begins with making a research instrument which is validated by two lecturers of the Mathematics Education Study Program, FKIP Sriwijaya University. So that some inputs and revisions were obtained regarding.

Research instruments that have been made and repaired, then the instrument is declared valid. Next, carry out the research permit process following administrative procedures.

The implementation phase begins with greetings, asking for attendance, convey learning objectives and provide direction for solving problems. Furthermore, the researchers gave LKPD using the Creative Problem Solving learning model assisted by ICT (Geogebra) media. Students are formed into several groups to discuss in solving the problem with each group consisting of 5-6 people. This stage is carried out with an estimated time of 2 × 30 minutes. According to Hohenwarter & Fuchs Geogebra is very useful as a medium for learning mathematics with various activities such as demonstration and visualization media, namely in learning, teachers use Geogebra to demonstrate, construct and visualize certain mathematical concepts [16].

After that, a test was conducted to measure the generalization type abstraction ability through students' Creative Problem Solving learning with an estimated processing time of 2 × 30 minutes. Each student works individually and collects the answers they get. Then the researcher collected and processed the data.

Figure 1 The process of doing the test questions

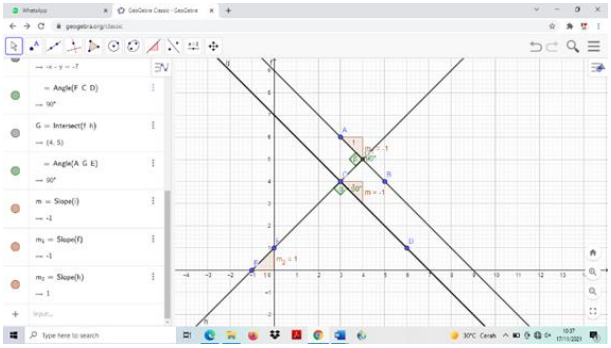
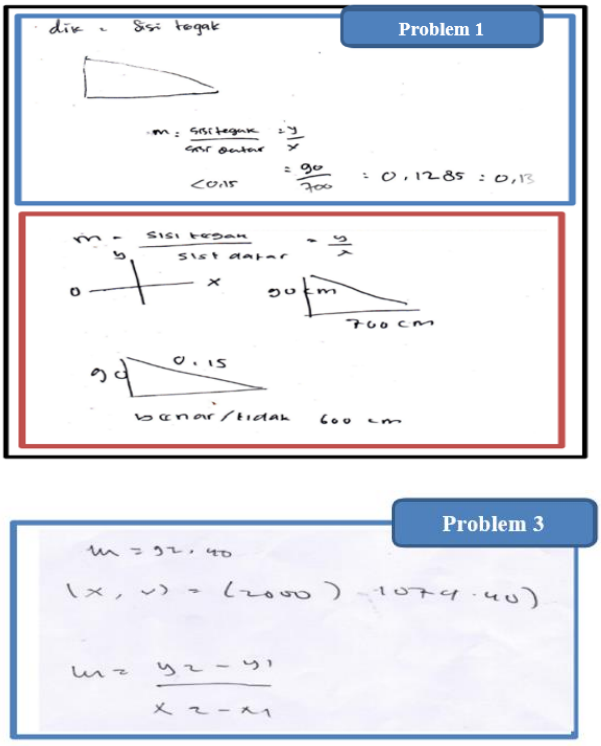


Figure 2 Media



Colour coding

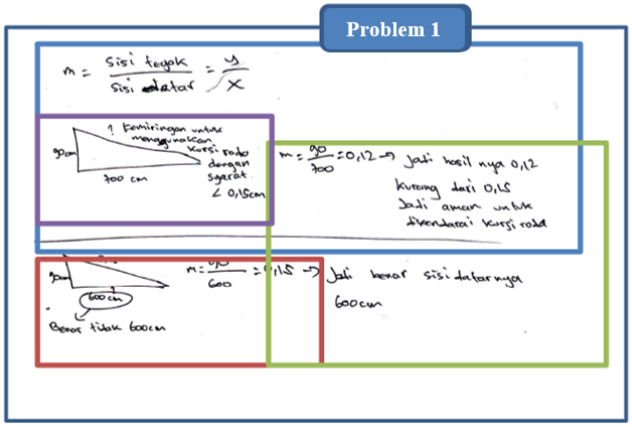
2 : Learners have the ability to use the results of problem identification to solve problems

3 : Students can formulate the results of identification into a symbolic conclusion

Figure 3 MJ's work (student subject research)

MJ students can already write down the information they know. The information written is in the form of a right triangle image. This represents the shape of the road for wheelchair users. In solving the problem above, MJ students use the concept of gradient. Based on the results of the work, it can be concluded that MJ students can apply the concept of gradient in solving problems. However, MJ students are still not able to generalize because the 4th indicator is not achieved because MJ does not make conclusions / generalizations from the problems solved. MJ student can't solve problem 2. In problem 3, MJ students do not identify existing problems and have not been able to use the results of problem identification to solve problems. However, by directly formulating the known information. The information written is in the form of a gradient concept that passes through two points. Based on the results of the work, it can be concluded that MJ students know the concept of a gradient that passes through two points but MJ students are still not able to solve the problem and generalize it.

Unlike MJ, MWS students can write down the information they know. The information written is in the form of a right-angled triangle, the length of the upright and flat sides and the problem being asked. This represents the shape of the road for wheelchair users. In solving the above problem, MWS students use the gradient concept. Based on the results of the work, it can be concluded that MWS students can apply the gradient concept in solving problems. However, MWS students still have information left behind. In this indicator, MWS has no difficulty in identifying the information contained in the problem and can generalize it.



Colour coding

1 : Students identify existing problems

2 : Learners have the ability to use the results of problem identification to solve problems

3 : Students can formulate the results of identification into a conclusion symbolically

4 : Students can use the generalization results to solve problems

Figure 4 MWS's work (student subject research)

MWS students do not identify existing problems and have not been able to use the results of problem identification to solve problems. However, by directly

formulating the known information. The information written in the form of the concept of a straight line equation of the problem. Based on the results of the work, it can be concluded that MWS students know the concept of straight line equations and are able to solve problems and generalize them. However, it is not in accordance with the expected indicators.

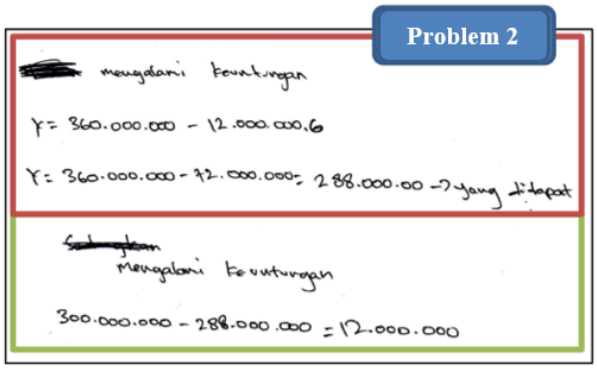


Figure 5 MWS's work (student subject research)

DA students are able to write down the information they know. The information written is in the form of a right triangle image. This represents the shape of the road for wheelchair users. In solving the problem above, DA students use the concept of gradient. Based on the results of the work, it can be concluded that DA students can apply the gradient concept in solving problems. However, there is still incomplete information and DA students are still not right in generalizing because one indicator is not achieved. DA students cannot solve problem 2.

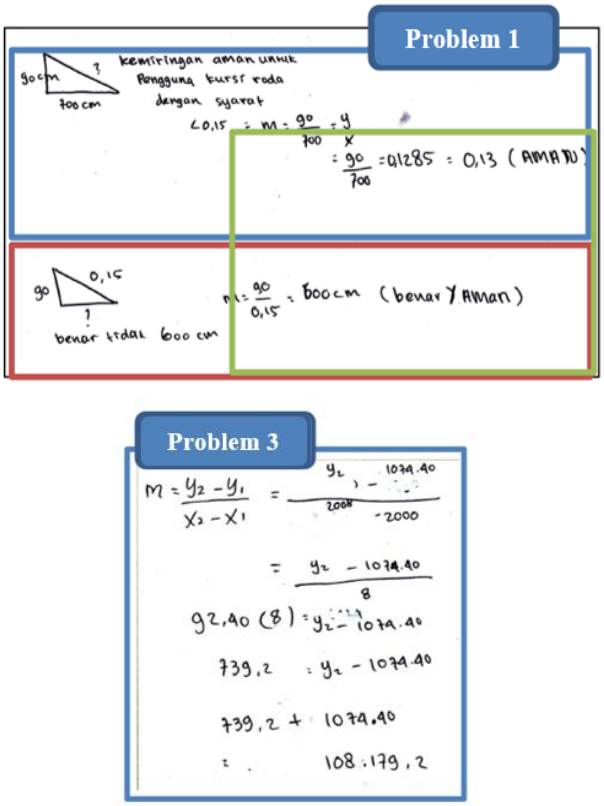


Figure 6 DA's work (student subject research)

DA students only use the results of problem identification to solve problems without fulfilling the other three indicators. The generalization ability is not visible yet.

Different EP students are able to write down the information they know. The information written is in the form of a right triangle, the length of the upright and the flat side and the problem being asked. This represents the shape of the road for wheelchair users. In solving the problems above, EP students are able to use the results of problem identification to solve problems using the gradient concept. Based on the results of the work, it can be concluded that EP students can apply the concept of gradient in solving problems and formulating the identification results into a symbolic conclusion. So that EP students can use the generalization results to solve problems and EP students have no difficulty in identifying the information contained in the problem and can generalize it.

While in the second problem, EP students did not write down the identification of existing problems, but directly used problem identification to solve the problem and directly formulated the information that was known. The information written in the form of the concept of a straight line equation of the problem. Based on the results of the work, it can be concluded that EP students know the concept of straight-line equations and are able to solve problems and generalize. However, it is not in accordance with the generalizability indicator because something is not achieved.

And in the third problem, EP students did not write down the identification of the existing problems, but directly use problem identification to solve the problem and directly formulate the known information. The information written is in the form of a gradient concept that passes through two points of the problem. Based on the results of the work, it can be concluded that EP students know the concept of a gradient that passes through two points and are able to solve problems and generalize. However, it is not in accordance with the indicator because something is not achieved.

Student M was able to write down the known information. The information written is in the form of a right triangle, the length of the vertical side and the length of the horizontal side. This represents the shape of the road for wheelchair users

In solving the problem above, student M uses the concept of gradient. Based on the results of the work, it can be concluded that M students can apply the gradient concept in solving problems

However, student M is still not able to generalize because the 4th and 1st indicators are not achieved because M does not make conclusions / generalizations from the problem being solved. DA students only use the results of problem identification to solve problems without fulfilling the other three indicators. The generalization ability is not visible yet.

For each aspect of mathematical generalization, it can be concluded that students in the category of high mathematical generalization ability have been able to

master the three generalization aspects, namely aspects of perception, expression, and symbolic of generality [3]. Then students in the category of moderate mathematical generalization abilities are only able to fulfill two generalization aspects, namely perception and expression, in other words, students in this ability are able to write down the information obtained from the questions and are able to decipher the information to determine the next pattern, but at the symbolic stage, students tend to write answers that are less relevant to the given solution. Meanwhile, students with low generalization abilities have not been able to fulfill the three generalization aspects, students with this category are only able to write down a little information to solve problems. Even that information is less relevant to the problem solving that should be done [18]. Therefore, generalization is very important as a basic capital in understanding mathematical concepts [1]. In addition, the right learning model can also facilitate students in solving problems. This is in line with the opinion of Osborn-Parnes which states: that the Creative Problem Solving (CPS) learning model can develop students' creativity in solving problems mathematics where in developing their creativity students will use their reasoning abilities [19, 20].

4. CONCLUSION

Based on the results of the study, it can be seen that in problem 1 students have been able to solve existing problems and some students have reached the generalization stage, in problem 2 students are very difficult to solve problems because they cannot identify existing problems and have not been able to use the results of problem identification to solve problems. problem and in problem 3 students do not identify the existing problem and have not been able to use the results of the problem identification to solve the problem, but by directly formulating the known information in the form of a gradient concept that passes through two points. but students are still not able to solve the problem and generalize it. So it can be concluded that students have no difficulty in solving problem 1 and very difficult in solving problem 2

AUTHORS' CONTRIBUTIONS

RS compiled and designed the research, EK and NS as validators and checked the instruments that were prepared and designed. ES as the research team.

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