Mathematical Understanding of the Underprivileged Students through GeoGebra

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Abstract. A student's mathematical understanding in high school from poor families in the district of Ciamis is still low. After reviews the various literature and earlier research, consequently, researchers convince that learning mathematics with GeoGebra can help students improve for the better understanding. Our long-term goal of this research is to support the implementation of new curriculum, namely ICT-based learning mathematics. Another goal is to give a basic mastery skill regarding mathematics software to students from underprivileged families. Moreover, the specific objective of this study is to examine the students' mathematical understanding from underprivileged families after the implementation of learning with GeoGebra. We use a quantitative comparative research method to determine differences in the mathematical understanding of students' from underprivileged families before and after mathematics learning with GeoGebra. Accordingly, the students of senior high school from underprivileged family in Baregbeg, Ciamis district, are the population of this study. This research is using purposive sampling. The instrument is in the form of a test question, which is the test of mathematical understanding. Research results show that the mathematical understanding students' from underprivileged families after the mathematics learning with GeoGebra becomes better than before. The novelty of this research is that students understand the material of trigonometry through the use of modules, aided by GeoGebra in learning activities. Thus, the understanding has an impact on improving students' mathematical understanding. Students also master the use of GeoGebra Software. Implementing these two things will be very useful for the next lesson.

1. Introduction
Students must master the ability of mathematical understanding which is the purpose of learning mathematics [1]. Mathematical understanding is a key to solve mathematical problems. The ability to solve mathematical problems is important. Recently research even observes the gesture of students in solving mathematical problems [2]. Most students with underprivileged backgrounds have poor mathematical understanding skills. National exam results corroborate the claim. Allegedly, It is because of their limitations on access to technology. Therefore, we need a technology that can help the learning process. GeoGebra software is one tool that can help students in understanding the concept of mathematics. Especially students who need visualization help. Because this software can construct the...
problem becomes more real. So that will facilitate students in understanding the problem and solve it more accurately.

According to Indonesian constitution article 31, education is the right of every citizen in Indonesia. Consequently, the government had to organize education for its citizens within the framework of the intellectual life of the nation with having faith, devotion, and noble character. The intelligent nation automatically improves the welfare of the nation. Moreover, to examine the extent of welfare, there are eight fields that should be the focus of attention which are population, health and nutrition, education, employment, extent and patterns of consumption, housing and the environment, poverty, and other social becomes a reference in an effort to improve the quality of life [3].

The implementation of education must reach all the people. Education is not only enjoyed by wealthy citizens. Accordingly, the government should seek education equally for all its citizen, ensure that every citizen has a minimum of elementary and secondary education. Moreover, education also does not know city or remote, rich or poor, prosperous or underprivileged family. All student should get the same opportunity in obtaining education let alone in math lessons. As Schnell and Preediger [4] “equity and opportunity are required to study especially for underachieving students and the opportunity to gain access to basic mathematics. This is particularly important because of the role of mathematics as a gatekeeper for higher education (secondary and tertiary), especially in the fields of science, technology, engineering, and mathematics (STEM) whose job prospects are good in many countries”.

Poor and underprivileged families still feel the lack of access to quality education. The National Family Planning Coordinating Board in Indonesia classifies the level of family welfare, including the underprivileged family classification. Underprivileged families are families who have not been able to meet basic needs (basic need) at a minimum, such as the need for spiritual, food, clothing, board, health and family planning. Moreover, underprivileged families have the main characteristics, which are unable to fulfill family needs which include, first, basic needs. Second, to reach health services. Third, the floor part of the house is the ground, fourth, lack of education.

Guarantees to the poor are listed in the 1945 Constitution article 34. Consequently, the state should develop social security for all Indonesians and empower the poor to make their lives prosperous and dignified. One way to achieve it is with education. For a long time, the mathematics education discourse about equity and the discourse about mathematics enrichment for students of high potential were conducted rather separately: On the one hand, the discourse on equity and access mainly referred to offering access to a minimum of basic mathematics, without systematically taking into account that there might be high potentials among the underprivileged students. Only recently, the underprivileged access to tertiary education came into view [5].

Quality education can certainly encourage the achievement of welfare and enhancement of the dignity of a nation. Efforts to realize the achievement of quality education is to develop technology-based education. Education without balanced technology development will lead to miss with other nations. Technological development efforts for education are absolutely necessary. In schools education, the most important aspect is how to provide effective and meaningful learning so as to impact students' ability in understanding the concepts. The use of technology should develop continuing. Mathematical learning using computer technology continues to develop. Consequently, students can use it in everyday life on various problem-solving. We expect the use of technology in mathematics learning can also improve students' mathematical abilities.

The students' mathematical understanding ability is still not satisfactory. The results of Wahyudin [6] provide claims about it. In detail, Wahyudin found five weaknesses that exist in the students, one of which is the students lack the ability to understand and explore the basic concepts (axiomatic, definitions, rules and theorems) mathematics-related subjects that become the focus of attention.

Seeing the influence of GeoGebra in mathematics learning on a mathematical understanding for students of underprivileged families on the trigonometric material is the focus of this research. We provide opportunities for students from underprivileged families to use GeoGebra in the learning process of mathematics. GeoGebra is a free dynamic software for teaching mathematics and learning that provide geometry and algebraic feature in a fully-fledged software environment [7]. There is a
several consideration to choose the software for a learning process. First, GeoGebra is easy to use for students and teachers because it has a fairly complete tool. Second, GeoGebra provides visualization in various representations to facilitate mathematical understanding. Third, GeoGebra can compute more than ordinary calculators.

The use of empirical investigations with GeoGebra contributes to student-centered learning by creating a discussion environment and it has been revealed in many studies that dynamic mathematics software used in learning environments in recent years has affected students positively. It was determined that GeoGebra, a dynamic mathematics software, had positive effects on students’ motivation and increased students’ interest towards the course [8]. The main reason for the implementation of the system GeoGebra into the mathematics education is the creation of a dynamic and interactive digital environment stimulating active learning [9].

The problem formulation in this research is: Is the mathematical understanding of underprivileged students after getting mathematics learning with GeoGebra assisted better than before obtaining mathematics learning with GeoGebra assisted?

2. Experimental Method
The method used in this research is an experimental method with experimental quasi one group pretest-posttest design as for research model which conducted is laboratory research using computer assisted GeoGebra software. This study was conducted on 10 high school students with underprivileged family background and had a very low initial mathematical ability. The research procedure conducted is as follows: first, Selection of students with background ability of low mathematical understanding and come from underprivileged families. Second, pretest the ability of mathematical understanding. Third, conditioned students to learn mathematics on the subject of trigonometry using computer with GeoGebra software. We carry out the learning process in 4 meetings. Every meeting is 60 minutes. The trigonometric subjects in this study are the comparison of trigonometry on right triangles (first meeting), angle and quadrant (second meeting), trigonometric functions (third meeting), and related angles at the fourth meeting. Students learn by using module guide and GeoGebra software on the computer. Module containing materials and worksheets that guide students to complete blank fields of questions. The GeoGebra software is helping to answer the questions. Thus, in addition to students understanding the trigonometric material as a concept, students can also visualize trigonometric material through GeoGebra software. Fourth, post-test of mathematical understanding ability. Fifth, data analysis using normality test of pretest-posttest data, homogeneity test with Levene and paired sample t-test one right side.

3. Result and Discussion

3.1 Results
The researchers collected data in the form of a test score of mathematical understanding ability before and after the action. To know the ability of students understanding of underprivileged family after obtaining learning with GeoGebra assisted better than before, hence used t-test by first doing a prerequisite test that is normality and homogeneity test. The analysis of mathematical comprehension test scores of underprivileged family students is presented in Table 1.

| Mathematical understanding | Sig. Test For Normality | Sig. Test For Homogeneity Test | Mean | Sig. 2-tailed Test Difference Of Two Mean |
|---------------------------|-------------------------|-------------------------------|------|-----------------------------------------|
| Pretest                   | 0.423                   | 0.781                         | 24.03125 |                                          |
| Posttest                  | 0.900                   |                               | 77.0625 | 0.00                                     |
Table 1 shows the results of research data analysis using the help of SPSS software. Both data are a normal distribution and homogeneous. Then, we apply the dependent t test one right side.

The learning process of trigonometry with GeoGebra-assisted, for four meetings, is seen in the activity of figure 1 and figure 2.

Figure 1 shows students understanding the trigonometric material in a computer lab using a module. The module used contains activities that require students to practice using GeoGebra software. Figure 2 shows one of the students’ works done by GeoGebra where the student visualizes the function $f(x) = \sin(x)$ by inputting the function to the GeoGebra software by first setting the x-axis and y-axis on the property. Finally, Figure 3 shows some student activity results in the module through GeoGebra software.

A more detailed explanation of the research is in Table 2. The result of dependent t test on pre-test and the post-test result shows that post-test result of students’ comprehension ability is better than pre-test result.

| Table 2. The Results of the Test Statistic Analysis of Mathematical Understanding Tests |
|-----------------------------------------------|-------------------|-------------------|--------------------------|
| Mathematical understanding                  | Test Normality    | For Homogeneity   | The conclusion of the     |
| Pretest                                      | Normal Distribution |                  | Mean Differences Test    |
| Posttest                                     | Normal Distribution | Homogen           | The average ability of mathematical understanding students of underprivileged family after obtaining mathematical learning with GeoGebra-assisted better than before obtaining mathematics learning with GeoGebra assisted |

Figure 1. Students understand the module

Figure 2. Results of student work using GeoGebra

Figure 3. Output function through Geogebra
3.2 Discussion
The ability of students' mathematical understanding after obtaining mathematical learning with GeoGebra-assisted is better than before learning. The exposure of the results of the study shows that fact. This fact cannot be separated from the success of the learning process.

We carry out the learning process in the mathematics laboratory of Mathematics Education Studies Program of Galuh University which has complete enough facilities to support the learning process. Each student uses a computer with GeoGebra software in it. According to Hohenwartner and Fuchs [5], GeoGebra is very useful as a medium of mathematics learning with various activities as follows: 1) as a media of demonstration and visualisation; 2) as a construction tool; 3) as a tool of the invention process.

We started learning with the introduction of GeoGebra software that is on the look of GeoGebra. The appearance of GeoGebra consists of 1) Menu (located at the top), menu consists of File, Change, Display, Options, Tools, Window, and Help; 2) Tool Bar (located on the second row, contains icons/symbols); 3) The Left Wind (consisting of free objects and bound objects, is where algebraic forms are displayed); 4) Right Window (where graph is displayed); 5) Input Section (located at bottom left); 6) Symbol Section (contains a list of symbols); 7) Function Section (contains a list of functions); 8) Help section (contains a list of help); 9) Command section (contains a list of commands).

The use of GeoGebra software makes it easier for teachers as facilitators to understand the concept of trigonometry in students. The systematically organized "Trigonometry with GeoGebra" module also help the learning process. The module directs students to understand trigonometric concepts visually. Visualization helps the construction of knowledge so that the discovery and understanding of trigonometric concepts become easier.

The usefulness of GeoGebra is to visualize trigonometric concepts, i.e. angles and quadrants, trigonometric ratios, trigonometric functions, and related angles. Visualization of such concepts is to construct and discover the definitions and properties of trigonometry. The diverse visualization of triangular triangles can understand the concept of trigonometric comparison. Visualization and construction of quadrant concepts, boundary angles, and special angles are to obtain the values of the special angles and the values of the series. Moreover, the visualization and construction of trigonometric comparison values of special and other angles are very easy with a graph of trigonometric functions.

The ease of use of GeoGebra also increases students' enthusiasm and confidence, whereas new students are first acquainted with GeoGebra software. Students come from an underprivileged family with no ICT facilities. Therefore, students are given the opportunity to use ICT that they do not necessarily enjoy at home. The hope is to open up their insights so that in the future they can develop their potential with confidence. So they can increase the dignity and the degree of the family into a prosperous family.

4. Conclusion
Based on the results of data processing, analysis, findings, and discussion, there are conclusions as follows: 1) Mathematics learning with GeoGebra-assisted gives effect to the result of mathematical understanding ability test of underprivileged students; 2) This lesson motivates underprivileged students to learn and understand mathematical concepts. Some of the recommendations of this research activity are: 1) Need further coaching so that underprivileged students can optimise ability to utilise GeoGebra software in learning mathematics; 2) Continue to develop the use of GeoGebra software in mathematics learning so that math learning is easy to understand.

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