

Linda

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Analysis HOTS Problem Solving: Comparison of Student Facilitator and Explaining and Geogebra-Assisted Discovery Learning Models Student Learning Outcomes

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ABSTRACT

Educators need to think about the difficulties that students often face when faced with high-order thinking skills in order to improve the teaching and learning system through the use of the right learning methods. This study aims to compare learning outcomes between using the Student Facilitator and Explaining learning model with Discovery Learning powered by Geogebra to help students be critical, creative and innovative in solving problems in the form of High Order Thinking Skills (HOTS) questions to think about in the context of science and everyday life. This experiment uses quantitative methods and is conducted in two classes. In the Geogebra-powered Discovery Learning model, the p-value is 0.059 with an average of 20.000, while in the Geogebra-powered Student Facilitator and Explaining learning model, the p-value is 0.276 with an average of 52.947. Thus, the learning model suitable for the application of Geogebra software is Student Facilitator and Explaining based on the generated data and has a higher learning outcome value than the pre-test and post-test of the Discovery Learning learning model. Students' success in learning depends not only on the learning model, but also on adequate school facilities that support the teaching and learning process between educators and students, thereby influencing student learning outcomes.

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1. INTRODUCTION

Education is one of the most important means of building quality human resources to move a country forward. As for the name of mathematics education, it is a part of national education that plays an influential role in developing students' thinking skills (Indah Perawansa et al., 2019). Education certainly requires facilities and infrastructure that help sustain education, such as schools, because school facilities and infrastructure have a influential impact on students' teaching and learning

activities (Padlan et al., 2022). Schools have something like compulsory and specialization subjects, one of the compulsory subjects is mathematics. Mathematics is a subject studied by all students from elementary school to high school and even college. The word math has multiple meanings depending on the perspective of the person doing it. With the ever higher development of science and technology, mathematics plays a crucial role as a fundamental science (Nuryana & Rosyana, 2019) that must be learned by every learner because human life is inseparable from mathematics.

Mathematics is an arithmetic science that contains symbols and numbers. Symbols and numbers are a universal language that serves as a tool for communication in mathematics. Therefore, mathematics plays a very important role in everyday life as a tool for the development of mathematics itself or the application of another scientific field (Fauziyah et al., 2022). Mathematics is also a standard subject to be assessed in pursuing a higher level of education. Therefore, the hours of instruction in mathematics are higher than in other subjects, since it has great potential to do its job, providing competent human resources, critical and logical thinking, initiative and creativity towards changes and advancements in knowledge. Although mathematics is a very important and widely taught subject in schools, students' desire to learn mathematics remains low (Desty Sugiharti et al., 2019). Because they find math to be a difficult and boring subject, when working on High Order Thinking Skill type questions, there are still many errors in the solution.

High Order Thinking Skills (HOTS) is a high-level thinking skill in students that requires critical, logical, reflective thought patterns and connections between previously received information to find a solution to a problem (Lihu et al., 2019). The importance of higher-order reasoning skills in mathematics education is for students to be good at mathematics since there is a correlation between higher-order reasoning skills and student learning outcomes in every respect (Tambunan, 2019). To enable students with HOTS skills to analyze problems, evaluate, and create innovation in solving problems. HOTS are needed in science learning and everyday life (Ichsan et al., 2019) various ways, one of which is the use of technology-enabled media. Because in addition to the development of science in the age of globalization, technology is one of the media for knowledge transfer. Technology is needed to support the teaching and learning process, especially given the various changes over time, as students get bored if they are constantly being taught with the same teaching method, even if the material being acquainted with is not well understood. According to (Anditiasari, 2020) the teacher plays an important role in learning. The use of appropriate methods makes it easier for students to understand the material and reduces students' boredom in the classroom, and when the learning methods used by teachers are not good, can affect students' learning.

Technology, especially computers has various software that can be used as a medium to connect abstract math inspiration with concrete math inspiration like Geogebra. Geogebra is geometry software that can solve algebra and calculus by constructing points, vectors, and abstract mathematical concepts so that they can be visualized and solved quickly, accurately, and efficiently (Tamam & Dasari, 2021). Meanwhile according to Simbolon (2020) Geogebra is a dynamic, free, and cross-platform math software that combines geometry, algebra, tables, graphs, statistics, and calculus in one simple package and can be used for all educational levels to help students understand abstract math material visually understand. Dynamic means that users can create interactive math applications. Free means it is free to use and contains open source software, so anyone can change or improve the program. Multiplatform means Geogebra is available for all computer types and different computer systems like Windows, Mac OS, Linux, etc (Nazhifah & Rosiyanti, 2021). Some of the benefits of the Geogebra program in learning mathematics are as follows: a) Able to create geometry drawings, even complex ones, quickly and accurately; b) Animation capabilities and manipulation Movements can provide a visual experience in understanding geometry concepts; c) Used as evaluation material to ensure that the geometry painting created is indeed correct; d) Facilitate the exploration or representation of the properties that apply to a geometry object, so students get a real visual experience and the resulting Geogebra painting can be used as assessment material (Hamidah et al., 2020). This proves the importance of the role of learning media for students

to balance the evolution of time, technology, and science trials. The learning media is one of the teaching tools for teachers to impart teaching materials, increase students' creativity and increase students' attention in the learning process, because the use of media makes students more motivated to study, and encourages students to write, speak and imagine stimulates more stimulated. In this way, learning media can make the teaching and learning process more effective and efficient and create a good correlation between teachers and students (Firmadani, 2020).

As for the name of the learning model, the learning model is a guide for educators in planning learning in the classroom, starting with the preparation of learning tools, media, and tools, ending with assessment tools that lead to efforts to achieve learning goals (Mirdad, 2020). Learning models play an important role in teaching and learning activities because the use of learning models makes it easier for students to gain in-depth knowledge of the subject matter. Also, the learning model used has to be good and in tune with the students, especially through the use of more and more sophisticated technological developments that can be used in the learning process. The use of this sophisticated technology will involve students more actively in the learning process by taking advantage of learning media such as the internet, mobile phones, and laptops, so the role of the educator has shifted from being the sole source of knowledge in the classroom to a facilitator. (Hanifah et al., 2019). However, the reality emerging for next-generation students has not resulted in improved learning outcomes, particularly in mathematics. This is because the use of mathematics learning models has not been maximized as expected, as there are still many teachers who have not applied mathematics learning models, which should be used as much as possible to help students understand mathematical concepts to facilitate. Nurhasanah & Luritawaty (2021) says that educators should be able to use learning processes that move learners towards independence, broader knowledge, and lifelong learning. The learning environment that teachers create must encourage reflective thinking, critical evaluation, and useful ways of thinking. Therefore, in this study, two learning models are applied to measure student learning outcomes.

This research combines Geogebra-powered learning media with Student Facilitators and Explaining and Discovery Learning learning models to generate data. Where Student Facilitator and Explaining (SFAE) is a learning model that makes students more active in learning by conveying statements or ideas and interacting with each other about the material they do not understand. (Putra et al., 2021). Teach students to explore optimal mindsets so they can teach them to be proactive and innovative in different situations. The Discovery Learning Model, on the other hand, is a model that is specially designed to allow students to discover concepts and principles through their mental processes. In this learning model, the emphasis is on the teacher presenting the problem to the students. Students are then asked to solve the problem through experimentation, collecting data, analyzing, and drawing conclusions (Salma & Sumartini, 2022). Starting from the explanation of the two learning models, researchers use Geogebra software as a learning medium.

There are several studies related to what researchers are researching, such as (Fitriani et al., 2022), (Anjarwati et al., 2022), Subagio, Lilik; Karnasih (2021) In this study, the student's motivation to learn increased after treatment with a learning model that was carried out in two classes using different models. A learning motivation questionnaire is used as an instrument. Nawir et al. (2019) Conducting quasi-experimental research using pre- and post-test group designs, aiming to determine the effectiveness of the Student Facilitator And Explaining the model for cooperative learning to mathematics learning outcomes of Grade VIII students. Observation, questionnaire, and test were used as instruments. Narrative statistics and inferential statistics are used as data analysis techniques, such that the descriptive data analysis on learning activities in the evaluation scale in the effective category gave an average value for the students' response, an average value of 100% was achieved in the good category on the evaluation scale. The class saw an increase after treatment, meaning that the experimental class saw an increase in learning outcomes in the effective category, while the control class also saw an increase but was in the moderately effective category. In summary, the mathematics learning outcomes taught using the Student Facilitator model and Explaining Cooperative Learning

are effective. Ritonga & Maryanti (2023) This is discussed in the context of student learning outcomes in mathematics subjects, which can be influenced by various factors such as, low student learning activity, resulting in students' knowledge being temporary. Teachers, learning activity situations, and learning institutions have a major impact on learning activities. The low learning outcomes in mathematics are also because students are not motivated to learn mathematics, since mathematics is considered to be difficult to understand and boring lessons, and the questions asked do not improve mathematical thinking skills. Therefore, efforts are made to learn math to eliminate negative perceptions as a student by understanding math concepts and using effective learning models. The effective model is the Student Facilitator and Explaining learning model, with the benefits of training students to be more independent and expected to be able to create an atmosphere of mutual collaboration, discussion, mutual help in understanding, and the courage to explain the material they master other students who do not understand the material. This can facilitate teaching and learning activities so that students can achieve good learning outcomes.

The aim of this study is to prove that learning models can influence student learning outcomes and the importance of educators' attention to facilitate student learning using technology-enabled media such as Geogebra. To help students think critically when solving HOTS problems. According to Hikmah (2020), critical thinking skills of students understanding with Geogebra media are better than with normal learning. Geogebra is used not only in linear subjects but also in other mathematics subjects such as calculus, geometry, functions, and algebra (Hamidah et al., 2020). The success of the students depends on how the teacher teaches, because learning is an activity that takes place in all people regardless of age and lasts a lifetime. It can also be interpreted as the process of acquiring various abilities, skills, and attitudes of a person, as direct mental (psychological) activity in active interaction with the environment causing changes in attitudes. Change is relative, constant, and permanent. So that knowledge works in the child's life and is intellectually important for social, emotional, ethical, and other aspects. Student learning outcomes can be measured using an assessment tool commonly referred to as a learning outcomes test. Learning outcomes are changes that occur in students in three aspects, cognitive, affective, and psychomotor (Ratu et al., 2022). In this study, the focus is on one of the domains of the theory of learning outcomes, namely the cognitive domain. Therefore, it can be finally concluded that the learning model that researchers use with the help of the Geogebra software has an impact on students who are research probationers or not.

2. METHODS

This research uses quantitative research methods. The quantitative method is a scientific method that has scientific rules, namely empirical, objective, measurable, rational, and systematic. Quantitative methods are also called discovery methods because this method is used to discover and develop new methods, given research data in the form of numbers and analyzed using statistics. The use of two samples and the following research phases are shown in Figure 1.

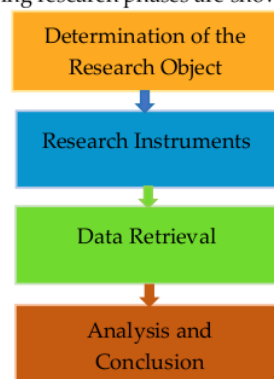


Figure 1. Research Procedure

The research phases presented in Figure 1 above can be explained as follows.

1. Determination of the Research Object

The population is the entire subject to be measured, the examined unit. The subject of the investigation is class XI students of the Assohwah Al-Islamiyah Islamic Boarding School with a total of 32 students, from the male class there are 13 students and from the female class there are 19 students.

2. Research Instruments

The instrument used in this study is a High Order Thinking Skill question consisting of five descriptive-type questions. The question to linguists and material experts is then validated using various assessment aspects. Starting from using language consistent with Elaborated Orthography (EYD), sentence structures that are clear and easy to understand so that they are free of ambiguity, and correct punctuation. Since two Geogebra-supported learning models were used in this study to progressively determine student learning outcomes, a Learning Implementation Plan (RPP) was required to help ensure that teaching and learning activities take place systematically as desired.

3. Data Retrieval

The research design used was a pre-test-post-test control group design consisting of two experimental classes, namely the male class with the treatment of the Discovery Learning model supported by Geogebra and the female class with the Student Facilitator and Explaining model. The following is Table 1. The research design of the control group before a test and after a test with treatment using different learning models.

Table 1. The Research Design of Pre-test Post-test Control Group

Group	Pre-test	Treatment	Pos-test
Male Group	O ₁	X ₁	O ₂
Girl Group	O ₃	X ₂	O ₄

Description:

X₁: Learning with the Discovery Learning model

X₂: Learning with the Student Facilitator and Explaining learning model

O₁: Results of the men's group pre-test

O₂: Results of the men's group pos-test

O₃: Pre-test results for the female group

O₄: Pre-test results for the female group

4. Analysis and Conclusion

This study uses quantitative research methods and data samples are taken from two classes, namely Class XI males and females. The data were then analyzed using JASP software with paired-sample t-test analysis techniques, descriptive tests, and data normality tests. From the analysis, conclusions can be drawn about the Geogebra-supported learning model, whether it influences the learning outcomes of the students after and before the treatment or not.

3. FINDINGS AND DISCUSSION

This research was conducted in three phases, namely pre-test, application of Geogebra's software-assisted learning model, and post-test to generate data. HOTS descriptive-type questions refer to linear program material designed to enable students to think critically and relate it to events in everyday life. The male class applied the Discovery Learning learning model with a total of 13 students, with the highest pre-test score being 15 and the highest post-test score being 30. The female class applied the Student Facilitator and Explaining learning model with a total of 19 students. The

highest pretest score is 52 and the posttest is 78. The pretest scores of the male and female classes show a difference, so initially assumed becomes that the female class is better than the male class.

- Descriptive Pre-test Results

Table 2. Pretest Descriptive

	N	Mean	SD	SE
X1	13	8.538	3.503	0.971
X2	19	28.368	6.405	1.469

In Table 2, there is a male class mean of 8.538 with SE 0.971 and a female class mean of 28.368 with SE 1.469, so from the data in Table 2 it can be said that the female class is still superior to the male class. Furthermore, the data generated after analyzing the post-test data of the two classes, to find out which learning model can influence student learning outcomes.

Table 3. Descriptive Statistics of Posttest

	X1	X2
Valid	13	19
Missing	6	0
Median	23.000	53.000
Mean	20.000	52.947
Std. Deviation	8.145	8.966
Coefficient of Variation	0.407	0.169
Variance	66.333	80.386
Skewness	-0.404	-0.390
Std. Error of Skewness	0.616	0.524
Kurtosis	-1.655	1.949
Std. Error of Kurtosis	1.191	1.014
Shapiro-Wilk	0.874	0.941
P-value of Shapiro-Wilk	0.059	0.276
Minimum	7.000	30.000
Maximum	30.000	72.000

Male and female classes have different sample sizes because they use two different classes, so with Geogebra-powered Discovery Learning learning model treatment, the male class has a mean of 20.000, a variance of 66.333, a kurtosis of 1.655, a minimum of 7.000, a maximum of 30.000, and a P-value of 0.059, while the female class with the Student Facilitator and explanation of learning model treatment has a mean of 52.947, a variance of 80.386, a kurtosis of 1.949, a minimum of 30.000, a maximum of 72.000, and a P-value of 0.276, as shown in Table 3.

- Data Normality Test

Table 4. Normality Test (Shapiro-Wilk) Posttest

			W	P
X1	-	X2	0.890	0.098

Note. Significant results suggest a deviation from normality.

Table 4 explains that if the p-value > 0.05, the data at 0.098 is normal, because if <0.05 H_0 is rejected and the data are not normally distributed, they must pass through the Wilcoxon signed rank - Test to be replaced. If the data are normal, it means that there are changes before and after the treatment in the class using.

- Hypothesis Test

Table 5. Post-test sample T-test

Measure 1	Measure 2	t	df	P	Cohen's d
X1	- X2	-11.999	12	< .001	-3.328

Note. Student's t-test.

In Table 5 there is a Cohen's d value representing the difference between the male and female class items of 3.328. Normality test performed using the Shapiro-Wilk test. The research hypotheses to be tested are: H_0 = There is no difference between the data before and after the treatment. H_1 = There is a difference between the data before and after treatment (Lu et al., 2020).

- H_0 is accepted, H_1 is rejected if $P \geq \alpha$
- H_0 is rejected, H_1 is accepted if $P \leq \alpha$

The results of the data analysis between the two classes differ significantly, both in terms of the number of students, the learning models, gender, and class atmosphere as well as the classroom equipment. The male class treating the Geogebra-supported Discovery Learning model has a mean of 20.000, a median of 23.000, a coefficient of variance of 0.407, a Shapiro-Wilk score of 0.874, a minimum score of 7.000, a maximum score of 30.000, and a P score of 0.059 > 0.05, so it is normally distributed, while the female class, using the Student Facilitator and the explanation of the learning model treatment, had a mean of 52.947, a median of 53.000, a coefficient of variance of 0.169, a Shapiro-Wilk score of 0.941, a minimum value of 30.000, a maximum value of 72.000, and a P-value of 0.276 > 0.05, so it is normally distributed. And has a Cohen's d value of 3.328. The two classes have different values, but both are normally distributed.

Testimonials from previous researchers state that the Discovery Learning learning model, powered by the Android version of the Geogebra program, increased student problem-solving ability on linear program material, with final test scores exceeding 80% in the second cycle, with an average score of 83.6. While in the first cycle, the proportion of classically graduated students was only 28%, with an average of 58.28, there were students with a score of 80 (Risdiyanto, 2021). This means that there is a change after the implementation of the learning model supported by the Android version of Geogebra software. According to research (Ritonga & Maryanti, 2023), the results of data analysis of hypothesis tests conducted by researchers conclude that the mean pre-test data is 47.17 and the mean post-test data is 85.33. A t-test was conducted to find out how the use of the Student Facilitator and Explaining learning model affected student learning outcomes in mathematics. This means that H_0 is rejected and H_1 is accepted, suggesting that students' mathematics learning outcomes are affected by the use of the Student Facilitator and Explaining learning model. And after treating the learning model, there is an increase.

In contrast to the research results of (Thelesy et al., 2022) that the average score of the discovery learning type cooperative learning model is 64.36. The average score of the student facilitator and explainer type cooperative learning model is 49.80. There are differences in the learning outcomes of students taught in Grade VII with the discovery learning model and the student facilitator and explainer learning model on the material of linear equations and inequalities of one variable. This is reflected in the results of the t-test calculation, namely the value of Sig. (2 - tailed) = 0.000 < the value of $\alpha = 0.05$, resulting in H_0 being rejected and H_1 being accepted. From these references it is evident that each research has its own challenges as school institutions also affect the learning outcomes of students as the development of more and more modern science encourages students to adapt to these developments.

Previous studies show that after the treatment of learning models, there are changes in students, both in terms of their cognitive and learning motivation. In addition, however, complete facilities are also required in a school. Complete facilities help students learn, while incomplete or non-existent classrooms mean that students often do not focus on what the teacher is explaining because there are many objects to see. The spirit of learning is also required to achieve good learning outcomes for students. The need for schools to meet the needs of students as much as possible, to support the teaching and learning process, and to educate students who can think critically and are motivated to

learn, as the school environment can influence the way students think. Whether a learning model is appropriate or not depends on how willing teachers and students are to learn in a way that is well designed by teachers. Because good cooperation between teachers and students can result in something good. The importance of critical thinking must also be realized by the students as they encounter different kinds of problems. Citing Kurniawati & Ekayanti (2020) critical thinking is very important because students with critical thinking skills can solve the problems they face. Education must be able to leverage advances in technology and science to achieve educational goals effectively and efficiently (Rahmi & Samsudi, 2020). Since the use of technology can also be helpful in the teaching and learning process, there is a need to facilitate all elements in the school so that there are no outdated elements.

4. CONCLUSION

The average score of the Discovery Learning learning model is 20.000. The average score of the Student Facilitator and Explaining learning model is 52.947. There are differences in the learning outcomes of students taught in class VII of the Islamic boarding school Assohwah Al-Islamiyah according to the learning model Discovery Learning with Student Facilitator and Explaining on linear program material. This is supported by the different p-values of the two classes and the Sig./P-value > 0.05, so the data are normally distributed. The learning outcomes of the students of both classes show different results before the test and are treated with different learning models after treatment so that different results are also obtained after the test. However, among the male and female classes in terms of the results before and after the test, the female class with the treatment of the Student Facilitator and Explaining learning model scored high. The male class treating the Geogebra-supported Discovery Learning model has a mean of 20.000, a median of 23.000, a coefficient of variance of 0.407, Std. The error of Kurtosis 1.191, Shapiro-Wilk 0.874, minimum score 7.000, maximum score 30.000, and P-value from 0.059 > 0.05, so it is normally distributed, while the female class with the Student Facilitator's treatment and the explanatory learning model has a mean of 52.947, median 53.000, coefficient of variance 0.169, std kurtosis error 1.014, Shapiro-Wilk 0.941, Minimum value 30.000, maximum value 72.000 and P value.

The researchers think there is still a lot to improve in this study, starting with the instruments, ending with the students and the schools, which are the research targets, because if you really choose a school, it will have an impact on the results of the study. Far from technology, with technology-based research, you should be able to prepare everything necessary without having to depend on school. Researchers are dissatisfied with this research for a number of reasons, including the unavailability of the necessary facilities at the school, making it difficult for students to apply the learning model applied using Geogebra software. For future researchers who wish to do further research in this regard, it is advisable to choose a suitable research site with better instruments that can support your research.

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