

THE EFFECT OF THE HOTS-BASED DISCOVERY LEARNING MODEL ON STUDENTS' CRITICAL THINKING ABILITIES IN QUADRANGLE AND TRIANGLE PLANE FIGURES

Rizky Sundari Putri

Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia

ABSTRACT

The discovery learning model is a learning strategy that encourages students to conduct observations, experiments, and scientific actions to achieve a deeper understanding. In this model, students are active in finding and understanding the concepts taught, as well as solving problems by collecting and processing data. This study aims to determine the effect of the use of HOTS-based discovery learning model on students' critical thinking skills on the material of quadrilaterals and triangles. The population in this study were grade IX students at MTs Az-Zahroh. The sample in this study were 23 students of grade IX Ibnu Khaldun (as the experimental class) and 23 students of IX Ibnu Sina (as the control class). The research method used in this study was a quasi-experimental one. The research instrument used a question validation sheet and an essay-shaped test (description) on the material of quadrilaterals and triangles. The data analysis technique used was the normality test. The research hypothesis test used the t-test, namely the independent sample t-test and the paired sample t-test with the help of the SPSS 25 application. The results of the independent sample t-test obtained a Sig. value. (2-tailed) of $0.000 < 0.05$, which means H_0 is rejected and H_a is accepted. Therefore, there is a difference in the test results of students' critical thinking abilities using the HOTS-based discovery learning model and those using the conventional teacher-centered learning model. In the paired sample t-test, Sig. (2-tailed) pair 1 = 0.000 and pair 2 = 0.026, meaning the significance value is < 0.05 , thus proving that H_0 is rejected and H_a is accepted. Therefore, it is clear that there is a difference in the average pretest-posttest between the experimental and control classes. Therefore, it can be concluded that the HOTS-based discovery learning model has an effect on students' critical thinking abilities, especially regarding quadrilaterals and triangles.

Keywords: Influence, HOTS-Based Discovery Learning Model, Student Critical Thinking, Mathematics Learning

Corresponding Author:

Rizky Sundari Putri

Universitas Muhammadiyah Sumatera Utara

1. INTRODUCTION

Mathematics is a discipline that plays a crucial role in education. This subject is mandatory for instruction from elementary school through university because it is considered practical in helping humans find solutions to problems (Harahap, 2020; Ginting, 2019). According to Gie (in Mubarak, 2022), mathematics can be categorized into several perspectives: the science of numbers and space, quantity, relationships, abstract forms, and deductive science.

One of the uses of mathematics is to train students' critical thinking skills. Maftuchah (2022) emphasized that mathematics trains students to think critically, systematically, logically, creatively, and consistently. Similarly, Marzano (in Rahimah, 2019) positions mathematics as a subject capable of developing critical thinking skills. Critical thinking itself is a complex process that helps systematically examine ideas so that problems can be solved more effectively (Nuraida, 2019). In the context of mathematics learning, critical

thinking requires students to analyze, identify, evaluate, and develop ideas before drawing conclusions (Rahmadani, 2019).

However, students' critical thinking skills tend to be low because teachers often assign questions that require low-order thinking skills (LOTS) rather than questions that require high-order thinking skills (HOTS). However, HOTS-based questions can train students' analytical skills, reflection, reasoning, and application of concepts in different situations (Kemala, 2021). Students' low critical thinking skills in schools are also caused by the dominance of conventional, teacher-centered learning methods, which tend to be passive and poorly trained in solving HOTS-based problems (Fahrudin et al., 2021; Yulianto et al., 2023).

To address this, learning models are needed that encourage students to play an active role. One such model is discovery learning, which provides opportunities for students to discover concepts on their own, while the teacher acts as a facilitator (Fajri, 2019). A meta-analysis by Hanifah et al. (2022) demonstrated that the discovery learning model is effective in improving critical thinking skills in mathematics at various levels of education, with a significant effect size.

Based on these conditions, this study was conducted to examine the effect of the HOTS-based discovery learning model on students' critical thinking skills in the topic of quadrilaterals and triangles.

2. METHOD

Research Type and Design

This study used a quasi-experimental method with a Nonequivalent Control Group Design (Sugiyono, 2016). This design involved two groups, an experimental group and a control group, both of which were given a pre-test and post-test. The experimental group received treatment in the form of the discovery learning model, while the control group used teacher-centered learning.

The research design is as follows:

- O1 = Pre-test for the experimental group
- O2 = Post-test for the experimental group
- O3 = Pre-test for the control group
- O4 = Post-test for the control group

X = Treatment with discovery learning

Data Collection Techniques

Data were collected through:

Observations → conducted to observe school conditions, facilities, teaching and learning processes, and student characteristics.

Tests → in the form of HOTS essay-style questions administered during the pre-test and post-test stages. The pre-test aimed to determine students' initial critical thinking skills, while the post-test was used to measure results after the treatment.

Research Instruments

The instruments used included:

A Question Validation Sheet, a questionnaire with a scale of 1–4, was used to assess the suitability of the test items to core competencies, critical thinking indicators, and question clarity.

The written test consisted of 10 HOTS-based essay questions on quadrilaterals and triangles. The test was divided into 5 pre-test questions and 5 post-test questions.

Instrument Testing

Validity was tested through expert assessment using a scale of 1–4. The instrument was categorized as valid if it obtained an average score of ≥ 3.0 .

Reliability was determined by a consistency test, meaning the instrument was considered reliable if it produced consistent scores across repeated measurements.

Data Analysis Techniques

Data analysis was conducted using SPSS with the following steps:

Normality testing used the Kolmogorov-Smirnov test to ensure data distribution. Data were considered normal if the significance value was ≥ 0.05 .

Hypothesis testing used a t-test to determine the effect of discovery learning implementation on students' critical thinking skills. The decision-making criteria are:

If $t_{\text{count}} > t_{\text{table}}$, there is a significant effect.

If $t_{\text{count}} < t_{\text{table}}$, there is no significant effect.

3. RESULTS AND DISCUSSION

This study aimed to determine the effect of the HOTS-based discovery learning model on students' critical thinking skills in the topic of quadrilaterals and triangles. Data were collected through pretests and posttests in the form of descriptive questions. The instrument underwent validity testing by experts (three validators: two lecturers from the Faculty of Teacher Training and Education at State Islamic University of Muhammadiyah Surakarta (UMSU) and one mathematics teacher from MTs Az-Zahroh) and a pilot test on students. Of the 10 HOTS questions, five were valid (numbers 2, 3, 5, 7, and 8) with a Cronbach's Alpha reliability of 0.794 (high category).

The Kolmogorov-Smirnov test for normality showed a significance value of $0.200 > 0.05$ for both the experimental and control classes, indicating a normal distribution of the data. An independent sample t-test showed a significant difference in the posttest average between the experimental class (81.43) and the control class (51.09) with a 2-tailed Sig. $0.000 < 0.05$. The paired sample t-test also showed a significant difference between the pretest and posttest scores in both classes: the experimental class (Sig. 0.000) and the control class (Sig. 0.026). The increase in pretest–posttest scores was higher in the experimental class (45.34) than in the control class (11.57).

Discussion

The results of this study demonstrate that the HOTS-based discovery learning model significantly impacts students' critical thinking skills. This is demonstrated by the higher improvement in the experimental class compared to the control class. In the experimental class, students were actively involved in discussions, problem identification, data collection and processing, and presentation of results, thus fostering the development of critical thinking skills. In contrast, in the control class with the conventional model, students tended to be passive, simply listening to the teacher's explanations and having fewer opportunities to express their opinions.

This finding aligns with research by Fajri (2019), which states that discovery learning

requires students to organize their own learning methods, thus retaining concepts longer and improving reasoning. Similarly, Budiastuti & Rosdiana (2023) emphasized that discovery-based learning enables students to be more active and discover learning principles through experience.

Thus, the application of discovery learning based on HOTS questions not only improves learning outcomes but also significantly develops students' critical thinking skills in the topic of quadrilaterals and triangles

4. CONCLUSION

Based on the research results described in the previous chapter, it is concluded that the HOTS-based discovery learning model has an effect on students' critical thinking skills in the topic of quadrilaterals and triangles. These results were obtained using t-tests, namely the independent sample t-test and the paired sample t-test. The posttest results obtained from both classes: Class IX Ibnu Khaldun (the experimental class) obtained an average score of 81.43 and Class Ibnu Sina (the control class) obtained an average score of 51.09. The pretest results for Class IX Ibnu Khaldun (the experimental class) obtained an average score of 36.09 and Class IX Ibnu Sina (the control class) obtained an average score of 39.52. Therefore, it can be concluded that the pretest-posttest increase in the experimental class was 45.34, while the pretest-posttest increase in the control class was 11.57, indicating a difference in the average scores between the experimental and control classes.

The research findings above indicate that the experimental class using the HOTS-based discovery learning model significantly improved students' critical thinking skills compared to the control class using the conventional teacher-centered learning model. Therefore, the researcher can conclude that the HOTS-based discovery learning model significantly influences students' critical thinking skills in the topic of quadrilaterals and triangles.

B. Recommendations

Based on the research findings, the researcher would like to offer the following recommendations:

- 1 MTs mathematics teachers can use the Discovery Learning model as an alternative learning method to improve students' critical thinking skills during the learning process, making it easier for students to understand and learn the material on their own.
- 2 For researchers, the application of the Discovery Learning model to mathematics can broaden their knowledge, skills, and experience, which can be used in future research.
- 3 For future researchers, it is recommended that they provide insights and innovations regarding the learning model studied, particularly to develop students' critical thinking skills.

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