# Mathematic Learning Using Discovery Learning Model to Improve Students' Critical Thinking Skills

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## ABSTRACT

*This study was conducted with the aim of knowing the process and effect of discovery learning to improve critical thinking skills of Vocational School NU Al-Hidayah students as many as 10 students for test questions and 21 students for the application of learning using the discovery learning model. In this study, the teaching module was prepared using the discovery learning model which consisted of 6 learning syntaxes and was conducted for 2 meetings. The research method used is a pre-experimental design with the type of one-group pretes-posttes design and uses a quantitative research approach. The test instrument was in the form of pretest and posttest description questions to measure students' critical thinking skills. The data analysis technique used is hypothesis testing. However, before testing the hypothesis, the data obtained was first tested for normality. Based on the results of the data normality test with Shapiro-Wilk, the pretest results have a significance value of 0.113 and the posttest results have a significance value of 0.253. The normality test is normal. Based on the paired sample t-test calculation, it shows that the t value is 0.000 with a significance of 0.000. The significance value shows 0.000 < the error rate of 0.05, so it can be concluded that Ha is accepted. Acceptance of Ha means that there is a positive influence on the critical thinking skills of students in class X APHP Vocational School NU Al-Hidayah after applying the paired sample t-test.*

*Keywords: Discovery Learning; Snakes and Ladders Game; Critical Thinking*

## INTRODUCTION

The subject is in the spotlight in Indonesia or in the world, because of the usefulness of its knowledge which is very useful in everyday life and very useful in various fields, one of which is mathematics (Ramadhani et al., 2019). In addition, the purpose of mathematics subjects given to all students is to support the development of the ability to work together and be creative, systematic, analytical, and logical thinking skills (Rahmaini & Ogylva Chandra, 2024). It can even be said that mathematics is the root of science that has a very large role. Mathematics has a very large role, it can be seen from the great demand for someone to have mathematical abilities that are not only a person's ability to count.

The strong assumption that mathematics is a very difficult subject to learn causes human unawareness of the importance of mathematics. Mathematics has an important role in education, as can be seen from the provision of mathematics at all levels of education from elementary school to college, considering the importance of mathematics lessons, then in its learning it is not only to know and understand what is contained in mathematics itself, but more emphasis on the thinking patterns of students so that they can solve problems critically, creatively, carefully, thoroughly, and logically (Setiawan & Rizki, 2018). In the educational environment, mathematics is one of the compulsory subjects that has an essential contribution to aspects of life, mathematics learning in this school aims for students to have the capability to solve problems. Therefore, the phase of mathematics learning is always linked to the daily lives of students, according to the real-life experiences of students. This is done with the aim that students can describe concepts and knowledge through direct experience regarding mathematics lessons.

Based on the results of interviews conducted by researchers with mathematics teachers at Vocational School NU AL-Hidayah Ngimbang on May 6, 2024, especially on the material of Arithmetic Sequences and Series, information was obtained that students' critical thinking skills were low because many students still did not understand how to work on questions that contained critical thinking indicators properly and correctly. This is evidenced by the low learning outcomes of students, more than 60% of students are still below the Learning Objective Achievement Criteria (KKTP). The ability to understand a concept and also students' ability to think critically can be increased through the application of learning using the Discovery Learning model in the classroom (Pratama & Mardiani, 2022). Discovery Learning is a learning model that requires students to be active in learning and also students are able to obtain and discover knowledge for themselves (Sapilin et al., 2019). The use of the discovery learning model motivates students to think, ask questions, foster students' confidence in solving problems, formulate hypotheses, and connect and collaborate on problems (Edi & Rosnawati, 2021). One way for students in learning to develop an attitude of being able to learn actively is by finding and investigating for themselves so that the results obtained are easy for students to remember by learning using the Discovery Learning model (Aji & Yuniawantika, 2022).

The Discovery Learning learning model also has advantages and disadvantages. Discovery Learning has many advantages that can be used in the learning process. Discovery Learning helps students to be more active in learning. Students are given the opportunity to develop their own thinking according to their abilities. Students are required to be able to investigate and collect their own needs used in the learning process. In addition, the Discovery Learning learning model also has many weaknesses. One of the weaknesses in the Discovery Learning learning model is that students are less skilled in carrying out learning because students are not used to the new learning model. This makes students who have a slow thinking process tend to be confused, while students who are smarter tend to understand the process faster and monopolize learning in class. The success of learning using the Discovery Learning model to help students find and understand a learning concept is proven by the results of research which states that the use of the Discovery Learning learning model can guide students to find their own understanding and also guide students to be able to solve their own problems independently but still involve group discussions. Through these discoveries, students are able to conduct further investigations, learn independently, and develop students' creativity and communication (Sapitri et al., 2021).

The PISA (Program for International Student Assessment) program conducted by the Organization for Economic Cooperation and Development (OECD) has released the latest results in 2023. The scores that can be seen have decreased by 13 points compared to the results in 2018. Indonesia's mathematics score is 366, 106 points away from the world average score. However, Indonesia has risen five ranks for mathematics skills (Yuda & Rosmilawati, 2024). Critical thinking skills are considered basic mathematical skills that are very important and must be possessed by students because in critical thinking students do not simply accept without knowing their origins, but students can be responsible for opinions and logical reasons (Butar & Jailani, 2023). Critical thinking skills are not innate abilities or cannot occur automatically in early adulthood. Therefore, critical thinking skills are abilities that need to be trained. Utilization of learning using the discovery learning model can be assisted by the use of learning media that have been created. Learning media plays an important role in improving the quality of learning in the classroom. Therefore, the success of learning is influenced by the use of learning media (Damayanti et al., 2022). The learning media used by researchers in this study was the Snakes and Ladders game which was created to measure the level of students' understanding of the material on arithmetic sequences and series. The snakes and ladders game media that has been created is also able to train students' critical thinking skills.

One of the materials studied in mathematics subjects in vocational schools is Arithmetic Sequences and Series. Therefore, students are expected to be able to solve every problem related to Arithmetic Sequences and Series. However, when viewed from the results of mathematics learning in schools, especially mathematics learning on the material of arithmetic sequences and series in the vocational schools studied, it is still less than satisfactory. Therefore, the researcher wants to conduct research using the material of Arithmetic Sequences and Series using the discovery learning method. Based on the description above, the researcher took the title of the final assignment "Learning Mathematics Using the Discovery Learning Model Assisted by the Snake and Ladder Game to Improve Critical Thinking Skills of Vocational School NU Al-Hidayah Students on the Material of Arithmetic Sequences and Series".

**METHOD**

This study aims to determine the effect of discovery learning to improve students' critical thinking skills on the material of arithmetic sequences and series conducted at Vocational School NU Al-Hidayah Lamongan. The method used in this study is a pre-experimental design research method with a quantitative approach. Based on the objectives that have been explained, this study uses a one-group pretest-posttest design. This study uses one group of research subjects, namely the experimental group using the Discovery Learning model. The design of this study uses a one-group pretest-posttest design. In this study, before being given treatment, the experimental class was given an initial test in the form of a pretest to determine students' initial critical thinking skills on the material that had been taught. After being given treatment using the Discovery Learning model, the experimental class was given a final test in the form of a posttest using the same questions as the pretest, to determine students' final critical thinking skills. The sampling technique in this study used the Probability Sampling Technique, so the subjects used were class X APHP (Agribusiness Processing of Agricultural Products) as many as 21 students.

**RESULT AND DISCUSSION**

**Result**

Next is the Inferential Analysis which explains the influence of mathematics learning using the Discovery Learning model assisted by the Snakes and Ladders Game to improve the critical thinking skills of vocational high school students on the material of Arithmetic sequences and series. The researcher conducted an assessment of the tests done by students on the material of arithmetic sequences and series which were then tested for their effectiveness. The effectiveness test used in this study is as follows:

- The Normality Test

The normality test in the study must be normally distributed. The distribution is said to be normal if the significance level is more than 0.05, while if the significance level is less than 0.05 then the distribution is said to be abnormal. Based on the results of the data normality test with Shapiro-Wilk, the pretest results have a significance value of 0.113 and the posttest results have a significance value of 0.253. The normality test can be concluded that both data have a significance value in Shapiro-Wilk of more than 0.05 so that the data is normally distributed.

- The Paired Sample t-Tes.

The tested data is proven to be normally distributed, so the data can be tested using the Paired Sample t-test. The samples used are the results of the Pretest and Posttest. Based on the test results obtained, the significant value is 0.000. The significant value of 0.000 <significant level of 0.05, so it can be concluded that Ho is rejected. The rejection of Ho resulted in the acceptance of Ha, thus having a positive impact which means that there is an influence of Discovery Learning assisted by the snake and ladder game to support students' critical thinking skills in the material of arithmetic sequences and series.

**Discussion**

The initial stage in this study was a construct validation test on the preparation of research instruments including teaching modules with a discovery learning model assisted by the snakes and ladders game and test questions used to determine the increase in students' critical thinking skills in the material of Arithmetic sequences and series. The results of the validation score analysis of the teaching module by two validators obtained a percentage of suitability with a percentage of suitability of 91.34%. Based on the results of the analysis, the teaching module was declared very valid. The research instrument used has been validated by two experts and revised according to the suggestions of the validators. The results of the validation score analysis of the test instrument by two validators obtained a percentage of suitability with a percentage of suitability of 91.67%. Based on the results of the analysis above, the test instrument was declared very valid.

The second stage is the content validation test by means of a trial on 10 students who will then be tested for content validity and reliability. This content validity test is used to test the validity of each test item further. Each question item is tested for validity before being used for research. This validity test uses the assistance of the IBM SPSS Statistics 22 application. Based on the results of the content validity test of the pretest and posttest questions, the significance value of pretest and posttest questions number one to five is less than 0.05. The calculated R (Pearson correlation) of questions number one to five is positive and above the R table in DF (degree of freedom) of 8, namely 0.6319, so the test questions are

declared valid. Test questions can be used in research to measure the increase in student learning achievement after implementing discovery learning with the help of the snake and ladder game on the material of arithmetic sequences and series because they are considered valid.

The test questions that have been tested for validity, then the questions are tested for reliability. The reliability test is used to determine whether the test items are reliable in providing results for measuring student learning achievement. This test uses the assistance of the IBM SPSS Statistics 22 application through Cronbach's Alpha method. Based on the results of the test question reliability test, it can be seen that Cronbach's Alpha pretest value is 0.748 which is stated as reliable and the posttest question is 0.805 which is stated as very reliable. The pretest and posttest questions can be used for research because Cronbach's Alpha value obtained is more than 0.61. The researcher applies the learning process according to the learning device with the discovery learning model assisted by the Snakes and Ladders game. The stages carried out in the research are divided into three, namely pre-implementation, implementation, and post-implementation. In the pre-implementation stage, activities consist of compiling research instruments which are carried out in June 2024, validating the instrument on September 23, 2024, and testing the test questions on September 24, 2024. Furthermore, in the implementation stage, the research was conducted on September 25 and 26, 2024 at Vocational School NU Al-Hidayah Ngimbang, with 21 students as subjects and the material tested was arithmetic sequences and series. Finally, in the post-implementation stage, an effectiveness test was carried out which included a normality test and a Paired Sample t-test. In this study, the devices used consisted of a teaching module with a Discovery Learning model assisted by snakes and ladders game media, and a test that had been validated by two validators. The test questions used were tested for validity and reliability using IBM SPSS Statistics 22.

This study includes descriptive analysis and inferential analysis. This descriptive analysis explains how the mathematics learning process uses the discovery learning model Assisted by Snakes and Ladders Game to improve the critical thinking skills of vocational high school students in the material of Arithmetic sequences and series. Based on the results of the study, it was found that there was a significant difference between the Pretest and Posttest in the material of Arithmetic Sequences and Series. In this discussion, the author tries to explain the differences in student learning outcomes in the material of Arithmetic Sequences and Series after the implementation of discovery learning assisted by the Snakes and Ladders game. Discovery learning assisted by the Snakes and Ladders game makes students more active in the learning process to find solutions to problems related to the material of Arithmetic Sequences and Series, so that with discovery learning assisted by the snakes and ladders game, student learning outcomes in the material of Arithmetic Sequences and Series can increase. The increase in student learning outcomes can be seen from the results of the Pretest and post-test, which were tested using the Paired Sample t-test with the help of the IBM SPSS Statistics 22 application. The following are the average results of the Pretest and Posttest on the material of Arithmetic Sequences and Series.

**Table 1.** Average Student Test Result

|  |  | Mean | N |
|---|---|---|---|
| Hasil Test | Pretest | 67.6190 | 21 |
|  | Posttest | 84.048 | 21 |

The average value of the pretest results is 67.6190 while the posttest results are 84.048. Likewise, based on the analysis of the results of the Pretest and Posttest of students on the material of Arithmetic Sequences and Series with the t-test using the Paired Sample t-test shows that the significance value is 0.000 <0.05 then Ha is accepted, which means there is a significant difference between student learning outcomes after implementing discovery learning assisted by the snake and ladder game on the material of Arithmetic Sequences and Series. The discovery learning learning process carried out by researchers has several stages in the core activities. The core activities of video-assisted discovery learning are as follows:

- Provision of Stimulation

At this stage, students are given problems about arithmetic sequences and series as a starter question to start learning. Furthermore, students are given pretest questions to measure how far students know and understand the material on arithmetic sequences and series. At this stage, the teacher facilitates students so that learning activities can lead to discovery activities as preparation for problem identification.

- Problem Statement or Identification

At this stage, the teacher discusses the pretest questions that have been given and explains using the help of a PowerPoint about arithmetic sequences and series. When explaining, the teacher gives provocative questions so that students can be active in the learning process. At this stage, the teacher also explains arithmetic sequences and series related to daily activities so that students can more easily understand the concept of arithmetic sequences and series.

- Data Collection

Data collection stage, students form heterogeneous groups. Next, the teacher provides group worksheets, and students are asked to complete the understanding test by working on the questions given in groups. The teacher walks around to see the activities carried out by students and provides assistance if there are problems while working on

- Data Processing

The teacher asks each group to present the answers they have worked on in front of the class. Other groups are asked to respond and provide arguments about what has been conveyed. The teacher provides reinforcement about the results of the group presentation. Next, the teacher and students make conclusions together about the learning activities that have been carried out and reflect on today's learning.

- Verification

The proof stage is carried out in the next meeting. First, the teacher discusses the material given in the previous meeting. Next, the teacher explains today's learning activities that use learning media assisted by the Snakes and Ladders game. The teacher gives examples of the use of learning media that will be used and the teacher explains the rules of the Snakes and Ladders game that will be played. In the next stage, students form heterogeneous groups and the teacher determines the order of the groups to take turns rolling the dice. Students play snakes and ladders and those who get a box containing questions are required to complete the questions correctly and if wrong the group must move back one box. The group that gets a box containing challenges is required to complete the challenges given by other groups. The group that reaches the finish line first gets a reward from the teacher.

- Generalization

Teachers and students make conclusions and reflections on the learning activities that have been carried out. Furthermore, students are given post-test questions to measure students' critical thinking skills and also to determine students' understanding of the material on arithmetic sequences and series using the Discovery Learning method.

## CONCLUSIONS

The research that has been conducted at Vocational School NU AL-Hidayah school by implementing the discovery learning model assisted by the snake and ladder game on the material of arithmetic sequences and series. A total of 10 students for the trial of test questions and 21 students for the application of learning using the discovery learning model. This study shows that there is a significant difference in student learning outcomes in improving critical thinking skills during learning. This shows that there is an influence on mathematics learning using the Discovery Learning model in improving students' critical thinking skills.

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