# Improving Students' Creative Thinking Skills on Exponential Function Material Through the Application of the Discovery Learning Model

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## Abstrak

Penelitian bertujuan untuk mengetahui proses dan pengaruh kemampuan berpikir kreatif peserta didik kelas X SMK Kreatif Bahrul Ulum sebelum dan sesudah menerapkan model pembelajaran *discovery learning*. Metode penelitian yang digunakan adalah *pre- eksperimental design* dengan jenis *one-group ptetest-pos-test design* serta menggunakan pendekatan kuantitatif. Subjek penelitian ini adalah peserta didik kelas X SMK Kreatif Bahrul Ulum Tambakberas. Instrument penelitian yang digunakan berupa tes dan non-tes. Instrument tes berupa soal uraian *pretest* dan *pos-test* untuk mengukur kemampuan berpikir kreatif peserta didik menggunakan pembelajaran *discovery learning*. Teknik analisis data yang digunakan adalah uji hipotesis. Data yang diperoleh terlebih dahulu dilakukan uji normalitas dan uji homogenitas. Berdasarkan perhitungan *uji paired sample t test* menunjukkan bahwa nilai t hitung sebesar 19.453 dengan signifikansi 0.000. Nilai signifikansi menunjukkan 0,000 < taraf kesalahan 0,05, sehingga dapat disimpulkan Ha diterima. Sehingga dapat disimpulkan bahwa terdapat peningkatan kemampuan berikir kreatif peserta didik kelas X SMK Kreatif Bahrul Ulum Tambakberas sebelum dan sesudah menerapkan model pembelajaran *discovery learning*.

Keywords: Berpikir_Kreatif; Fungsi_Eksponensial; Model_Discovery_Learning.

## *Abstrac*

*The study aims to determine the process and influence of creative thinking skills of class X students of SMK Kreatif Bahrul Ulum before and after implementing the discovery learning model. The research method used is pre-experimental design with one-group pretest-posttest design and using a quantitative approach. The subjects of this study were class X students of SMK Kreatif Bahrul Ulum Tambakberas. The research instruments used were tests and non-tests. The test instrument was in the form of pretest and post-test essay questions to measure students' creative thinking skills using discovery learning. The data analysis technique used was hypothesis testing. The data obtained were first tested for normality and homogeneity. Based on the calculation of the paired sample t test, it showed that the t count value was 19.453 with a significance of 0.000. The significance value shows 0.000 <error level of 0.05, so it can be concluded that Ha is accepted. So it can be concluded that there is an increase in the creative thinking skills of class X students of SMK Kreatif Bahrul Ulum Tambakberas before and after implementing the discovery learning model.*

*Keywords: Creative_Thinking;Exponential_Function; Discovery_Learning_Model.*

## Introduction

Formal education in Indonesia starts from elementary education to higher education. One of the most widely studied studies at every level of education, even in all collections of sciences in higher education, is mathematics. The importance of studying mathematics cannot be separated from its role in various aspects of life. In

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addition, after studying mathematics, a person will be accustomed to thinking systematically, critically, scientifically, and can foster their creativity. Mathematics is the science of logic, regarding forms, sequences, and concepts that are related to each other to remember the importance of studying mathematics, it is only natural that every student at every level of education should master mathematics. in addition, students will also be instilled with concepts in mathematics learning (Rahmah, 2018).

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, precisely, 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 (Susilawati & Dewi, 2019).

From the statement above, there are still many students who have not been able to understand mathematics lessons properly and correctly because there are still students whose abilities do not meet the average or it can be said that students have problems in learning. Learning difficulties can be interpreted as the inability of students to complete assignments from teachers (Fitri, 2019). In learning mathematics, difficulties in understanding the material have become commonplace, this is because mathematics is considered difficult by students, even students assume that mathematics is studied for no reason and do not understand the importance of mathematics in life and its relationship to other lessons at the next level (Kurnia et, al., 2022). The material in mathematics is interrelated with each other, so that when students do not understand one of the contexts in mathematics they will have difficulty learning in the next sub-chapter. Therefore, it is important to apply a learning model that attracts students' interest in learning more actively and creatively. Susanto (2016) stated that interest is a factor that significantly influences learning success because interest makes a major contribution to students' learning success. According to Firdaus (2019)low interest in learning is due to the way teachers deliver material, and the lack of active participation of students can be factors that influence this to occur.

Discovery learning is an active and direct learning style developed by Jerome Bruner in the 1960s. Bruner emphasized that learning must be done by doing. With this method, students actively participate, not just passively receive knowledge. The discovery learning method creates active learning where material or content is not given by the teacher at the beginning of learning directly. During the learning process, students are asked to find their own way to solve problems (Rahmawati, 2020). Discovery is carried out through observation, classification, measurement, prediction, determination, and inference activities. The process above is called the cognitive process or the mental process of assimilating concepts and principles in the mind. discovery learning model, students are required to play a more active role in seeking information. According to Mukaramah et. al, (2020) stated that in the discovery learning model, students study problems, solutions, seek relevant information, develop

solution strategies, and implement the chosen strategy. Basically, every educator wants the material taught to be accepted as a whole. Educators must also understand that the characteristics of students vary, both in terms of interests, potential, intelligence, and efforts of the students.

Marisya & Sukma (2020) outline the discovery learning procedure. The steps or syntax in the discovery learning model are as follows; 1) Simulation (stimulus or giving stimulation); 2) Problem statement (statement or identification of the problem); 3) Data Collection (Data Collection); 4) Data Processing (Data processing); 5) Verification (Proof); 6) Generalization (Drawing Conclusions). According to Wulandari (2016), she added the 7th stage, namely assessment, with per assessment, namely the work of a student is assessed by other students with the help of an assessment rubric made by the teacher. The characteristics of the discovery learning model as expressed by Rahayu et. al., (2019) are as follows: 1) Exploring and solving problems to create, connect, and generate knowledge; 2) Student-centered; 3) Activities to combine new knowledge and existing knowledge.

One of the subjects that requires creative thinking is mathematics learning. The ability to think creatively is the ability to analyze something based on available data or information but also to produce new concepts that are much more perfect or better and determine alternatives with various ideas that can be used to solve student problems. The ability to think creatively in mathematics learning is very necessary because it can make it easier for students to solve math problems. that mastery of creative thinking in mathematics learning aims to formulate uncomplicated mathematical problems, find easy solution methods so that complicated problems can be easily solved. creative thinking is a variety of efforts to see or do something that is characterized by four components, namely 1) Fluency (creating various ideas; 2) Flexibility (skills to look ahead easily); 3) originality (composing something new); 4) Elaboration (building something from other ideas (Nuriani et al., 2020).

Based on the results of interviews with mathematics teachers at SMK Kreatif Bahrul Ulum on September 12, 2024, information was obtained that the creative thinking skills of students at SMK Kreatif Bahrul Ulum are still low, because there are still many students who do not understand how to work on questions that contain creative thinking indicators properly and correctly. Where the questions require students to think creatively, and many students do not understand which formula to use in working on the questions. By implementing variations in the discovery learning model, it is hoped that it can improve the creative thinking skills of class X students at SMK Kreatif Bahrul Ulum Tambakberas Jombang. The process of learning mathematics in schools should be changed. The concept of mathematics must be built with the understanding of the students themselves. What educators must do is how to encourage students to think, ask questions, solve problems, put forward ideas, discuss ideas and even find something new.

As stated by Van de Walle said that "educators must change their teaching approach from educator-centered teaching to student-centered teaching" (Siregar et al., 2020). Low mathematics learning outcomes are influenced by factors, both from within and outside the students themselves, one of the factors that is the root cause of low mathematics learning outcomes is the lack of creative thinking skills of students in learning (Magfiroh et al., 2021). Another factor that is the origin of low mathematics learning outcomes is the mathematics learning process which is more centered on educators rather than centered on students. To improve the quality of education current education, changes in the learning paradigm that must be carried out by

teachers (conventional) into learning activities that are more active in student involvement. The factors that cause low or lack of student understanding of mathematical concepts, one of which is the learning method used by the teacher, for example in learning that is oriented towards a traditional approach that places students in the teaching and learning process as listeners. Another factor that causes low student mathematics learning outcomes is the lack of student interest in following mathematics lessons. This is due to the assumption that mathematics lessons are one of the most difficult and terrible subjects compared to other subjects.

## METHOD

The appropriate type of research for this research according to Sugiono (2016) is to use a pre-experimental design research type with a one-group pretest-posttest design type which can be described as follows.


**Figure 1**. Pre-Experimental Design

The sample taken by the researcher was class X of SMK Kreatif Bahrul Ulum Tambakberas, Jombang. The sampling technique used probability sampling technique with simple random sampling technique. The research subjects used in this study were class X of Bahrul Ulum Tambakberas Vocational School, Jombang with 45 students in one class. The researcher conducted an interview with a mathematics subject teacher of class X SMK Kreatif Bahrul Ulum Tambakberas, Jombang. The interviews were conducted twice, conducted during the pre-research (observation) on September 12, 2024 and during the research (non-test instrument) on November 14, 2024. Using a structured interview type, meaning that the interview was conducted using interview guidelines that were systematically arranged to help the implementation of research properly and correctly regarding the creative thinking abilities of class X students of SMK Kreatif Bahrul Ulum Tambakberas, Jombang.

There are two tests given, namely pretest and post-test. The pretest is given before implementing the discovery learning model to determine the creative thinking skills of students before the treatment, and the post-test is given after implementing the discovery learning model to determine the creative thinking skills of students after the treatment. The pretest and post-test questions each consist of 5 descriptive story or essay questions about the exponential function material. The data obtained from the pretest and post-test results are internal data, so the researcher will compare the

pretest and post-test results using statistical tests, with the type of parametric statistics t-test related (paired sample t-test). Based on the two tests above, if the data is normally distributed and the data is homogeneous, then a related t-test (paired sample t-test) can be carried out by determining the t-table

## Result

This content validity is used to test the validity of each pretest test item further. Each question in the pretest is tested for validity before being used for research. The results of the validity test using the IBM SPSS Statistics 26 application. Based on the results of the content validity test of the pretest questions above, the r-count of questions no. 1-5 is greater than the r-table (r-count > r-table), so that the pretest questions are declared valid. Because the validity test shows that the pretest questions are valid, the pretest questions can be used for research to measure students' creative thinking skills before implementing discovery learning.

**Tabel 1.** Post-test Content Validity Test Results

Correlations

| | | X01 | X02 | X03 | X04 | X05 | Jumlah |
|---|---|---|---|---|---|---|---|
| X01 | Pearson Correlation | 1 | .761* | .000 | .238 | .690* | .666* |
| | Sig. (2-tailed) | | .011 | 1.000 | .507 | .027 | .035 |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |
| X02 | Pearson Correlation | .761* | 1 | .326 | .290 | .709* | .817** |
| | Sig. (2-tailed) | .011 | | .357 | .416 | .022 | .004 |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |
| X03 | Pearson Correlation | .000 | .326 | 1 | .654* | .355 | .686* |
| | Sig. (2-tailed) | 1.000 | .357 | | .040 | .314 | .029 |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |
| X04 | Pearson Correlation | .238 | .290 | .654* | 1 | .592 | .739* |
| | Sig. (2-tailed) | .507 | .416 | .040 | | .071 | .015 |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |
| X05 | Pearson Correlation | .690* | .709* | .355 | .592 | 1 | .845** |
| | Sig. (2-tailed) | .027 | .022 | .314 | .071 | | .002 |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |
| Jumlah | Pearson Correlation | .666* | .817** | .686* | .739* | .845** | 1 |
| | Sig. (2-tailed) | .035 | .004 | .029 | .015 | .002 | |
| | N | 10 | 10 | 10 | 10 | 10 | 10 |

Based on the results of the validity test of the content of the post-test questions above, the r-count of questions 1-5 is greater than the r-table (r-count > r-table) so that the post-test questions, both numbers 1 to 5, are declared valid, the post-test questions

can be used for research to measure students' creative thinking abilities after implementing discovery learning. Based on the results of the reliability test of the pretest and post-test questions, it can be concluded that the Cronbach's Alpha value of the pretest is .815 while the Cronbach's Alpha value of the post-test is .775. The Cronbach's Alpha values of the pretest and post-test are more than 0.60 so it can be concluded that the pretest and post-test questions are declared reliable and can be used for research. The tested data is proven to be homogeneous and normally distributed, then the data can be tested using the Paired Sample t Test or the paired two-sample t test. The samples in question are the pretest and post-test questions. The results of the paired two-sample t test can be seen in the following table 2:

**Tabel 2.** Paired Sample t Test Results

| | | Paired Differences | | | | | t | Df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | pretest - post-test | -15.267 | 4.299 | .785 | -16.872 | -13.662 | -19.453 | 29 | .000 |

Based on the test results obtained, the significance value is 0.000. Significance 0.000 < significant level 0.05, so it can be concluded that Ha is accepted. Acceptance of Ha means that there is a difference in the level of creative thinking ability of students before and after implementing discovery learning.

## Discussion

The research conducted aims to determine the creative thinking ability of students after implementing the discovery learning model. The creative thinking ability studied includes 3 indicators, namely (1) being able to determine the number of a period properly and correctly (2) being able to solve mathematical problems related to the growth of exponential functions in everyday life (3) being able to work on mathematical problems related to the decay of exponential functions in everyday life. The creative thinking ability of students can be known through the test results that are tested. The researcher gave pretest questions to determine the creative thinking ability of students before implementing the model discovery learning and post-test questions to determine students' creative thinking abilities after implementing the discovery learning model. Before being given pre-test questions on the exponential function material, students had been taught the material by teachers at SMK Kreatif Bahrul Ulum Tambakberas, but the learning method used by the teacher was a conventional method.

Contextual problems of pretest questions, students are asked to use their abilities to determine the number of a period properly and correctly from the question. In this indicator, what is assessed in the student's work is how students can determine properly and correctly about the population in a certain period, or the mass of an item at a certain time from the question. The pretest results show that the creative thinking skills of class In indicator 1 studied, the pretest results showed that 57% of students were able to use their abilities to determine the number of a period properly and

correctly, while the post-test results showed that 71% of students were able to use their abilities to determine the number of a period properly and correctly. The comparison of the percentage of indicator 1 can be seen in Figure 2 below.

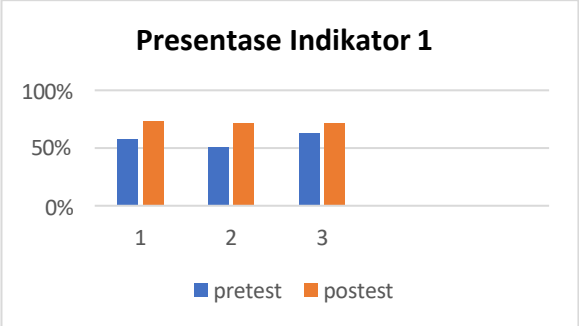


**Figure 2.** Indicator 1 Presentation

Based on the data obtained, the pretest results for question number 1 showed that 58% of students met this indicator, while forpost-test questions the percentage of students increased to 73%. Question number 2 which contains level 2 of creative thinking skills showed an increase before and after implementing the discovery learning model. Where the pretest results showed 51% of students who were able to meet indicator 1, while the post-test results increased to 72%. At level 3, namely question number 3 also experienced an increase before and after implementing discovery learning. Namely the pretest results showed a percentage of 63% of students were able to meet indicator 1 while the post-test increased to 71% of students were able to determine the remaining population of the question. The average number of students who were able to determine the number of items, population, mass etc. in a certain period or time properly and correctly was 57%, while in the post-test results 72% of students were able to work on the questions.

In indicator 2, namely being able to solve mathematical problems related to the growth of exponential functions in everyday life. Some students cannot solve problems about the growth of exponential functions in everyday life. The percentage of test results on indicator 2 can be seen in Figure 3 below:

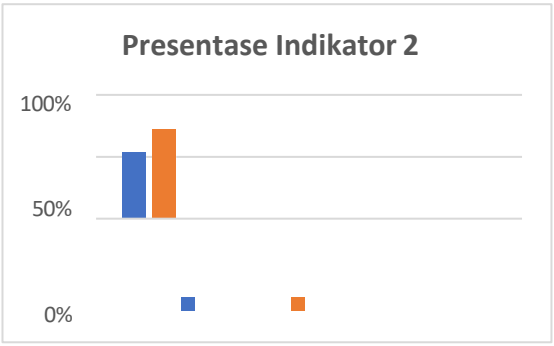


**Figure 3.** Indicator 2 Presentation

Learning activities are carried out in accordance with the teaching module that has been validated by experts, and accompanied by learning media in the form of Student Worksheets (LKPD). The instruments used by researchers include teaching modules, Student Worksheets (LKPD), and creative thinking ability test questions. During the learning process, researchers found various obstacles. These obstacles include: (1) time constraints, in the discovery learning process it takes quite a long time while the allocation of learning time applied by the school institution is limited (2) lack

of inadequate facilities at school such as projectors, (3) there are several students who are noisy or fight over themselves during the learning process.

The data to be tested using the paired two-sample t-test must be normally distributed and homogeneous. Based on the results obtained using the IBM SPSS Statistics 26 application, the significance value of the pre-test question is 0.162> 0.05 and the significance value of the post-test question is 0.037> 0.05, meaning that both data are normally distributed. Then a homogeneity test was carried out with a significance value of 0.014> 0.05. These results indicate that the data is homogeneous.

Based on the results of the normality and homogeneity tests, the data was then subjected to a paired two-sample t-test using the IBM SPSS Statistics 26 application to test the proposed hypothesis. From the results obtained, the significance value is 0.000. Where the significance value> 0.05 then Ho is rejected and Ha is accepted. This means that there is a difference in students' creative thinking abilities before and after applying the discovery learning model. So, it can be concluded that by applying the discovery learning model, students' creative thinking abilities can be increased effectively. These results are relevant to research conducted by Agusmanto Hutauruk, et al. (2023) which shows that the discovery learning model can improve students' creative thinking abilities.

## Conclusion

Based on the results of the study and discussion, it can be concluded that there is a significant difference in the creative thinking ability of class X students of SMK Kreatif Bahrul Ulum Tambakberas before and after implementing the discovery learning model. This is shown in the Paired t Test where the significant value produced is 0.000, a value smaller than the error rate used, which is 0.05, so Ha: there is a difference in the creative thinking ability of students before and after implementing the discovery learning model is accepted. This difference can be seen from the average results of the creative thinking ability test which shows that the average post-test value is higher than the pre-test value. So it can be concluded that the discovery learning model has an effect on improving the creative thinking ability of class X students of SMK Kreatif Bahrul Ulum Tambakberas.

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